

AMITY INSIGHT

THIRSTY PLANET REVISITED

Scarcity | Risk | Opportunity

PROFIT WITH PRINCIPLES

AMITY INSIGHT: THIRSTY PLANET REVISITED

“Ten years from now 1.8 billion people will live in areas with absolute water scarcity, and two out of three people around the world could live under water stress conditions

Former UN Secretary General Ban Ki-Moon speaking in 2015

By Neville White

*Head of SRI Policy & Research,
EdenTree Investment Management Limited*

In 2011 we published the first of a two-part resource series ‘Thirsty Planet’ which looked at water threat, stress and opportunity. This noted that a rising population was ‘likely to place unprecedented strain on the world’s natural resources [and]...the ability for vast sections of the population to access fresh water’.

Six years on, we view the challenge of providing clean, potable water to a growing, urban population, balanced against the demands of agriculture, commerce and industry to be among the most pressing and urgent. Indeed the World Economic Forum’s (WEF) annual Global Risk Report¹ has placed ‘water crises’ in the top three global risks in terms of impact since 2012. For the WEF, the impact of water crises is second only to extreme weather events and the use of weapons of mass destruction – whilst a significant water crisis is now considered more likely than either food related crises, or the failure of financial systems and institutions.

Water is perhaps uniquely, an economic, societal and environmental risk. Lack of water has an immediate and catastrophic impact on human, societal and economic viability. In ‘Thirsty Planet Revisited’ we provide a fresh look at water risk and opportunity, and provide a new section on the interconnected links of water shortage and climate change. We look at the ability of new technology such as forward osmosis to make desalination a solution of scale in many water-stressed parts of the world.

The Insight looks too at the broad investment value chain and the opportunities for responsible investors in the \$600bn global water sector providing sustainable solutions in the water and waste-water sectors.

1. World Economic Forum ‘Global Risks Report 2017’
<https://www.weforum.org/reports/the-global-risks-report-2017>

WHAT DOES IT TAKE TO MAKE...

It takes a surprising amount of water to make some of our most familiar consumer products, see how many litres it takes:

1.1kgx **Chicken Meat**



1x **Cheese on Toast**



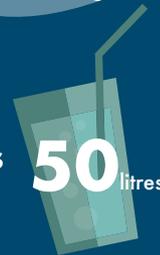
1 litre **Milk**



1 litre **Wine**



1x **Hamburger**



1 litre **Soft Drinks**



1 litre **Bottled Water**



1 litre **Beer**



1 sheet **A4 Paper**



1x **Cotton T-Shirt**



1x **Semiconductor Wafer**



1kg **Beef**

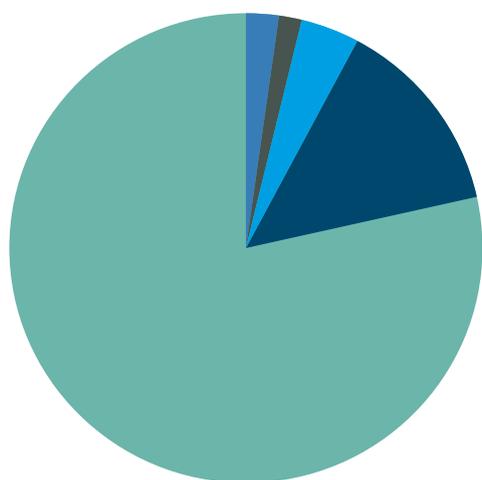
WATER AS A CRITICAL SUSTAINABILITY ISSUE

Water is critical to support all life on Earth, and cannot be artificially created in volume. Unlike carbon, water is also essentially local in the sense that supply and demand varies dramatically across the world. This is precipitated by population growth, density and urbanisation and by erratic rainfall patterns exacerbated by climate change. Access to fresh, potable water is held as a fundamental human right – indeed the United Nations recognised this as such in 2010 – and as a result, water is seldom priced as a scarce economic commodity. Viewed as free and abundant by many, waste through leakage and overuse remains a societal challenge.

The ‘problem’ of water is manifested in the statistics. Despite inhabiting a planet in which 71% of the surface is ocean, around 97.5% of all water on Earth is saline and undrinkable; the

remaining 2.5% is fresh, however only a small proportion of this is exploitable after permanent ice caps and water held in inaccessible subterranean pockets is accounted for. Around 0.25% of all water is therefore directly accessible through lakes, reservoirs, river systems and underground aquifers.

