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Peak water: Risks embedded in Japanese supply chains

Analysis of how companies in the Nikkei 225 Index are exposed to water risk through suppliers in Asia

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Contents

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1.0 Executive summary

KPMG AZSA Sustainability Co. has partnered with environmental data and insight experts Trucost to look at supply chain water risk in the Nikkei 225 Index.

KPMG and environmental research company Trucost worked in partnership to produce this special report on exposure to water risk among companies in the Nikkei 225 Index. Trucost analysed data on water consumption in the operations and supply chains of 225 companies in the Index, which had a market capitalisation of more than ¥184 trillion (US$2.2 trillion) and combined revenues totalling more than ¥342 trillion (US$4.2 trillion). Key findings include:

Cross-border production and trade by Japanese companies could increase vulnerability to water risk across Asia.
Many Japanese companies are relocating and outsourcing business activities across Asia, increasing their dependence on specialised manufacturing hubs in the region. Suppliers of intermediate goods are often located in countries such as China and Singapore, which face growing risks from water scarcity and floods. Japanese companies are exposed to water impacts that could disrupt their supply chains and increase manufacturing costs, through higher water tariffs, commodity prices or operating restrictions. More and more companies and investors are looking to understand financial risks and opportunities from water-related challenges in operations and supply chains.

Supply chains are responsible for three-quarters of the water used by all 225 companies.

- Companies in the Nikkei 225 Index use more than 19 billion cubic metres (m^3) of water in their operations. Suppliers in the first tier of their supply chains, as well as those further upstream, are responsible for a further 60 billion m^3 of water use. More than 75% of total water use by the 225 companies is embedded in their supply chains.
- Six supersectors account for 82% of total operational and supply chain water use across the Index – Food & Beverage, Basic Resources, Industrial Goods & Services, Personal & Household Goods, Chemicals and Automobiles & Parts.
- For 149 companies, more water is used in their supply chains than in their operations. Of the six sectors with the highest levels of water use, supply chain water consumption is greatest for Food & Beverage, Personal & Household Goods and Automobiles & Parts companies. They could be affected by pressure on water resources through water pricing or scarcity driving up the costs of key commodities.
- For the Personal & Household Goods companies, first-tier suppliers such as packaging and logistics providers are responsible for the highest share of water use (55%). This suggests that companies in the sector have significant potential to engage with suppliers to improve water management and reduce risk.
- Automobiles & Parts companies have the largest share of water use further upstream in their supply chains (80%). This is largely due to embedded water in inputs such as steel and energy. Floods in Thailand in 2011 damaged a cluster of component plants and caused several Japanese vehicle manufacturers to shut plants in the country, with knock-on effects on profits.

Water intensity varies among Food & Beverage, Personal & Household Goods and Automobiles & Parts companies.

- Water use relative to revenue generated varies by as much as 18 times among Food Producers. The next widest range in water intensity is among Personal Goods companies (76-1,206 m^3/¥ mn). Within the Leisure Goods sector, the water intensity of Consumer Electronics companies varies most (62-397 m^3/¥ mn). Upstream water use drives the higher water intensity of tyre manufacturers, compared with Automobiles and Auto Parts companies. Information on which operations and suppliers are more or less water-intensive than sector peers can help target efforts to manage exposure to rising water costs and business disruption driven by growing water stress.

If suppliers to Personal & Household Goods companies were to pay water prices that reflect water scarcity in Asia, water costs passed through the supply chain could equate to 84% of earnings on average.

- Water is increasingly being priced to reflect the impacts of water use on the environment. The external costs of water use vary geographically, depending on levels of water scarcity. If suppliers were to pay the average water scarcity costs for 16 Asian countries, calculated by Trucost, 19 Personal & Household Goods companies could see input costs rise by ¥882 bn (US$9.5 billion). Measuring water scarcity costs relative to financial metrics provides a proxy for water risk to identify where water stress could be material, and to benchmark suppliers on exposure to water risk.

Data on purchasing patterns can reveal which industries contribute most to water use in supply chains. For audio and video equipment manufacturers, water hot spots include suppliers of electronic components and packaging.

- Trucost's advanced environmental profiling modelling identifies water-intensive economic activities – known as "hot spots" – in supply chains. Findings show that audio and video equipment manufacturers in the Nikkei 225 Index could most effectively measure and reduce supply chain water risks by focusing on suppliers of paperboard packaging, electron tube and other electronic components.
- In the Personal & Household Goods supersector, water hot spots include the Farming & Fishing, Specialty Chemicals and Steel sectors. Personal Goods companies are particularly exposed to water risks through greater volatility in prices for commodities such as cotton, sourced from countries including China.

Water scarcity costs could equate to at least 10% of earnings for 32 out of 56 Asian companies analysed.

- To illustrate how companies in the Nikkei 225 can assess exposure to water risks in supply chain water hot spots, Trucost analysed direct process water use by Farming & Fishing, Specialty Chemicals and Steel companies listed in Asian countries (ex-Japan). If the companies were to pay the external cost of water that reflects scarcity in the countries in which they're based, water costs could total more than ¥512 billion (US$6.3 billion). Companies can use engagement and data collection to identify where water is consumed in order to benchmark suppliers on water risk.
- Water scarcity costs could equate to more than 10% of earnings for 29 Specialty Chemicals and Steel companies. Most of these are based in the Republic of Korea or Taiwan, which are both exposed to water stress. Understanding which suppliers are using the most water in areas of water scarcity is crucial to managing supply chain water risk.

Supply chain water risk assessments can be used to secure supplies and stabilise input costs.

- Infrastructure and contracts that lock in high levels of water use in areas of water stress could face higher-than-forecast costs, lowering future cash flows and earnings. Understanding which suppliers are most exposed to water scarcity and flooding is important to reduce exposure to business disruption, operating restrictions and higher water tariffs.
- Companies need to monitor data on water withdrawals, consumption and discharge and understand risks to water resources that their operations and supply chains depend on. Applying water scarcity prices to water consumption data and measuring resulting water costs relative to financial metrics provides a proxy for water risk that can be used to help identify where water-intensive business activities could present a material financial risk.
- Japanese companies that can account for water use in their operations and supply chains will be well placed to strengthen strategies to manage water risks. By identifying water hot spots and benchmarking suppliers on water risk, water management can be strengthened to help secure supplies and stabilise input costs in an era of growing competition for resources.

2.0 Trade in water risk: Corporate financial exposure in Japan

Many Japanese companies are shifting production to countries that are vulnerable to growing risks from water scarcity and floods.

Water scarcity and flooding can play havoc with global supply chains. The financial risks were brought home to more than 400 large manufacturers in 2011, when the worst floods in Thailand in almost 70 years disrupted supplies.[1] Thailand is one of the world's largest producers of automobile and computer components, and shortages of key parts cut production at several Japanese vehicle manufacturers and electronics firms.[2]

Japanese companies were among multinationals hit hardest,[3] reflecting a shift in their manufacturing to suppliers and subsidiaries in Thailand. Last year's Great East Japan Earthquake has accelerated the trend of many Japanese companies relocating production to other Asian countries in order to cut costs and benefit from high-growth markets.[4] More than half of affiliates controlled by Japanese companies are located in Asia,[5] and rising imports now outweigh exports in Japan.[6]

Imported goods make up a large share of exports in many East Asian countries. More fragmented manufacturing in the region has led to more sophisticated and complex supply chains. Production and trade often rely on suppliers in one country creating goods and services and exporting them to suppliers in other countries as inputs for further processing, often for (re-)export before the final goods reach their market. Most materials processing and assembling takes place in "export processing zones" (EPZs).

Supply chains have been reorganised around industrial clusters with specialised tasks and business functions. In general, the Information Technology and Electronics sectors account for a large share of the most-traded intermediate goods in Asia. The newly industrialised economies (NIEs) of Singapore, the Republic of Korea, and Taiwan now have production surpluses in industries such as computer and electronic equipment manufacturing. Monolithic integrated circuits and parts and accessories of data processing equipment are among major intermediate goods imported into Japan.[7]

Offshore outsourcing and cross-border production are deepening the economic interdependence of Asian economies including the emerging Association of Southeast Asian Nations (ASEAN) economies of Malaysia, the Philippines and Thailand. Trade policies such as the ASEAN Free Trade Area (AFTA) support growth in cross-border trade. Trade flows of intermediate goods from China to Japan reached a record high in 2011, and Japan's trade deficit with China almost doubled year on year to US$6.7 billion (¥588 bn) by the start of 2012. Japan is also increasingly dependent on other Asian countries for sales and investment returns.[8] More than 60% of Japanese companies' overseas production in Asia now goes to local consumers, and China and Thailand are the top destinations for overseas expansion.[9,10] Supply chain disruption can have repercussions beyond borders and the financial stakes are growing.

Disruption caused by the Thai floods revealed how greater dependence of Japanese companies on other Asian economies puts them at the frontline of growing water-related risks to businesses in Asia. However, supply chains could be more vulnerable to risks from too little water, rather than too much. Inefficient use of water resources and their degradation in areas of water stress could slow economic growth in economies including China, India, South Korea, Vietnam and Indonesia.