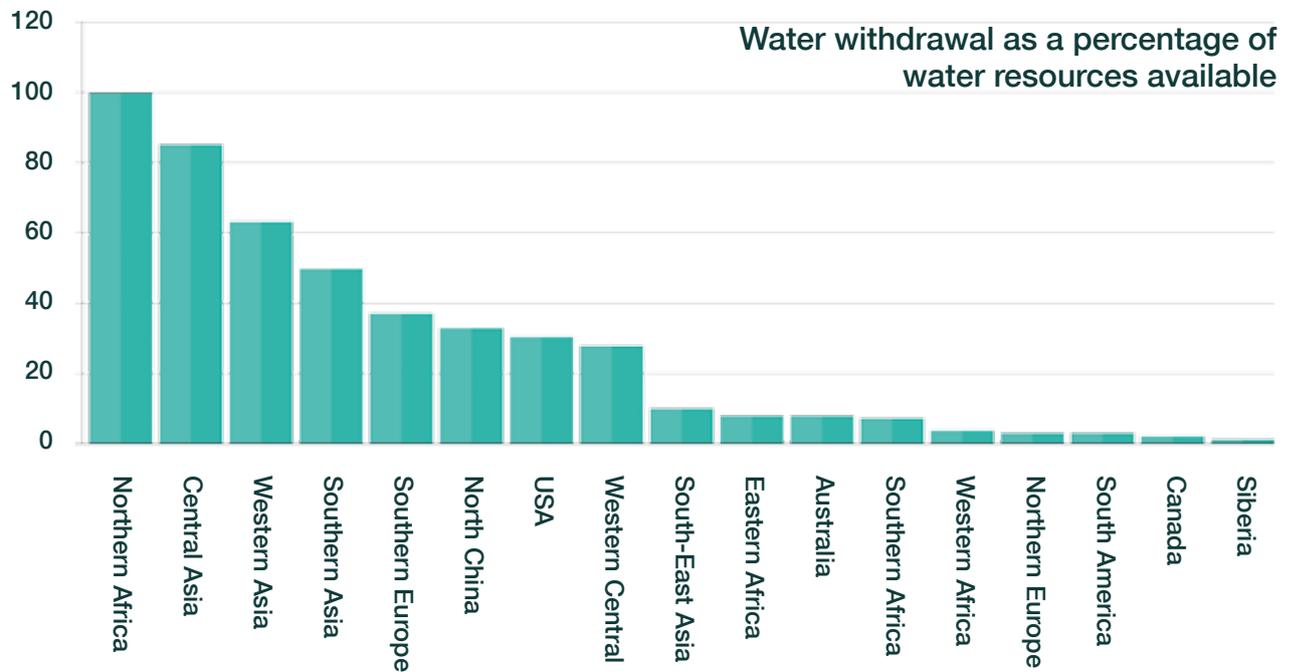
Moreover, water is unevenly distributed – Siberia has low withdrawal and abundant resources for instance. China, with 21% of the world’s population has only 7% of its available water². Consumption – key to overuse – is also uneven; whilst average consumption is put at 1,240m³ per person per annum, this hides the vast disparity of use and overuse. For instance, in the developing world some have access to less than 10 litres a day, whilst the US on average uses 400 litres per person per day.



Sources of water globally

- Wastewater re-use
- Desalination
- Agricultural drainage
- Groundwater
- Surface Water

Source: Food and Agricultural Organization of the United Nations www.fao.org



Source: Ibid

Over 40% withdrawal is viewed as ‘stress’ – North Africa withdraws more than is technically replenishable.

Freshwater withdrawals have tripled over the last half century however demand varies region to region. In developing economies, agriculture accounts for over 80% of use; conversely, in Europe this reduces to 44%, with 40% directed at industry and energy generation. Agriculture remains the largest consumer of water globally at 70%, but 55% is lost through poor water economy and harvesting.

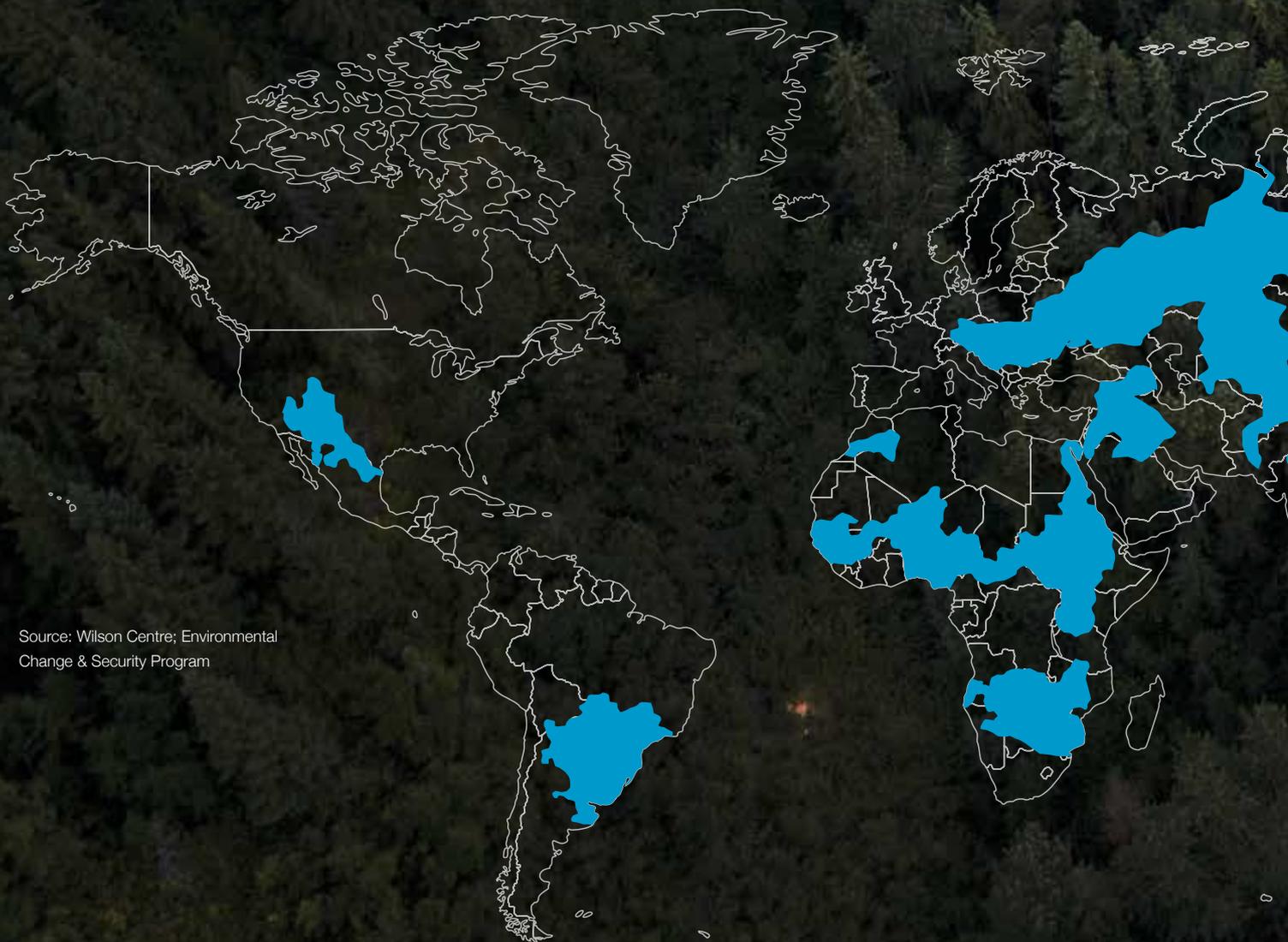
A POTENTIAL CAUSE FOR CONFLICT

Water security is predicted to become a key element in potential inter-state conflict as the world moves towards a greater demand-supply imbalance. Inadequate supply has already resulted in 'tension', for instance in securing the water resources trapped in the Taurus-Zagros Mountains which encompasses the 'power-conflict' zone of Iran, northern Iraq and Turkey. Water and access to the Shatt al-Arab river basin was among the key conflict points between Iran and Iraq in earlier decades, whilst droughts in Syria undoubtedly exacerbated economic decline

and civil strife. Water scarcity has also resulted in conflict in Bolivia, Ecuador and stand-offs in countries such as India-Pakistan, Israel-Palestine and Egypt and Ethiopia.

The potential for conflict over 'shared' river basins has become an acute issue in many parts of the world as below in the highlighted areas of the map.

■ River basins with potential conflict



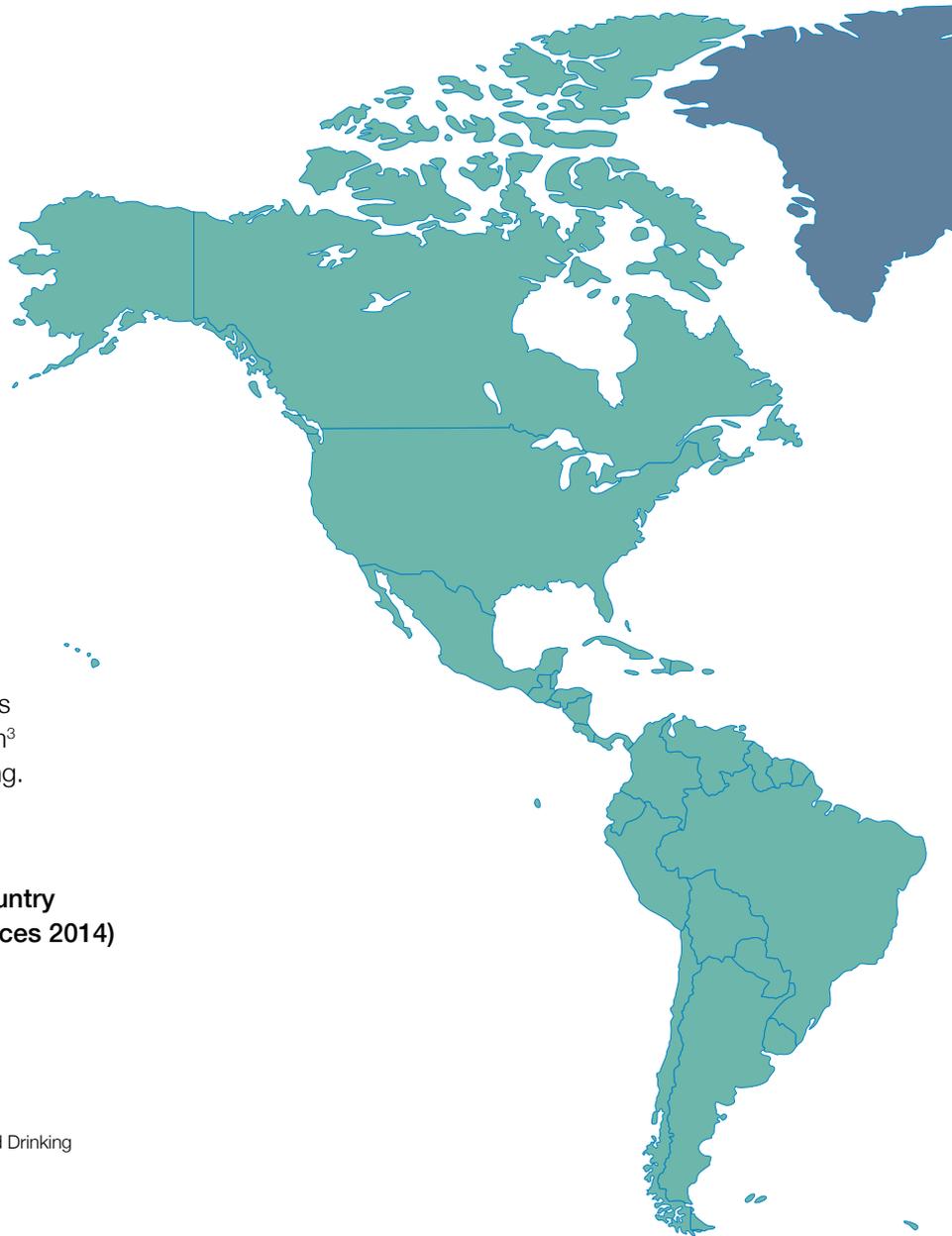
Source: Wilson Centre; Environmental Change & Security Program



DEMAND - SUPPLY IMBALANCE

According to the UN, the Basic Water Requirement (BWR) per day to support drinking, sanitation, cleaning and cooking is 30-50 litres. As we have seen, actual individual use varies enormously; even in Europe where water conservation has been a priority, average use is 200 litres per day within the European Union.