China is among the largest exporters of products with embedded water, yet some 40% of food production and 53% of industrial production is in water-stressed areas[11] – where demand exceeds supply or poor quality restricts use. Business risks from water shortages were made apparent last year, when the worst drought in 50 years brought Yangtze River levels to near-record lows,[12] disrupting shipping, electricity supplies and agricultural production.[13]

1 Thai economy shrinks in fourth quarter, Financial Times, 20 February 2012
2 Update 1-Thai floods batter global electronics, auto supply chains, Thomson Reuters, 28 October 2011
3 Flood damage to industry curbs Thailand growth, Financial Time, 21 February 2012
4 What 2011 means for Japan in 2012 and beyond, The Japan Times, 1 January 2012
5 Ibid
6 Japan deficit rises to record in January, Financial Times, 21 February 2012
7 http://www.wto.org/english/res_e/booksp_e/stat_tradepat_globvalchains_e.pdf, accessed 6 March 2012
8 http://www.atimes.com/atimes/Japan/LG30Dh01.html, accessed 1 March 2012
9 Trade patterns and global value chains in East Asia: From trade in goods to trade in tasks, World Trade Organization/Institute of Developing Economies Japan External Trade Organization, 2011
10 http://www.jetro.go.jp/en/news/releases/20120301540-news, accessed 1 March 2012
11 Jon Lukomnik, Executive Director of the Investor Responsibility Research Center Institute (IRRC), The CERES Aqua Gauge webinar, 2012
12 China faces worst drought in 50 years, Financial Times, 24 May 2011
13 Drought poses major risks to companies in China, World Resources Institute, 25 May 2011

Rapid industrialisation and urbanisation in Asia, the world's driest continent, are driving fast-growing water demand.[14] China is expected to need 818 billion cubic metres (m^3) by 2030, with half of this going to agriculture and almost one-third to industry.[15] Current supply amounts to just over 618 billion m^3, and poor water quality due to wastewater pollution could exacerbate the 200 billion m^3 shortfall. Annual national average water shortages have already reached more than 50 billion m^3.[16]

China leads Asia's investment in large-scale projects to tap into water resources, such as dams. However, most of the best sites are already being used for water supplies. Furthermore, infrastructure can affect water quality and quantity downstream and change ecosystems, damage biodiversity and lead to coastal erosion and saltwater intrusion.[17] Downstream countries such as Bangladesh and Vietnam are particularly vulnerable to upstream changes in water systems.

Southern China has 80% of the country's freshwater supply and a Government project is diverting water from the south to the arid north. The project plans to divert almost 45 billion m^3 of water annually from the Yangtze river to northern China – about 5% of the river's average annual runoff (951 billion m^3/year).[18,19] Implementing the South-North Water Transfer project will increase water tariffs, and could encounter disruptions as a result of increasing environmental and climate change impacts (see box).

To address the challenge that water use has already surpassed natural resource limits in many areas and could undermine economic development, China's State Council announced plans in February to regulate water use under "the strictest criteria."[20] The Government will cap the maximum volume of water used at 700 billion m^3 by the end of 2030.[21,22] Plans to strengthen controls on water withdrawals, water use efficiency and pollutants – the "Three Red Lines"[23] – to promote water conservation are in line with China's 12th Five-Year Plan target to cut water consumption per unit of value-added industrial output by 30% by 2015.[24]

CLIMATE CHANGE IMPACTS IN CHINA

Climate change-induced disruptions to rainfall patterns and snowfall are blamed for a 13% drop in total water resources in China since the start of the century. China's 2nd National Assessment Report on Climate Change warns of severe imbalances in water supplies in the future – with risks from too much or too little. Grain production has shifted to the dry north, and more frequent droughts and floods could cut production by between 5% and 20%. More concentrated rainfall in the summer/autumn could threaten food security. Eight of China's 31 provinces and cities could face severe water shortages, as glaciers which feed major rivers retreat and low-lying coastal regions are exposed to rising sea levels.

Source: 2011 Year in Review & 5 Trends for 2012, China Water Risk, 9 February 2012

14 Asia's water stress challenges growth and security, The Japan Times, 3 December 2011
15 Charting our Water Future, 2030 Water Resources Group, 2009
16 Briefings on the opinions of the State Council on implementing the strictest water resources management system, China.org.cn, 16 February 2012
17 Asia's water stress challenges growth and security, The Japan Times, 3 December 2011
18 http://www.fao.org/nr/water/aquastat/countries_regions/china/index.stm, accessed 6 March 2012
19 http://www.fischer.eawag.ch/organisation/abteilungen/surf/teaching/management_as/unterlagen/01/TheSouth-NorthWaterTransferProjectInChina.pdf, accessed 6 March 2012
20 Water shortage, pollution threaten China's growth, China.org.cn, Xinhua, 16 February 2012
21 http://chinawaterrisk.org/notices/state-council-issued-new-water-management-decree/, accessed 6 March 2012
22 China warns on growing water shortages, FT.com, 16 February 2012
23 Briefings on the opinions of the State Council on implementing the strictest water resources management system, China.org.cn, 16 February 2012
24 Key targets of China's 12th five-year plan, xinhuanet.com, 5 March 2011

Businesses will see stricter implementation of a permit system for water withdrawals, and construction projects that will increase water withdrawals in areas of water stress will be restricted or suspended.[25] There will also be a stricter practice of paid use of water resources, with tighter collection, use and management of water resources fees. Water tariffs will rise,[26] and at best, the cost of manufacturing goods will increase.[27]

Concerns about water scarcity and quality are driving up water pricing to fund water and wastewater infrastructure and operations worldwide. Stronger price signals to water users aim to ensure that companies pay for environmental damage or resource depletion. They also create an incentive for firms to use limited resources more sustainably. Businesses may be vulnerable to internalising water costs through water price volatility, water shortages that disrupt production, operating restrictions, declines in water quality, and the costs of damages to biodiversity and ecosystem goods and services from water abstraction. Water issues can degrade product quality, feed through into higher commodity costs, and lead to reputational damage or loss of social license to operate.[28,29] The local effects can ripple across industries and supply chains.

Companies and investors are increasingly looking to understand water-related risks and opportunities in operations and supply chains. More than 551 institutional investors with US$71 trillion of assets backed last year's Carbon Disclosure Project (CDP) water questionnaire asking 500 of the world's largest companies to provide information on water use. Of 28 companies in Japan that were sent the questionnaire, nine responded publicly and eight responded but did not allow information to be made public. The CDP Water Disclosure Global Report 2012 points to a new water management paradigm that includes improved water data and analytics, precision agriculture and water efficiency.[30] Good water stewardship that focuses on business activities and locations where water use matters most requires data on water use across operations and supply chains.

WATER RISK SETTO GROW IN JAPAN

Japan has plentiful water supplies in spring but it does not have abundant water resources. Due to population density, per capita precipitation is about one-sixth of the global average. Since rivers have small basins and steep channels, little is available for use. Cities have comparatively few water reserves. Every year, parts of the country are affected by water shortages.

Japan is vulnerable to climate change impacts, and within 100 years, a dramatic decrease in snow cover in the upstream catchments of major rivers will reduce spring water storage levels of reservoirs, affecting agricultural water. More frequent heavy rainfall is expected to increase flood risk. Greater fluctuations in precipitation are expected to lead to more intense tropical cyclones and more severe droughts. Rivers are prone to flooding and almost half of the population and 75% of properties are in flood prone areas.

Adaptation plans include improving water efficiency. The Japanese national integrated water resources management plan aims to establish a sustainable water use system, improve the water environment and develop a water-related culture. Measures include stricter limits on groundwater and surface water abstraction, which are modified during droughts. Industrial effluent and agricultural runoff is regulated, and wastewater recycling and rainwater collection are being promoted.

Source: http://www.mlit.go.jp/river/basic_info/english/land.html, accessed 6 March 2012

25 Briefings on the opinions of the State Council on implementing the strictest water resources management system, China.org.cn, 16 February 2012
26 Sino French discusses water pricing, China Water Risk, 9 February 2012
27 2011 Year in Review & 5 Trends for 2012, China Water Risk, 9 February 2012
28 Ceres Aqua Gauge, 2011
29 Expect the Unexpected: Building business value in a changing world, KPMG, 2012
30 CDP's Water Disclosure Report highlights businesses failing to act, guardian.co.uk, 16 November 2011

2.1 Study to assess supply chain water risk in the Nikkei 225 Index

KPMG and environmental research company Trucost worked in partnership to produce this special report on exposure to water risk among companies in the Nikkei 225 Index. Trucost analysed data on water consumption in the operations and supply chains of 225 companies in the Index, which had a market capitalisation of more than ¥184 trillion (US$2.2 trillion), based on the latest available data as of 4 March 2012. The companies' combined revenues totalled more than ¥342 trillion (US$4.2 trillion). To convert US Dollars (US$) to Yen (¥), the main exchange rate used was as of 28 February 2012 (80.47).[31] Financial analysis at a company level uses exchange rates as of the end of each company's financial year.

The special report looks at:

Nikkei 225 Index

- Sectors with the highest levels of process water use, measured in cubic metres (m^3).
- Operational and supply chain water use in high-impact sectors.
- The water efficiency of companies in the Food & Beverage, Automobiles & Parts and Personal & Household Goods sectors. Measuring water intensity as cubic metres (m^3) of operational and supply chain water use per million Japanese Yen (¥) or US Dollars (US$) in revenue enables benchmarking of companies on water efficiency regardless of size or sector.
- Analysis of exposure to water scarcity costs in supply chains of Personal & Household Goods companies.
- Analysis of critical areas of water use in the supply chains of Personal & Household Goods companies to identify water "hot spots".
- Case studies highlighting company reporting on water risk.