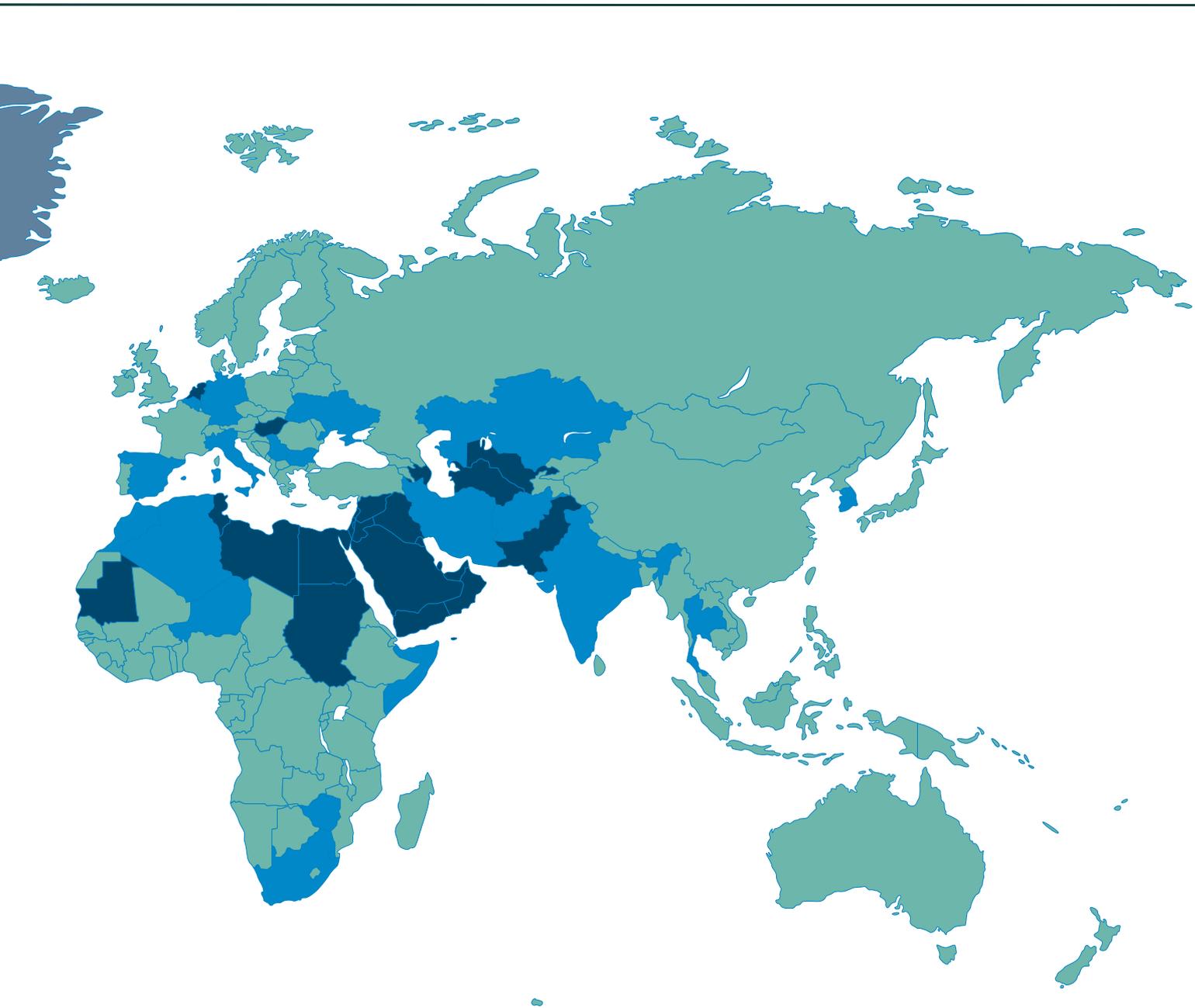
This abundant 'overuse' masks significant imbalances. 663 million people have no access to safe, potable drinking water, whilst 2.4bn people (according to the World Health Organisation) have no access to sanitation. 842,000 people – many of them infants – die prematurely as a result of unsafe drinking water, poor sanitation and hand hygiene³. Upstream, the migration of populations to urban, middle-class environments has seen exponential growth in protein enriched diets, which require significant additional water to support; a diet containing 20% meat increases water consumption to between 1,000-1,300m³ in terms of livestock production and processing.



**Total annual freshwater withdrawals by country
(% of internal renewable freshwater resources 2014)**

- 0-25
- 75+
- 25-75
- No data

3. Source: World Health Organization 'Progress on Sanitation and Drinking Water, 2015 Update and MDG Assessment www.who.int



DEFINING WATER STRESS

Absolute definitions are problematic; however, the UN defines 'stress' as withdrawal of over 40% of 'total actual renewable water resources' (ANWR). 'Shortage' is defined as a withdrawal rate of 100% as exists in North Africa. Water can also be assessed in terms of the amount available per person per year.