Corporate water risk in Asia

- To illustrate how companies can assess exposure to water risk through suppliers in key industries, Trucost analysed operational process water use (excluding cooling water) by companies listed in Asian countries in the Farming & Fishing, Steel, and Specialty Chemicals sectors.
- Country-level water scarcity costs are applied to the water used by each company to identify exposure to water risk.

TRUCOST WATER DATA

The analysis covers process water used in operations (abstracted and purchased from water utilities) as well as water used in supply chains. The study includes industrial and agricultural process water consumption, but excludes water used for cooling. Trucost has analysed the environmental performance of over 4,000 companies worldwide. Trucost's data on quantities of corporate water use and other environmental impacts incorporates information disclosed by companies in Annual Reports and Accounts, Environmental Reports, Sustainability or Corporate Social Responsibility Reports, company websites, and other publicly disclosed data. Since many companies do not comprehensively disclose their environmental impacts in quantitative terms, Trucost has developed a unique methodology based on an input-output model to calculate companies' environmental impacts and allow for comparisons between all companies, regardless of disclosure levels. Data on water consumption are categorised as operational (quantities abstracted and purchased) and supply chain (volumes of water used in all tiers of the supply chain, excluding quantities purchased from utilities). Trucost's input-output model analyses business activities at a global level to calculate supply chain water use, based on extensive studies to identify industry-specific quantities of water use per unit of output. Trucost calculates the environmental impacts of 464 sectors. The environmental impacts modelled for each sector are allocated to a company according to the proportion of its revenues in each subsector. The input-output model estimates the amount of resources that a company and its suppliers use (the inputs) to produce goods or services (outputs). The model also calculates the related level of pollutants, such as greenhouse gas emissions. To find out more, see the Appendix on page 23.

31 http://www.oanda.com/currency/converter/, accessed 6 March 2012

3.0 Water use in the Nikkei 225

Trucost's analysis shows that supply chains are responsible for three-quarters of more than 79 million m^3 of water used by all 225 companies.

Total water use by the operations and supply chains of Nikkei 225 companies amounts to over 79 billion cubic metres (m^3) – more than total annual water use by industry and agriculture in Japan (67 billion m^3).[32] This is because much of the water used is embedded in imported materials and components.

Operational

Trucost analysed data on water used globally by companies in the Nikkei 225 Index. The companies and their subsidiaries consumed an estimated 19.4 billion m^3 of water in 2009/10. This includes water that was directly abstracted and purchased from water utilities for consumption at operations worldwide. Industrial water users in Japan use more groundwater than agricultural water users.[33] Government subsidies for water provision help limit water tariffs.[34] Average water and wastewater tariffs reached ¥206/m^3 (US$2.56) in Japan in 2011.[35] Pumping and treating water can be energy intensive, so improving water efficiency can reduce exposure to rising fuel costs and cut greenhouse gas emissions.

Supply chain

First-tier suppliers (excluding water utilities) are responsible for more than 24.4 billion m^3 of process water use. Other suppliers in tiers 2 onwards use a further 35.3 billion m^3. Together, first-tier and upstream suppliers account for 76% of total water consumption by the companies analysed (see Figure 1). Companies can incur the costs of supply chain water consumption through rising input costs.

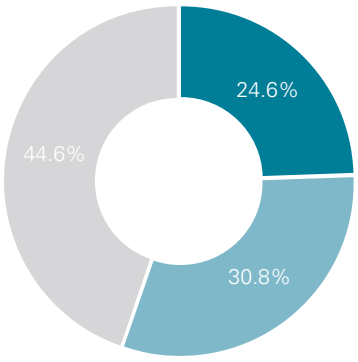
3.1 Supply chain water use varies across sectors

For 149 companies in the Nikkei 225, the majority of water consumption takes place in their supply chains. The costs of sourcing process water and treating it to meet water pollution and quality standards before discharging wastewater can be passed through by suppliers of goods that are water intensive to manufacture. Figure 2 on page 8 shows a breakdown of operational and supply chain water use in the six supersectors[36] with the highest levels of total water consumption in the Nikkei 225. Together 127 companies in these sectors account for 82% of total water use by all companies analysed in the Index.

Food & Beverage (12 companies): Of the top six sectors, Food & Beverage has the highest share of first-tier and other supply chain water use – 98% of more than 16.8 billion m^3 of water consumption in the sector is by suppliers in the first tier and further upstream. Eight food producers account for 71% of water use in the supersector. Food & Beverage companies are highly exposed to pressure on water resources, and could be affected through water pricing or scarcity driving up the costs of key commodities. South Asia, China and Southeast Asia account for about half of the world's total irrigated crop land, and irrigation is exacerbating water stress in the region. Limits to water for irrigation are limiting production growth rates and contributing to food price volatility.[37] Growing demand for animal products is expected to result in more intensive livestock production, making land and water requirements for meat production a major concern by 2030.[38]

Basic Resources (17 companies): 71% of almost 12.9 billion m^3 of water is used in operations. Twelve companies analysed are in the Industrial Metals & Mining sector, which accounts for 78% of water use by Basic Resources firms analysed. Processes to produce iron & steel, aluminium and nonferrous metals can be water intensive. Steel production in China and India can use four times

Figure 1: Breakdown of water use by source



Source: Trucost Plc

32 http://www.mlit.go.jp/tochimizushigen/mizsei/water_resources/contents/current_state2.html, accessed 6 March 2012

33 http://www.slideshare.net/Water_Food_Energy_Nexus/oecd-agricultural-water-pricing-in-japan-and-south-korea, accessed 6 March 2012

34 http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/WRM_Japan_experience_EN.pdf, 6 March 2012

35 Global water tariffs continue upward trend, Global Water Intelligence, Vol 12, Issue 9, September 2011

36 The study uses Industry Classification (ICB) supersectors, a classification system developed by the Dow Jones Index and FTSE Group, used by investors. It provides four levels of classification – industries, supersectors, sectors and subsectors.

37 http://www.agri-outlook.org/document/63/0,3746,en_36774715_36775671_47923007_1_1_1_1,00.html#drivers, accessed 6 March 2012

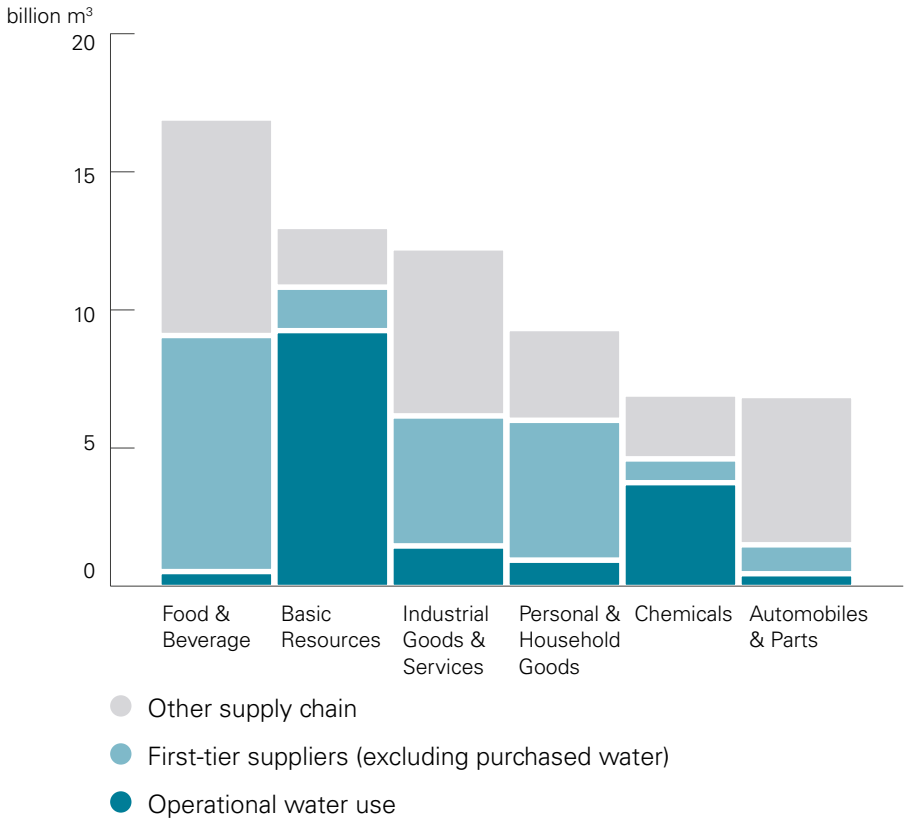
38 http://www.fao.org/DOCREP/005/AC911E/ac911e05.htm, accessed 6 March 2012

more water per tonne of steel than plants in Japan.[39]

Industrial Goods & Services (51 companies): Almost 90% of water use by the diverse industrial companies in the Index is consumed by suppliers (excluding water utilities that supply operations). Seven Support Services companies, many of which are industrial conglomerates with varied business activities, are responsible for more than 60% of water used by the Industrial Goods & Services firms analysed. 16% of water use in the Industrial Goods & Services supersector is by 23 Industrial Engineering companies. Within the supersector, Industrial Engineering companies have the highest share of water use in their supply chains (91%), which is likely to be driven by water consumption in the production of metal products to make commercial vehicles and trucks and industrial machinery.