Available supply per person per year (m³)

Under 500	500- 1,000	1,000- 1,700	1,700- 4,000	4,000- Plus	1,240
Extreme Scarcity	Scarcity	Stress	Sufficient	Abundant	Average Consumption

Under 'business as usual' scenarios, demand will exceed supply by 40% by 2030. More than 20% of GDP is produced in water-scarce areas, with the International Food Policy Research Institute estimating that water stress could place 45% of global GDP at risk by 2050⁴. Water scarcity already affects 40% of the world's population, and this is projected to rise. Over 1.7bn people live adjacent to river basins where water use exceeds an ability to replenish. The World Health Organisation (WHO) estimates that by 2025, half of the world's population could be living in a water-stressed landscape⁵.

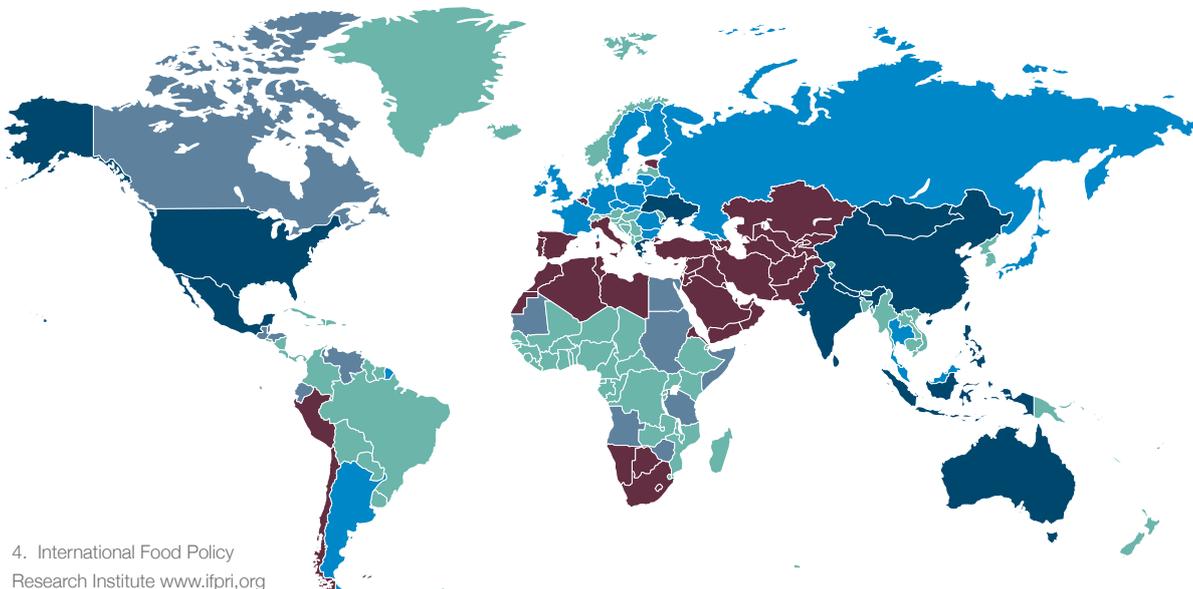
Globally, water use is growing at twice the rate of population growth and is already unsustainable, not least, as population growth is at its strongest in areas of water shortage or stress, such as parts of Asia and North Africa.

By 2040 if nothing is done, much of the world will be enduring water stress.

- Low <10%
- Low to medium 10-20%
- Medium to high 20-40%
- High 40-80%
- Extremely high >80%

Source: UK Met Office www.metoffice.gov.uk

Water Stress by Country: 2040



4. International Food Policy Research Institute www.ifpri.org

5. WHO *ibid*

WATER STRESS: A CRITICAL BUSINESS RISK

Industry and commerce are wholly dependent on a reliable source of water to ensure manufacturing processes are not interrupted. In many cases, water is a 'shared resource' with indigenous communities requiring thoughtful withdrawal and use. The CDP water survey is a helpful snapshot in illustrating how water shortages are already impacting business. Over a quarter of companies said they had experienced detrimental impacts from water risk already, and over half expected water restrictions to impact operations within the next six years. Over half of those responding had set targets and goals to reduce the impact of water stress. However in the main, water, unlike carbon, has been slow to gain the attention of company management and only a relatively

small minority of companies have developed appropriate responses to a risk this acute.

These risks arise from the direct use of process water in manufacturing (e.g. semi-conductors or beverages) and through the supply chain. Companies sourcing fresh or water intense commodity crops (such as cotton) are particularly exposed. In industry, mining, power generation and electronics require a generous water supply; for instance mining companies can use between 800 and 3,000 gallons of water to extract and process coal; up to 6,000 gallons of water may be needed to make one tonne of paper in the least efficient plants (see table).

Sector	Exposure	Risk
Power generation	Among the largest users of water, mainly for cooling and steam generation	Water scarcity may impede capacity, largely impacted by fresh water availability
Oil & gas	Water is used throughout the process, extraction, lubrication, processing	Refining capacity constrained areas of stress, significant constraint in Canadian oil sands; pollution, spills
Semiconductors	Heavy user of ultrapure water for water washing and rinsing	Dependant on fresh water supplies in abundance; propensity to locate in arid or stress regions
Food & Beverages	Among the heaviest users of water as a basic raw component	Access to fresh water; impact of drought agricultural yield, price volatility, reputation (abstraction)
Chemicals	Intensive user of water for cooling, cleaning, diluting, steam generation	Discharges to water supply, pollution, accidents, spills, main risk is through supply chain
Steel	Water one of the three most important commodities used; cooling, steam	Severely exposed to water scarcity risk, reputation (abstraction), pollution
Mining	Water is essential to extraction, processing, cooling, lubrication	Contamination of water tables, waste talings, leaching, abstraction in areas of stress
Paper & pulp	Water is used intensively, cleaning, bleaching, washing, pulp production	Severely exposed to water scarcity risk especially US & China, heavy industrial polluter

Source: EdenTree www.edentreeim.com



Sustainable Development Goals (SDG) 6 and 14 focus on water: SDG 6 has an aspiration for the sustainable management of water and sanitation for all; universal and equitable access to safe and affordable drinking water and sanitation and to improve water quality by reducing pollution. SDG 14, more widely seeks to conserve the oceans and marine life by reducing pollution, protecting marine eco-systems, minimising ocean acidification and preventing over-fishing.

WATER & THE IMPACT OF CLIMATE CHANGE

Climate change introduces a further dimension to the challenge of water stress and shortage as it threatens the availability of sustainable freshwater, and is influencing an increase in extreme weather events. The Intergovernmental Panel on Climate Change (IPCC), as part of its regular reporting on climate change impacts⁶ estimates that for every additional degree of global warming, between 7-20% of the world's population may be exposed to extreme water shortage. Examples of the physical impact of climate change on water supply include:

- Changing, irregular rainfall patterns; variability in distribution (e.g. droughts and flooding)
- More severe and prolonged droughts in more territories
- Reduced snow and melting ice
- Reduced soil moisture and crop failure
- Rising sea levels, ocean acidification and contaminated fresh water

6. Intergovernmental Panel on Climate Change www.ipcc.ch



Climate change risks impacting the natural water cycle of precipitation and evaporation by exacerbating extremes: These include more unusual weather events, accelerated evaporation from reservoirs and water-courses, longer and more extreme exposure to soil moisture deficit, greater stress on groundwater resources, and increased demand for irrigation owing to drought. A survey by the UK Meteorological Office⁷ suggests that the risk from serious crop failure arising from climate related factors – principally water shortage – has been underestimated. The Met Office, using advanced climate modelling, showed that extreme weather events (drought and flood) could devastate and disrupt global food supplies, indicating there is now a 6% risk every decade that a failure in the maize crop will happen in China and the US, the two primary producers. Maize accounts for 51% of the world's primary calorie intake and its absence would lead to widespread famine. A simultaneous weather event affecting maize would impact 60% of global supply. The principal weather event providing these conditions is drought.

The role of water as part of the response to climate change has been acknowledged. The Marrakesh climate talks (COP22) in 2016 devoted an entire day to water risk for the first time. Better water management can help reduce energy use and its associated emissions; according to the Carbon Disclosure Project (CDP),⁸ more than half of disclosing companies had noted that improved water management had led to lower greenhouse gas emissions (GHGs). However, there are no easy solutions; even low energy alternatives such as solar photovoltaics or biofuels require a stable supply of readily available quality water.

7. UK Met Office www.metoffice.gov.uk

8. Carbon Disclosure Project www.cdp.net

OPPORTUNITIES IN THE WATER SECTOR

As responsible investors, we see water shortage as presenting a risk to business and society and we will continue to engage with material users of water on its efficient use and management.

The water demand-supply imbalance also presents opportunities, especially via technology and engineering plays, and through solutions such as desalination, smart-metering, variable pumps and improved recovery and leakage reduction. There are opportunities too in brackish water recovery in the oil and gas sector, where the US alone produces 800bn gallons a year.

Dry cooling power systems require around 90% less water, and improved solutions are already being seen in water treatment, testing, piping and leak detection. Strongest growth is expected to be seen in the process control and management segment, whilst regulated utilities continue to exhibit strong cash-flow and dividend yield.

McKinsey & Co.⁹ has estimated that between now and 2030, \$7.5 trillion of investment is needed globally to keep pace with demand forecasts, to respond to climate change, and to replace life-expired infrastructure.

The total water market is put at \$625bn, with the World Economic Forum (WEF)¹⁰ saying that for every \$1 of investment, an economic return of between 5-25% is generated.

We view the substantial water value chain as presenting significant investment and sustainability opportunities, going far beyond water utilities such as Severn Trent, United Utilities or Pennon Group.



9. McKinsey & Co. 'Bridging Global Infrastructure Gaps 2016' www.mckinsey.com

10. WEF *ibid*

FOCUS: DESALINATION

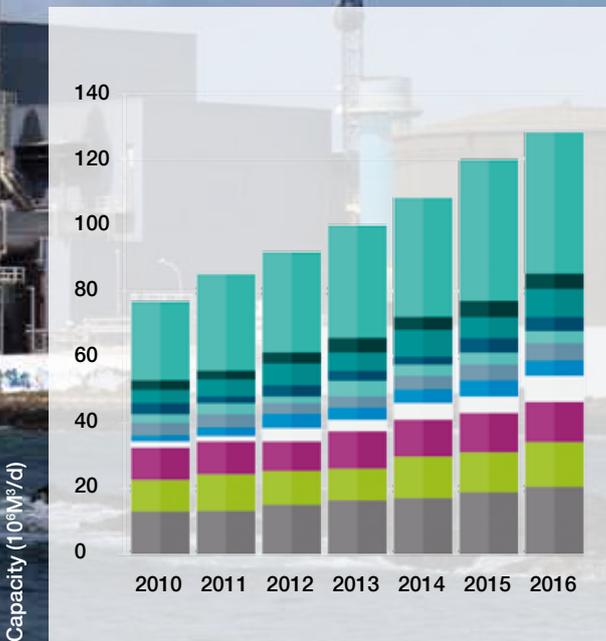
Basic desalination, the process of removing minerals from saline or sea water to produce potable drinking water, is a well-proven technology developed in ancient times. More recently it was a familiar 'on-board' technology used at sea. Reverse osmosis, the first scalable technology was developed in the 1950s.