39 Watching water, A guide to evaluating corporate risks in a thirsty world, JPMorgan, 31 March 2008

Figure 2: Six sectors with the highest levels of water use in the Nikkei 225



Source: Trucost Plc

CASE STUDY: Leading General Industrials company asks suppliers for information on water use

Trucost data show that one Industrial Goods & Services firm, which accounts for 5% of water consumption in the Nikkei 225 Index sector, used more than 560 million m³ of water globally through its operations and supply chain in 2010. The company reported to the 2011 CDP Water Disclosure Project information request that a board-level committee is responsible for a policy to cut water use and promote recycling and reuse in order to use water resources more efficiently and reduce environmental impacts.

The firm has reduced its water withdrawals by 29% per unit of production from 2000 levels, exceeding a target to reduce water intensity by 10%. Trucost data show that its water use relative to sales fell by 11% year on year in 2010.

The Great East Japan Earthquake and floods in Thailand caused its operating income to fall by 25% in the first nine months of the financial year 2011. Some operations in Thailand only restarted in February 2012, and the company has shifted some production elsewhere.

The firm reports that 2% of its water withdrawals (in China) are exposed to water stress. Globally, it uses environmental surveys and audits to ask key suppliers for water-related information. However, the company says that it is unable to identify which of its key water-intensive inputs (excluding water) come from areas of water risk. Suppliers have not reported significant water-related risks. It could overcome this information barrier by monitoring data on suppliers' water use and mapping this against local water stress levels.

Personal & Household Goods (19 companies): First-tier suppliers (excluding suppliers of purchased water) account for 55% of total water use by Personal & Household Goods companies – the highest share among the six supersectors. This suggests that there is significant potential to engage with direct suppliers to drive improvements in water efficiency. Other suppliers account for a further 36% of water use in the supersector. Suppliers are responsible for almost all water use in the Tobacco sector, which accounts for the majority of water consumption in the supersector (60%). The next highest share of water use is by 10 Leisure Goods companies (23%), followed by six Personal Goods firms (13%) and two Household Goods & Home Construction companies (4%).

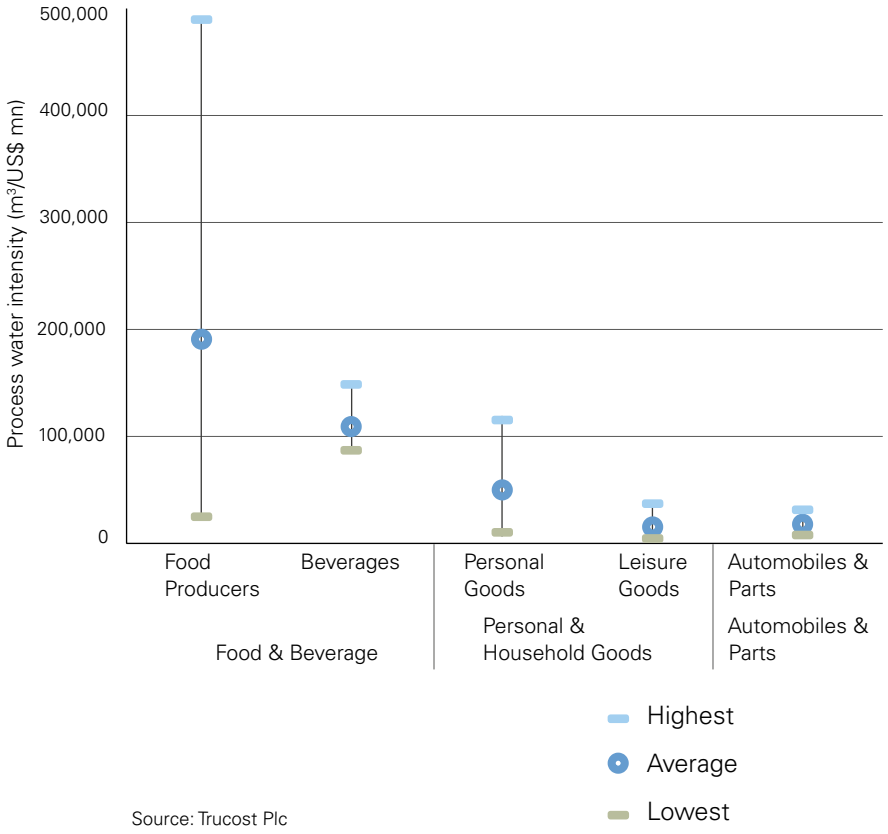
Chemicals (15 companies): Operations drive more than half of the water use by companies in the sector. Renewable feedstocks and biotechnology materials and processes can be particularly water intensive, and could increase water consumption.[40] Companies can use innovation and low-water consumption processes, techniques and technologies to reduce freshwater use and reuse wastewater.

Automobiles & Parts (13 companies): Seven Automobiles companies account for 72% of almost 6.8 billion m^3 of water used in the sector. The Automobiles & Parts sector has the largest share of water use from upstream suppliers in tiers 2 onwards (80%). This is largely due to water used to produce inputs such as steel and energy. Vehicle manufacturing is among industries in which production has become increasingly horizontally diversified, with companies producing the same goods as they do in home countries in final Asian markets using a "build-where-you-sell" strategy.[41] Japanese automobile assemblers procure key parts from four ASEAN countries – Thailand, Malaysia, the Philippines and Indonesia. The Thai floods damaged a cluster of component plants and caused several Japanese vehicle manufacturers to shut plants in the country, with knock-on effects on their profits.

40 http://ec.europa.eu/environment/etap/inaction/policynews/518_en.html, accessed 6 March 2012

41 Trade patterns and global value chains in East Asia: From trade in goods to trade in tasks, World Trade Organization/Institute of Developing Economies Japan External Trade Organization, 2011

Figure 3: Variations in water intensity in top 3 supersectors (m^3/US$ mn)



Source: Trucost Plc

3.2 Variations in the water intensity of companies

Dependence on water resources to sustain business activities in operations and supply chains varies at a company level within sectors. To compare the water intensity of companies and sectors regardless of size, Trucost measured each company's total cubic metres of operational and supply chain process water consumption per ¥/US$ million in revenue. Variations in water intensity can indicate varied exposure to disruptions to water supplies and rising water scarcity costs. Companies that are less water-intensive for their sectors could be more resilient as pressure on water resources grows. In the three supersectors with the highest levels of supply chain water use – Food & Beverage, Automobiles & Parts and Personal & Household Goods, the subsectors with the widest variations in water intensity (m^3 per US$ mn) at a company level are shown in Figure 3. Table 1 on page 10 shows the range and average water intensities of all subsectors in Yen.

Key findings include:

- The water intensity of Food Producers ranges from 283 m^3/¥ mn (26,302 m^3/US$ mn) for a marine products business to 5,277 m^3/¥ mn (490,011 m^3/US$ mn) for a company with flour milling and processed foods businesses.
- Beverages companies have the second-highest average water intensity, at 1,209 m^3/¥ mn (109,460 m^3/US$ mn). Processes to produce alcoholic beverages contribute to the above-average water intensity of one Beverages company, which is an outlier compared with its sector peers. Suppliers are responsible for the majority of its water use, and would be key to reducing its overall water intensity. The other seven companies in the subsector are less water intensive than the average.
- The least water-intensive Personal Goods company (76 m^3/¥ mn or 7,461 m^3/US$ mn) mainly manufactures watches and clocks, while the most water-intensive company produces fibres and materials. The water intensity of textiles manufacturers ranges from

Table 1: Variations in water intensity in top 3 supersectors (m^3/¥ mn)

Sector	Number of companies analysed	Lowest	Average	Highest
Food Producers	4	283	2,125	5,277
Beverages	8	977	1,209	1,605
Personal Goods	6	76	584	1,206
Leisure Goods	10	41	126	397
Household Goods	2	100	115	131
Automobiles & Parts	13	109	160	331

Source: Trucost Plc

813-1,206 m^3/¥ mn (75,482-119,077 m^3/US$ mn). The most water-efficient textiles company reduced its water use by 26% over five years.

- The least water-intensive Leisure Goods company produces amusement machines. At a subsector level, the water intensity of Consumer Electronics companies varies most – ranging from 62 m^3/¥ mn to 397 m^3/¥ mn (5,771-36,906 m^3/US$ mn). 86% of total water use by the five Consumer Electronics companies analysed is in their supply chains. Imported content accounts for almost 20% of computers and electronic equipment exported from Japan.[42] The industry has a high degree of staging production along a global supply chain, where lead firms purchase key components from suppliers and have them assembled in a third, low-cost country for export of the products to final markets. This "vertical specialisation"[43] reflects the complexity of manufacturing electronic and electrical equipment. Electronic parts and components are the most traded types of inputs within Asian supply chains. Semiconductor manufacturing requires large volumes of ultra-pure water, however most of the industry's water impacts are upstream from activities such as raw materials extraction and processing and chemicals production. Trucost modelling can provide a detailed breakdown of water consumption across supply chains to identify which business activities in different tiers use the most water (see page 13). Despite the industry's water dependence, producers tend to be located in regions with potential water stress and scarcity, such as Taiwan, Singapore and South Korea.[44]
- The two outliers with the highest levels of water intensity in the Automobiles & Parts sector are tyre manufacturers. The majority of water used in tyre manufacturing is upstream through raw materials used to produce synthetic rubber and rayon.[45] The most water-intensive carmaker analysed uses 20% more water relative to revenue generated than the least water intensive. Vehicle and tyre manufacturers are increasingly conducting life cycle assessments to identify environmental impacts such as water use by suppliers. Understanding water stress in regional manufacturing hubs and export platforms will become increasingly important to manage related risks.