Energy intensity and cost have traditionally been the greatest barriers to desalination at scale, but many of these barriers have been overcome via co-generation technology. The Carlsbad Desalination plant in the San Diego valley is the world's largest, serving 500,000 people and producing 50 million gallons of potable water a day. Advances particularly in membrane filtration means cost has been reduced to around \$0.7 cents to produce one gallon of water.

Need is driving take-up. 21,400 plants have been installed in 120 countries producing some

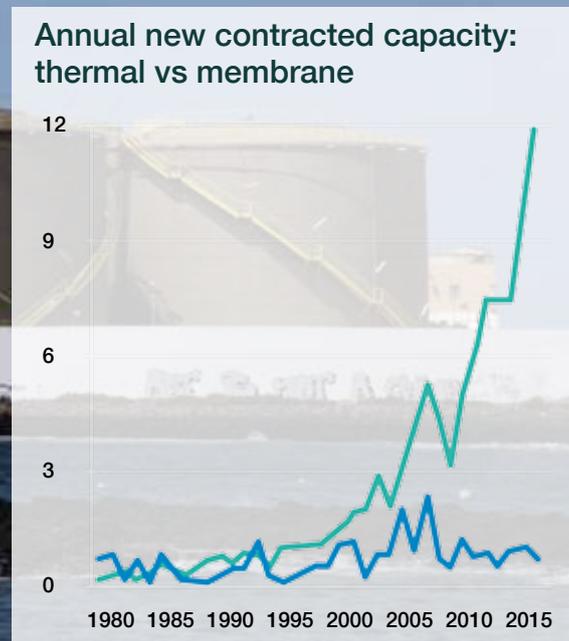
3.5 billion gallons a day. Some territories such as Dubai and Kuwait are now sourcing close to 100% of their water needs from desalination. The largest proponents of the technology are, not surprisingly, the Middle East (Saudi Arabia and UAE) and the US. Thermal and reverse osmosis are the most frequently cited methodologies, but there are others, Vacuum Distillation, Flash Distillation + Multiple Effect Distillation, Vapour Compression Distillation, Solar Evaporation + Multiple Effect Distillation, Freezing and Electrolysis.

Forward osmosis, using semi-permeable membranes and a 'draw' (rather than hydraulic) solution is the next generation technology, but is not yet scalable. The basic advantages to desalination are falling input and plant costs and an abundant, readily available supply of saline water ready for conversion.



- ROW
- Algeria
- Spain
- India
- Australia
- Kuwait
- Israel
- China
- USA
- UAE
- KSA

Source: Desalination (installed capacity by region) cited at www.researchgate.net



- Membrane desalination
- Thermal desalination

Source: Desalination (installed capacity by technology) cited at www.nasdaq.com

INVESTMENT THESIS

We believe there are compelling investment opportunities in companies providing solutions to resource scarcity across water driven by five long term trends:

- Inadequate supply of water
- Increasing demand driven by population growth, industrialisation and urbanisation
- Increasing regulation and government support
- Increasing investment in infrastructure to address urgent global need
- Increasing investment in technology solutions to facilitate more efficient use of resources

One study (KBI Global Investors)¹¹ identified a universe of 157 companies operating in the water resources sector, the majority in technology and infrastructure.

Water Supply:



Water technology:



Environmental Services:



11. KBI Global Investors www.kbiglobalinvestors.com

EdenTree is well represented across the value chain, and additionally holds **Impax Environmental Markets** (Amity UK) which is a Fund investing in long-term macro-economic themes including water. Water scarcity presents strong opportunities in industries focused on water conservation, accessibility and affordability. Analytical equipment, piping, metering, purification and testing are key areas of potential growth. The global science and technology innovator **Danaher Corporation**, which is focused on improving quality of life around the world, including its leading role in water testing equipment is just one such company. Elsewhere there has been a renaissance in desalination technology, which is now at scale globally, driven by urgent necessity in regions such as India, Israel, the United Arab Emirates and southern Europe. Advances in filtration and membrane technology are replacing chemicals, and ultraviolet disinfection is replacing the use of chlorine in water purification treatment.

Leakage is known to be a particular challenge in developed markets where infrastructure is ageing, and in the developing world owing to poor or substandard installation. It is estimated that 1.7 trillion gallons are lost annually in developing urban environments according to the US Geological Survey¹². Companies with proprietary technology reducing leakage play an important role in preserving limited resource. Companies such as **Pure Technologies**, **Mueller Water** and **Pentair** operate in this well-developed space.

12. Value of Water Survey www.itt.com citing US Geological Survey

CASE STUDY: ACCIONA

Acciona is a Spanish infrastructure company with expertise across construction, services, renewable energy and water. The Group had turnover of €5,977m in FY16, and profit before tax of €408m (up 28% on 2015).¹³ Acciona employs over 32,500 people in 40 countries. The Group of businesses represents a strong sustainability play especially in its energy business focused on wind, solar and hydroelectric generation. Acciona is the first 'carbon neutral' company in the utilities sector on the DJSI Index.

Its water business (revenues of €708m) is focused on water and waste-water treatment and reuse and recovery technologies such as desalination. Its particular expertise is management of the integrated water cycle (collection, treatment, distribution, maintenance, and quality testing). It is the owner-operator of the world's biggest wastewater treatment plant in Mexico, with a world-beating treatment rate of 35m³ per second, rising to 50m³ per second at maximum output. The plant employs co-generation technology ensuring that bio-gas released from waste sludge treatment is recycled back into energy.

Acciona Agua is a global leader in reverse osmosis design, build, commission and operation – for instance it designed, built and operates the UK's largest desalination plant on behalf of Thames Water at Beckton in East London, which can deliver 150,000m³ of desalinated water daily. Acciona operates 70 plants globally producing over 2,300,000m³ per day to over 10 million people. Cities and countries served include Adelaide and Perth in Australia, Chile, Mexico and Florida in the US.