42 Ibid

43 http://www.wto.org/english/res_e/booksp_e/stat_tradepat_globvalchains_e.pdf, accessed 6 March 2012

44 UBS Investment Research, Q-Series: Water Risks to Business, 2011

45 http://www.conti-online.com/generator/www/com/en/continental/csr/themes/ecology/download/oekobilanz_en.pdf, accessed 19 March 2012

CASE STUDY: Food & Beverage company reports on material risks from supply chain water use

A Japanese Beverages firm that used 89 million m^3 of water in 2009 says that any one of "a multitude of environmental issues – climate change, natural resources running dry, scarcity, and the conservation of biodiversity – [...] could undermine its ability to operate."[46] The company reports that 5% of facilities are located in water-stressed regions in Australia. Up to 10% of malt and grain inputs are from regions exposed to water risk. The firm requires key suppliers to report on water use, risks and management, and believes that its supply chain is exposed to water-related risks that could be material. Current risks identified include exposure to rising water prices and water shortages through suppliers in Australia.

Future water-related risks that could substantially change its operations, revenue or expenditure include reduced demand for water-intensive products, due to the large water footprint of inputs, in Japan, Australia and China within 6-10 years. The firm expects to face increased water shortages in China and higher costs to comply with stricter effluent standards in Japan within 11-20 years. Water shortages in Japan are expected to present a business risk beyond 20 years. The firm warns that growing water stress could disrupt operations, drive up commodity or energy prices and even put it out of business.

The Group aims to address these risks through a strategy to use water more efficiently, treat wastewater properly and protect water resources. The company has set a product-based water intensity target for operations in Japan, and an absolute target to reduce water use in Oceania. Initiatives to achieve these goals include designing a factory to minimise water use, redesigning cleaning processes, using more recycled wastewater and exceeding mandatory water treatment standards.

46 Reported to the 2011 CDP Water Disclosure Project

3.3 Water scarcity pricing to identify risk

Water prices rose by up to 51% in many Asian cities between 2009 and 2010, with an 8% increase in tariffs in Beijing.[47] Globally, water and wastewater tariffs increased by 6% on average between 2010 and 2011.[48] However, increases in water bills over the past decade have mainly covered the costs of wastewater treatment and disposal.[49] Further rises in water charges are vital to encourage more efficient use and investment in water infrastructure. The World Bank and OECD have called for "substantial" increases in water prices so that households and industry pay the true cost of the water they consume to help manage water as a finite resource.[50] Companies will also face higher water prices as utilities pass on rising costs for energy, infrastructure, achieving water quality standards and licensing conditions, and treating wastewater and sewerage.

Water is increasingly being priced to reflect water stress. The impacts of water use vary depending on local pressures. Trucost has calculated the external costs of water scarcity for water used in countries worldwide. Water scarcity costs reflect the impact that water extraction has on freshwater replenishment, ecosystem maintenance, and the return of nutrients to the water cycle. The prices used reflect levels of water scarcity, which is measured as the total annual volume of groundwater and surface

47 Global Water Intelligence
48 http://www.globalwaterintel.com/archive/12/9/market-profile/global-water-tariffs-continue-upward-trend.html, accessed 6 March 2012
49 Water - The right price can encourage efficiency and investment, OECD
50 Experts call for hike in global water price, guardian.co.uk, 27 April 2010

water withdrawn from their sources by agricultural, domestic and industrial sectors, relative to the total volume of water available annually through the hydrological cycle (total renewable water resources).[51]

Trucost examined the exposure of Personal & Household Goods companies in the Nikkei 225 to the costs of water use if prices per m^3 were to reflect water scarcity. Assuming the majority of water used by suppliers is sourced in Asia, Trucost applied average water scarcity costs for 16 Asia Pacific countries, including Japan and China, of ¥90.93 (US$1.13) to each m^3 of process water used in supply chains (excluding water purchased from utilities and used in operations). If suppliers were to pass on water scarcity costs in higher prices, the 19 companies analysed could see input costs rise by ¥882 bn (US$9.5 bn).

Water costs are measured relative to earnings before interest, taxation, depreciation and amortisation (EBITDA) to identify the potential materiality of financial risk from these costs being internalised (see Table 2).

Table 2: Supply chain water scarcity costs as % of EBITDA in Personal & Household Goods sector

Lowest	Average	Highest
2%	84%	>100%

Source: Trucost Plc

Measuring water scarcity costs relative to financial metrics provides a proxy for exposure to risks from rising water prices or disruptions to water supplies.

Excluding three companies that had negative EBITDA, water scarcity costs for supply chain water use would equate to 84% of earnings on average across the 16 companies analysed. Earnings could be wiped out for two companies. Less than 50% of earnings would be at risk for 12 companies. Companies that are more exposed to water costs than sector peers could find it more difficult to pass on rising input costs and maintain market share if supplies are disrupted. Actual financial exposure to water risk would depend on factors including the locations and water intensity of suppliers.

Companies need to measure their operational and supply chain water use, understand risks to supplies, and look at where and how to use resources more efficiently. It is important for water-intensive industries to monitor their water needs in relation to local water availability, water quality, competition for resources and ecosystem goods & services that require and support freshwater supplies. Water prices that reflect the scarcity of supplies can be applied to water use at a water basin, country or regional level to identify potential exposure to risks from rising water prices and business disruption.

TRUCOST WATER SCARCITY COSTS

Trucost has calculated the cost of water use in different locations based on a relationship between water scarcity and the value of water. Prices correlate to the proportion of total water resources used or withdrawn, expressed as a percentage of total renewable water resources. Water valuations are adjusted to the geographical mapping of water stress levels where water is used. Country-level water costs are adjusted for local incomes and water scarcity. The granularity of water risk assessments depends on the availability of water use data and information on the locations of suppliers. Applying water scarcity costs to water consumption data can help monitor changes in risks from water scarcity in supply chains, compare exposure to water risks in different locations, identify potential financial risk from rising commodities prices and benchmark suppliers on water risk.

51 http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/freshwater/total_water_resources_used.pdf, accessed 15 March 2012

4.0 Mapping water use in supply chains

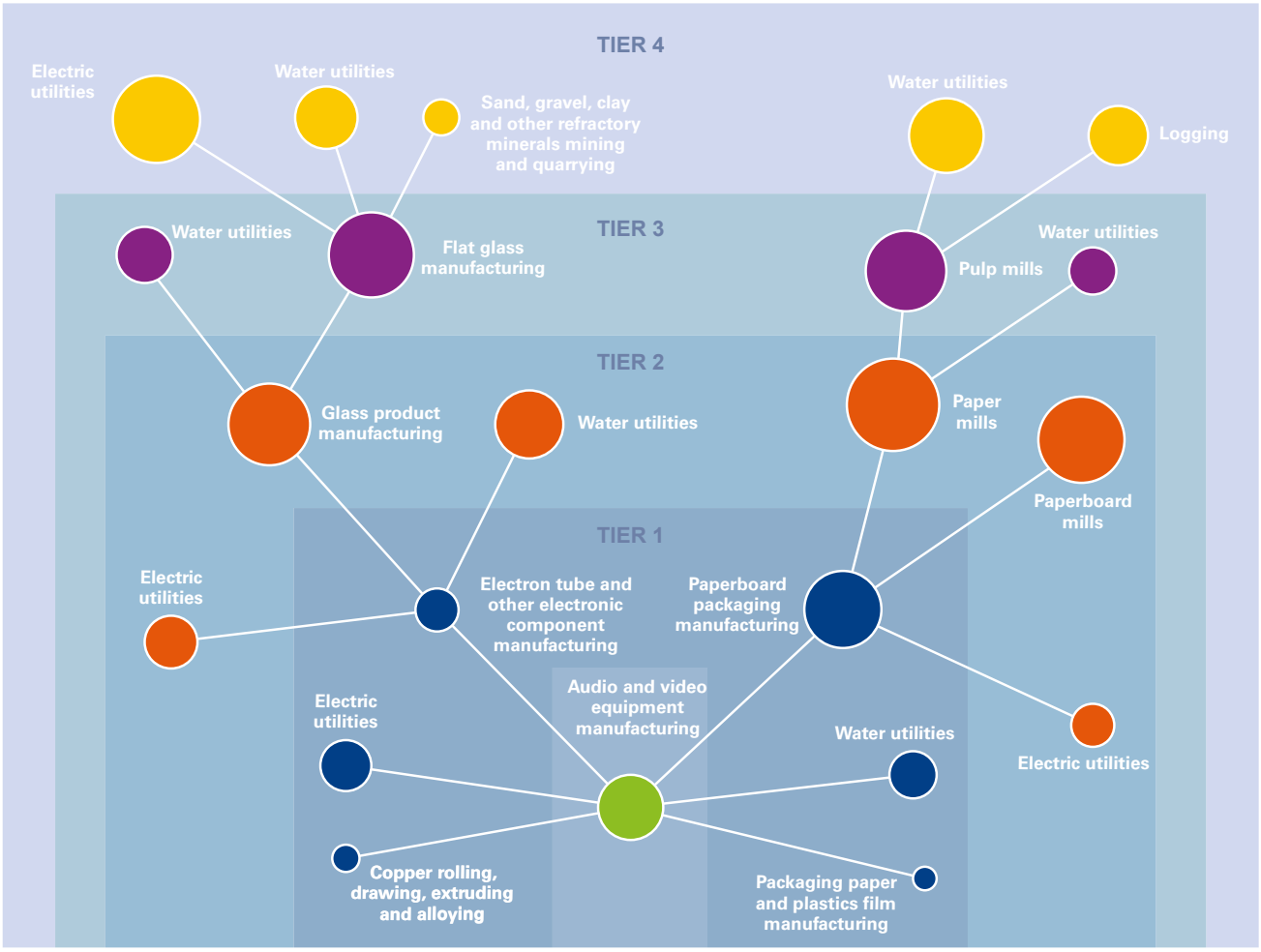
Data on purchasing patterns can reveal which industries contribute most to water use in supply chains. For audio and video equipment manufacturers, water hot spots include electronic components and packaging suppliers.