	Construction	38%
	Energy	30%
	Water	12%
	Services	11%
	Other	9%

¹³. All figures Acciona SA FY 2016 www.acciona.com



CONCLUSION

Thirsty Planet Revisited points to a steady worsening of the supply-demand imbalance, in which water stress and shortage will increasingly impact geo-political tension, poverty, migration and threaten economic growth. Under a ‘business as usual’ scenario demand will outstrip supply by 40% by 2030 with two-thirds of the global population potentially impacted by water stress as early as 2025.

Compared to carbon, business has been slow to respond to the risk to production arising from water shortage, although the CDP water survey bears visible testimony from many businesses that they are being impacted already. As a scarce resource, water needs to be carefully managed and shared between competing needs; on the one hand to secure uninterrupted business processes, on the other the need to sustain communities and agriculture against over withdrawal and drought.

The best companies are already well advanced in understanding and responding to water shortage with technology and careful harvesting, reducing need and waste. Companies operating in water intensive sectors (power, mining, semiconductors, beverages) or exposed through the supply chain (food and apparel retailers) will be worse hit. Despite the challenges, this Insight also points to a vibrant value chain of major technologies that are part of the solution: desalination, filtration, osmosis, leak detection, pipes, pumps smart-metres and other instrumentation, in which the Amity Funds are particularly well represented.



VIEW FROM THE TOP



Ketan Patel CFA
Fund Manager,
EdenTree Investment
Management Ltd

The increasing scarcity of water continues to be one of the major challenges of the 21st century. The trends highlighted in our 2011 Insight remain well entrenched and without a concerted effort billions of people around the planet will continue to live in water-stressed regions. This Insight has revealed that water stress is more than just a business critical issue, with water security being a key element in potential inter-state conflict. Both technology and engineering will play a pivotal role in alleviating water stress and addressing the demand-supply imbalance which has grown ever more acute with a rapid rise in urbanisation.

Responsible investors have an important part to play by investing in companies that are working on developing solutions and services that will alleviate water stress. We see a wide and deep investible universe, ranging from companies supplying water, to those developing technologies to conserve, reduce use and encourage re-use and those focused on delivering environmental services. Across the \$600bn water sector, we are focused on seeking out exciting opportunities that represent strong sustainability stories with the potential to deliver long-term sustainable investment returns.

OUR PEOPLE



Sue Round
Director of Group Investments and Senior Fund Manager

Sue is the UK's longest-serving retail SRI Fund Manager. She launched the Amity UK Fund 29 years ago – pioneering our Profit with Principles investment approach.



Neville White
Head of SRI Policy and Research

Neville is responsible for SRI policy and research and leads on global corporate governance proxy voting and engagement with business around environmental, social and governance issues. He previously managed socially responsible investments for a number of church and charity investment managers and joined EdenTree in 2010.



Rob Hepworth
Chief Investment Officer

Robin joined EdenTree as an Investment Analyst in 1988, became a Fund Manager in 1990 and CIO in 2011. Robin is responsible for forming the investment team's long-term strategy. He was nominated for Fund Manager of the Year in 2013 (Balanced Category) and won the Fund Manager of the Year Award (Global Category) in 2010. He has also been named FE Alpha Manager for six consecutive years.



Esmé van Herwijnen
SRI Analyst

Esmé holds a Master's degree in Sustainable Business from Toulouse Business School and gained experience in ESG research from Sustainalytics and PIRC. She is the EdenTree lead on climate change and supports the SRI team with company screening, proxy voting and engagement.



Chris Hiorns CFA
Senior Fund Manager

Chris has worked at EdenTree since 1996 having gained an MSc in Economics from University College London. He started as an Investment Analyst before being appointed as a Fund Manager in 2007. He has managed the Amity Balanced Fund for Charities since launch in 2011 and the Amity Sterling Bond Fund since 2008. He has been a CFA Charterholder since 2004.



Ketan Patel CFA
Fund Manager

Ketan joined EdenTree in 2003. He began his career on the equity derivatives desk at JP Morgan, before moving to Insight Investment as a Global Healthcare Analyst. Ketan is a co-manager on the Amity UK and UK Equity Growth Fund. He has been a CFA Charterholder since 2009 and holds post-graduate degrees in both Geography and Economics from the University of London.



David Osfield CFA
Fund Manager

David joined EdenTree in July 2016 after beginning his career at sustainable investment specialist Alliance Trust in 2002. During his time there, David largely focussed on Asian equities, although he has also covered pan-European and Global equities. David has a 1st class BA (Hons) in Business Finance from Durham University and is a CFA Charterholder.



Phil Harris
Fund Manager

With over 25 years' experience in UK small and mid-cap company sectors, Phil joined EdenTree in 2015 to run the UK Equity Growth Fund. He focuses on growth small-caps and previously specialised in corporate activism.



David Katimbo-Mugwanyana CFA
Fund Manager

David joined EdenTree in 2015 bringing almost a decade of fixed income experience to our portfolios. David is a CFA Charterholder and holds a BSc in Economics from the University of Essex. His previous experience at Epworth Investment Management saw him managing institutional client and charity portfolios.



Thomas Fitzgerald
Associate Fund Manager

Having graduated from Oxford Brookes University with a degree in Economics and Business Management, Tom supports the Fund Managers providing detailed company research and analysis. Tom is currently studying for the CFA.

How to contact us

We hope you have found this Amity Insight interesting and useful. If you have any questions, or would like to know more about our responsible investment, in-house research and analysis, please get in touch.

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