Companies can use an understanding of water use in their supply chains to identify areas to focus on to improve water management and reduce risk. Secondary data such as input-output modelling can be used to identify the largest water users in supply chains. Findings can help prioritise suppliers for engagement up front, making data collection more time and cost effective. Trucost's advanced environmental profiling modelling, based on average water use by industries along with interactions between sectors, can be used to map critical areas of water use – known as "hot spots" – in supply chains. Overseen by an academic advisory panel, the model combines financial data with sector-specific water data to identify which sectors use the most water in a given supply chain.

Suppliers can be prioritised based on levels of water use in their operations and supply chains. As an example, Trucost mapped hot spots of water use across different tiers in the supply chain of four audio and video equipment manufacturers in the Nikkei 225 Consumer Electronics sector (see Figure 4).

The sizes of bubbles represent levels of water use – the larger the bubble, the bigger the water hot spot. Connections between water hot spots in different tiers reveal how purchasing by suppliers leads to water use further upstream in the sector's supply chain. Findings show that suppliers of paperboard packaging contribute most to water use in the first tier of the supply chain of audio and

Figure 4: Breakdown of water use in the supply chain of audio and video equipment manufacturers



Source: Trucost Plc

video equipment manufacturers. In turn, paper and paperboard suppliers in the 2nd tier account for high levels of water use, and their pulp and water purchases result in further water consumption in tier 3.

Electron tube and other electronic equipment manufacturers also contribute to relatively high levels of water consumption in tier 1. However, their purchases of glass, water and power result in larger water hot spots in tier 2. Glass manufacturing also results in significant water use in tier 4.

Audio and video equipment manufacturers could initially focus on understanding water use by paperboard packaging manufacturing and electron tube and other electronic component manufacturers in order to prioritise data collection and strengthen accountability for water management. Actual supply chain water impacts could be mapped more precisely for each company individually to reflect their product mixes and purchasing of materials. Initial estimates based on spend with suppliers in different sectors can be used to identify critical areas of water use throughout supply chains.

Data on suppliers' water use can be collected from company disclosures, where available. For companies with business activities in sectors with high levels of water consumption that do not report data adequately, engagement programmes can be used to collect data. Suppliers' water consumption can be allocated to companies based on spend. For instance, where a company purchases semiconductors from a supplier in South Korea, the supplier's water data can be allocated to the buyer based on its purchases as a proportion of total supplier revenue. Secondary data from environmental modelling can be used to fill gaps.

Data on suppliers' water use can be analysed to assess water consumption linked to procurement and benchmark suppliers on water efficiency. Water data can be collected on a geographical basis so that local water scarcity prices can be applied to quantities of water used to identify exposure to water stress. Potential water scarcity costs can be calculated across suppliers to prioritise action to reduce risk. Modelling can show the potential effects of internalising water scarcity costs on operating expenditure.

Water data can shed light on inefficient water use and can lead to innovation and opportunities to use less water-intensive materials and processes to produce goods and services. Water data can inform decision-making on raw materials and components during product design. Sourcing alternative materials or components or switching suppliers could be used as a last resort if water-intensive suppliers operating in areas of high water risk fail to improve water management. Including water data in procurement decisions can help develop more resilient supply chains and inform strategies to adapt to climate change impacts.

4.1 Water hot spots across the Personal & Household Goods sector

Across the Nikkei 225 Personal & Household Goods supersector, suppliers in the first tier (excluding utilities supplying purchased water used in operations) and further upstream were responsible for more than 8.3 billion m^3 of water use. Trucost data show that the Farming & Fishing subsector contributes most to the supersector's supply chain water use. Personal Goods companies are particularly exposed to water pressures on the production of vegetable fibres such as cotton and flax. Cotton contributes 90% of natural fibres[52] used in the global textile industry. It can currently take 2,650 litres to make a T-shirt and 10,000 litres to make a pair of jeans.[53] Water-intensive companies and supply chains in the industry can be indirectly affected by water scarcity and water stress through crop price volatility.

Water risk in China's cotton-producing regions, for example, can increase price volatility in the supply chains of many textile companies. China produces about 25% of global cotton production, with more than half of its cotton grown in high-water risk areas of the Yangtze and Yellow river basins. China's drought in 2010/11 contributed to cotton prices rising to a 15-year high. Shrinking water availability under climate change impacts in the northwest cotton-growing region of Xinjiang could lead to a "marked decline in agricultural crop productivity".[54,55]

Asia now accounts for more than half of world exports of garments and nearly half of textile exports.[56] More than 80% of garments and accessories and more than half of textiles imported by Japan come from China. Japanese imports of clothing and textiles have also increased from Cambodia and Vietnam. Cambodia is less water stressed than China, Bangladesh and Vietnam, and could therefore gain a competitive advantage in the future. Switching suppliers could be preferable to changing textiles in the clothing industry. Potential to switch to alternative materials such as synthetic fibres could be limited by market demand and the high cost of raw materials and fuels needed to produce synthetics such as nylon resins. The fibre of a garment is important to many Japanese consumers, who generally prefer clothing made of cotton and cotton blends.

Many suppliers will need to improve their environmental performance in order to maintain relationships with Apparel Retailers that are increasingly using environmental credentials to differentiate themselves in the market and achieve efficiencies such as energy cost savings. The shift is buyer-driven in the global value chain – retailers and brand owners are emphasising

52 Better Cotton Initiative, China Scoping Study Version 2.0, 2010

53 The Impact of World Recession on the Textile and Garment Industries of Asia, UN Industrial Development Organization/University of East Anglia, 2010

54 China report spells out "grim" climate change risks, Thomson Reuters, 17 January 2012

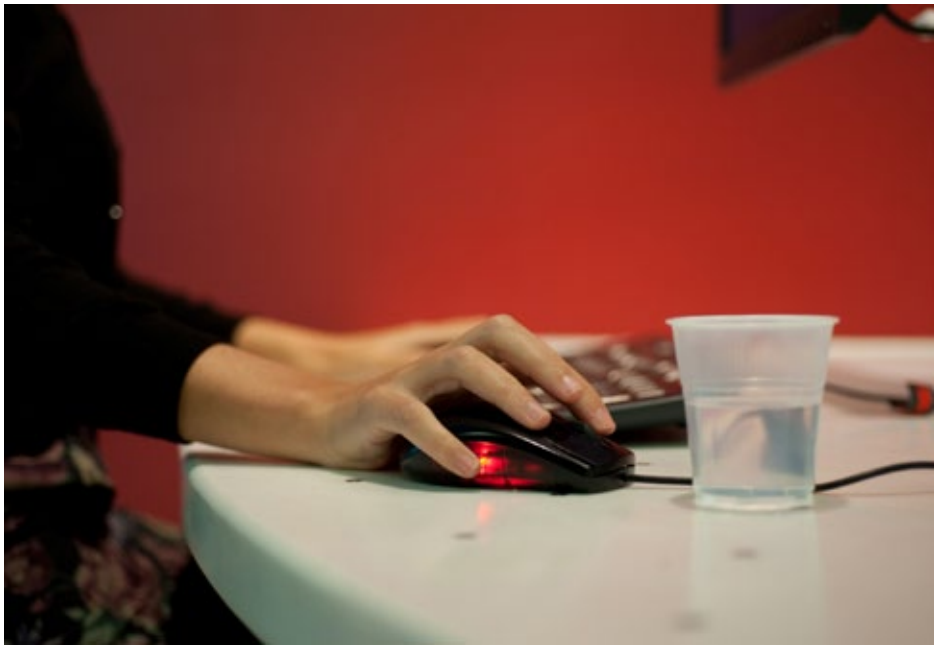
55 Cotton gains on reports of Chinese drought; orange juice falls, Bloomberg, 18 May 2011

56 The Impact of World Recession on the Textile and Garment Industries of Asia, UN Industrial Development Organization, Working Paper 17/2009

key environmental issues including water use, chemical use and waste and recycling.[57] Water data can be used to calculate the water footprints of products and develop water-efficient products and services, which could help companies build more sustainable brands and benefit from opportunities to use environmental labelling to promote products. In Japan, the Environment Association manages an Eco Mark Programme[58] to promote environmental labelling across more than 53 products, with more than 300 retailers and manufacturers signed up. In Thailand, a Green Label Scheme covers more than 40 products, including textiles and computers.[59]

The Containers & Packaging, Water Utilities, Conventional Electricity, Commodity Chemicals, Paper, Aluminium, Steel, Specialty Chemicals and Nonferrous Metals subsectors are also among the top 10 drivers of water use by first-tier suppliers in the Nikkei 225 Personal & Household Goods supersector. Packaging and logistics are critical for production networks as trade in components increases and international supply chains with "just-in-time" strategies are sensitive to transaction costs and business disruption. Hong Kong and Singapore are distribution and logistics hubs in Asian production and trade networks, including cargo handling, storage and warehousing, freight logistics and transport services as well as packaging.

Singapore is water-scarce as its land area is insufficient to collect and store water, and it has no natural sources



such as groundwater.[60] The country has a long-term agreement to import water from neighbouring Malaysia. One such agreement expired in 2011, and the other will expire in 2061. Climate change impacts such as sea-level rise could lead to saltwater intrusion into coastal reservoirs. To meet an expected doubling of water demand in the long term, the Government plans to increase supply from non-conventional sources such as desalination and water reclamation to meet up to 30% and 50% of water needs respectively by 2060. Desalination can be energy intensive and increase the costs of water supplies.

Global chemicals production is shifting towards Asia to meet growing customer demand in the region. The industry is the third-largest in China, after textiles and machinery, and the country is expected to become the largest chemicals producer globally.[61] But chemicals production in China suffers from a crisis of raw materials and resources, which depend on imports of inputs such as petroleum.[62] Growth is also limited by energy supply, electricity and transport shortages.

57 Ibid
58 http://www.jeas.or.jp/english/activ/04_label.html#02, accessed 6 March 2012
59 http://www.tei.or.th/greenlabel/, accessed 6 March 2012

60 Dealing with Water Scarcity in Singapore: Institutions, Strategies, and Enforcement, The World Bank, July 2006

61 http://www.economywatch.com/world-industries/chemical/china.html, accessed 6 March 2012
62 China Chemical Industry, Economy Watch, 30 June 2010

5.0 Corporate water risk in Asia

To illustrate how companies in the Nikkei 225 can assess exposure to water risks in their supply chains once water hot spots have been mapped, Trucost analysed operational process water use by Farming & Fishing, Specialty Chemicals and Steel companies listed in Asian countries (excluding Japan). Together the 56 companies analysed used more than 6.6 billion m^3 of water, equivalent to 80% of supply chain water use attributed to the Personal & Household Goods sector in the Nikkei 225 Index. Based on the countries in which the companies are listed, Trucost applied country-level water scarcity costs to quantities of water used by each supplier to identify the potential materiality of exposure to water risk.

If the companies were to pay the external costs of water scarcity (see page 11), water costs could amount to more than ¥512 billion (US$6.3 billion), as shown in Table 3. Suppliers that internalise these costs through increased water pricing or reduced access to water resources are likely to try to pass these costs on in higher prices. The companies could be exposed to further water costs through their own supply chains.

Across the three subsectors, water costs would equate to more than 10% of earnings for 32 companies. If water scarcity costs were internalised they would be most material to the Steel companies, and could equate to at least 3% of revenue and 20% of EBITDA for 12 companies in the subsector.

Twenty of the 29 Specialty Chemicals and Steel companies with more than 10% of EBITDA at risk from water scarcity costs are based in the Republic of Korea or Taiwan. Both countries face water shortages due to unequal distribution of rainfall between seasons. In Korea, narrow river basins and steep inclines mean that much of the water flows out rather than being stored. The country often faces drought during dry seasons,[63] and climate change and inefficient water management contributed to its worst drought in 12 years in 2010.[64] The UN categorises the country as vulnerable to tensions because of its water supply.

In Taiwan, rainfall mainly occurs during typhoons, which can disrupt supplies. Heavy rain during a typhoon in February damaged water infrastructure, causing water services in Taitung City to be suspended until June.[65] The semiconductor industry struggles to comply with the Government's policy of rationing water to non-domestic users in response to water shortages. In 2011, shares trading on the Taiwan Stock Exchange fell due to concerns that drought could adversely affect the high-tech industry.[66] Water shortages in Taiwan are expected to worsen in the future and the Government is strengthening controls on water use and pollution.[67]

63 http://www.un.org/esa/agenda21/natlinfo/countr/repkorea/drought.pdf, accessed 6 March 2012
64 http://www.koreaherald.com/national/Detail.jsp?newsMLId=20090323000074, accessed 6 March 2012
65 http://www.water.gov.tw/eng/02stoppages/sto_a_main.asp?no_s=664, accessed 6 March 2012
66 Taiwan faces tough water choices, guardian.co.uk, 24 June 2011
67 http://www.water.gov.tw/eng/04water/wat_a_list.asp, accessed 6 March 2012

Table 3: Water use and exposure to water costs in 3 hot spot subsectors

Sector	Number of companies analysed	Total operational process water use (m^3)	Total operational water costs ¥ mn	Total operational water costs US$ mn	Average water costs as % of revenue	Average water costs as % of EBITDA
Steel	26	3,246,260,565	414,696	5,153	4%	42%
Farming & Fishing	7	3,067,113,949	18,302	227	3%	10%
Specialty Chemicals	23	357,283,482	79,924	993	3%	27%
Total	56	6,670,657,996	512,912	6,374	3%	32%

Source: Trucost Plc

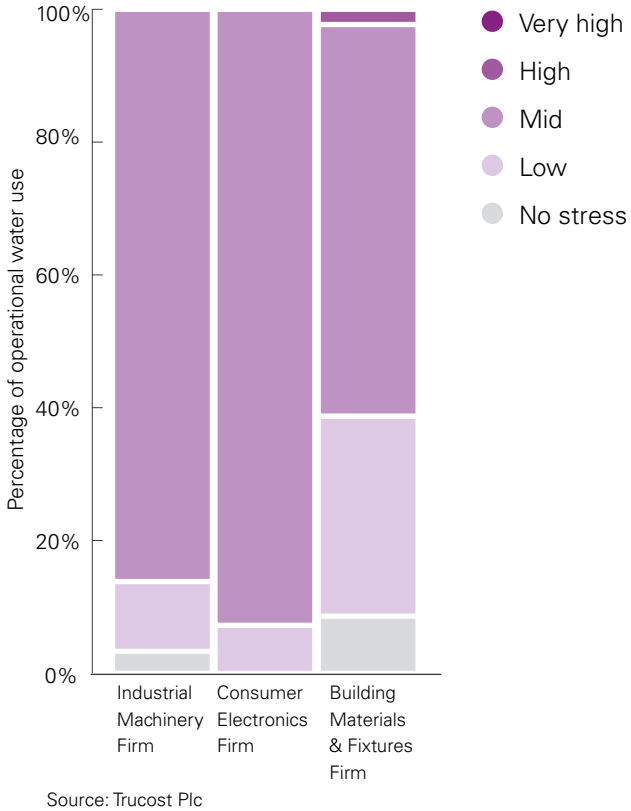
5.1 Creating supplier water risk profiles

Many of the companies analysed in this study are likely to source water from locations outside of the countries in which they're listed. Nikkei 225 companies can collect data on suppliers' water use by site to assess water risk profiles of individual companies. Country-specific water scarcity costs could be applied to suppliers' water use so that water risks are identified based on both levels of water use at each location and local water availability. To demonstrate how this approach could be used to compare suppliers on geographical water risk, Trucost analysed the country-level breakdown of water withdrawals reported to the CDP Water Disclosure Project. Based on levels of water use in areas with different levels of water stress, Trucost created risk profiles for three companies that reported data on a geographical basis (see Figure 5).

Most of the water used by the companies is sourced from areas with medium levels of water stress. Where possible, water scarcity could be calculated at a water basin level. Local water tariffs can be reviewed to assess the extent to which they already reflect water scarcity and/or capital and operating costs to maintain water supplies and environmental quality. Water utilities are likely to try to increase tariffs in order to pass the cost of asset depreciation on to customers to protect credit quality.[68] Businesses need to monitor water withdrawals, consumption, reuse/recycling and wastewater discharge to identify exposure to supply disruption from water scarcity or flooding, as well as risks from non-compliance with regulatory controls on water pollution, quality and abstraction. Identifying potential exposure to water risks can lead to opportunities to improve the water efficiency of raw materials sourcing, processes and products.

68 Credit FAQ: How Water Shortages In Eastern England Could Increase Costs For U.K.-Based Utilities, Standard & Poor's, February 2012

Figure 5: Breakdown of company water risk profiles – water use by level of water stress



Source: Trucost Plc

5.2 Exposure to water risk in raw materials sourcing

Trucost is able to provide a materiality assessment of current and future water risk for key commodities. For instance, an analysis of FTSE 350 companies revealed that if water used in supply chains were priced to reflect water scarcity, commodity costs for oil, coal, wheat and cotton used in supply chains could rise by 140% on average.[69]

The analysis looks at how the costs of agricultural raw materials such as cotton might change if they were to reflect levels of water scarcity. This helps identify exposure to water risk through rising commodities prices due to lower productivity or rising water infrastructure or irrigation costs, disruptions to supplies and reputational risk.

Research can be based on actual expenditure on raw materials in the supply chain and quantities of the agricultural commodities sourced from producers in specific locations. If this information is not available and the origin of materials sourced upstream is uncertain, Trucost assesses the materiality of water risk based on publicly available data on global crop production or resource extraction. Data on the geographical profile of production for each raw material can be combined with average water use for commodities from different countries to identify likely water use by suppliers.

Results are combined with data on water stress levels to calculate water scarcity prices that reflect the environmental impacts of water extraction. Water scarcity costs can be applied to data on water use in crop production to map country-specific water costs. Data on the share of crops produced in a specific country can be combined with the water scarcity cost of growing the crop in that location to create risk profiles for procurement of different commodities. As an example, if a crop is water-intensive and a large share of global production/expenditure is in water-stressed areas in India, the water scarcity cost for the crop would be relatively high. Findings provide insight into which crops and locations present the greatest exposure to upstream water risk, and which commodities could face the greatest volatility in prices.

The analysis can be tailored to specific companies and their supply chains by weighting costs based on expenditure. Water risk profiles of agricultural commodities can take account of purchases by companies in the Nikkei 225. Companies can use this evidence to address exposure to rising raw materials costs driven by water scarcity. Findings can be used to identify areas to focus further monitoring and management of water risks.

Engagement programmes and plans to improve resource efficiency could focus on raw materials/product lines with the greatest potential to reduce water risks. As the data collection process and review of environmental reporting by suppliers upstream is developed over time, modelled water data can be supplemented by actual data to track changes in water efficiency. Water data could also be included in life cycle analyses of the environmental footprints of products. Outcomes could support brand development.

69 FTSE 350 Commodity Exposure Index, Green Monday/Trucost, 2011

6.0 Conclusions and next steps

Supply chain water risk assessments can be used to secure supplies and stabilise input costs

Trucost's findings that many companies in the Nikkei 225 are likely to be exposed to water-related financial risk through their supply chains suggest that understanding which suppliers are most exposed to water shortages and floods is important in order to secure supplies and stabilise input costs. Infrastructure and contracts that lock in high levels of water use in areas of water stress could face higher-than-forecast costs, lowering future cash flows and earnings. KPMG and Trucost are working in partnership to provide companies with the data and intelligence to make business sense of environmental risks and opportunities.

Measuring and reporting on water impacts

Japan's environmental reporting guidelines for business[70] and initiatives such as the CEO Water Mandate,[71] CERES Aqua Gauge[72] and the World Business Council for Sustainable Development Global Water Tool 2011[73] all encourage companies to collect and monitor data on water use and discharge. Companies need to understand risks to water resources that their businesses depend on. Although the timing and exact location of water risks can be uncertain, an understanding of the likelihood of water scarcity and flooding can be used to make operations and supply chains more resilient.

Supply chain resource risk assessments

Companies need to measure and understand the exposure of suppliers to rising water costs and disruptions from water issues. Challenges to improve accountability include inadequate disclosure on water use by many companies in their supply chains and difficulties in assessing local levels of water stress or flood risk. However, this study shows how secondary data on water use by different activities in supply chains can help identify hot spots to focus action to measure and reduce water impacts. It can also help fill data gaps to develop risk profiles and identify the potential materiality of water use across geographical locations.

Benchmarking (peer analysis) to assess water risk relative to competitors

Data on water use can be used to benchmark suppliers on water efficiency and identify priority areas to focus operational and technical measures to reduce water consumption. Companies can engage with critical suppliers to collect site-specific data on water consumption and management. Engagement can help raise awareness and build organisational capacity to measure and manage water use.

Environmental scenario analysis of water risk to support integrated strategic planning

Scenarios that use water valuations based on current and future water scarcity can provide insight into water risk. Water scarcity prices can be applied to water consumption data and resulting water costs can be measured relative to financial metrics as a proxy for water risk. This can be used to help monitor changes in overall risk profiles, to identify where water-intensive business activities could present a material financial risk, and to benchmark suppliers on exposure to water shortages. Companies that measure water impacts and identify related risks will be better positioned to develop effective water management strategies. In an era of growing scarcity and climate change impacts, risks to water and other resources need to be fully integrated into decision-making. Systematic, strategic long-term thinking around global sustainability megaforces takes account of the relationship between factors such as resource productivity and water security.[74]

Positioning operations and supply chains for growing water stress

Japanese companies that can account for water use in their operations and supply chains will be well placed to identify opportunities to reduce exposure to business disruption from water shortages, changes to operating licences, supply disruptions, volatile prices and climate change impacts. Companies that are equipped with knowledge of which suppliers present the greatest risks and opportunities to strengthen water management in supply chains will be better positioned for growing resource pressures.

70 http://www.env.go.jp/en/policy/economy/erg2007.pdf, accessed 6 March 2012

71 http://ceowatermandate.org/, accessed 6 March 2012

72 http://www.ceres.org/issues/water/aqua-gauge/aqua-gauge, accessed 6 March 2012

73 http://www.wbcsd.org/work-program/sector-projects/water/global-water-tool.aspx, accessed 6 March 2012

74 Expect the Unexpected: Building business value in a changing world, KPMG International, 2012

About KPMG AZSA Sustainability

KPMG AZSA Sustainability Co., Ltd. offers non-financial assurance services such as sustainability report assurance services, based on KPMG's global sustainability assurance methodology, as well as professional advisory services in the field of sustainability. The company supports enterprises to tackle various sustainability issues in an increasingly complex business environment by sharing leading-edge knowledge with KPMG's Climate Change and Sustainability Services professionals around the world.

About Trucost

Over the last 11 years, Trucost has researched, standardised and validated the world's most comprehensive data on corporate environmental impacts, including carbon, water, waste and pollutants. This provides Trucost's clients with:

- The most efficient approach to measuring carbon and wider environmental impacts across organisations, supply chains and investment portfolios;
- Clear identification of focus areas for reducing material environmental risks;
- Validation of source data, including completion of gaps in data which are currently not being tracked or reported;
- Comparison of environmental performance against peers, sectors, investment benchmarks and portfolios;
- The ability to transform quantitative environmental data into environmentally-oriented investment strategies.

For more information, visit www.trucost.com

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7.0 Appendix: Trucost methodology

The study includes the latest available financial and environmental data for companies in the Nikkei 225 in Trucost's database – an Environmental Register of more than 4,000 companies' environmental impacts – at the time of analysis. The majority of data analysed cover the financial year 2010. Trucost's Environmental Register provides quantitative measures that can be used to assess company resource use, waste generation and pollution releases in operations and through supply chains. The study classifies companies based on the Industry Classification Benchmark (ICB), a classification system developed by the Dow Jones Index and FTSE Group, used by investors. It provides four levels of classification – industries, supersectors, sectors and subsectors.

Modelling environmental impacts

Trucost has conducted extensive studies of industries to identify the quantities of over 700 environmental indicators per unit of output. These indicators cover the use of resources such as water, as well as waste production and pollutants such as mercury and greenhouse gas emissions. The system is consistent with the United Nations Millennium Ecosystem Assessment.

Quantitative data on industrial facilities' pollutant releases are combined with economic data from sources such as the US Bureau of Economic Analysis to analyse interactions between economic productivity and the environment. Trucost's input-output model includes data from the US Toxic Release Inventory, Federal Statistics Office of Germany (Destatis), the UK Environmental Accounts, Japanese Pollution Release and Transfer Register, Australia National Pollution Inventory and Canada's National Pollutant Release Inventory.

Trucost's input-output economic model analyses business activities in different sectors based on the North American Industrial Classification System (NAICS). Trucost primarily uses data from FactSet and company accounts to identify segmental revenue data and map each company to a set of sectors. The input-output model incorporates sector level inflation data to adjust calculations in line with annual inflation and movements in commodity prices. The model also describes the economic interactions between each sector.

Trucost's analysis takes into account both operational and supply chain impacts. Within supply chain impacts, the Trucost model can distinguish between any level of the supply chain from the first tier of suppliers all the way through to upstream raw material extraction. The input-output methodology models the purchases a company makes and the resultant resource use and environmental impacts. This analysis can incorporate actual expenditure and revenue data to analyse impacts of first-tier suppliers that the company buys from, as well as their suppliers, and so on until reaching the suppliers of raw materials. In this way, Trucost can cost the upstream impacts of purchases. This analysis can be used to assess the direct and indirect environmental impacts of a company of any size, industry sector or geography.

Company disclosures

Trucost's database incorporates company disclosures on environmental impacts and resource use, where available. Where a company only discloses data for part of its overall activities, Trucost may attempt to normalise quantities in order to estimate the environmental impacts of the business's entire operations. If this is not possible due to insufficient disclosure, Trucost may have to exclude the company's publicly available data altogether from its environmental profile. Trucost standardises the quantities of resources used or pollutants emitted using metric tonnes or cubic metres to allow for direct comparison across companies, industrial sectors and geographies. All quantities correlate with the company's relevant fiscal year to allow the costs associated with environmental impacts to be compared with the company's financial results. Companies are given the opportunity to review and verify their data.

Water data

Trucost analysed data on water withdrawn or purchased as operational water use. Manufacturing the final product involves the input of various raw materials and other products and services at various stages of the production process through the supply chain. The study therefore includes water use in supply chains, calculated using Trucost's environmental profiling model. The types of water data analysed by Trucost are mapped to classifications of water used by companies in Japan in Table 4 on page 24.

Table 4: Mapping of Trucost water data to classifications of water used by companies in Japan

Water classifications Japan	Use	Pricing in Japan	Trucost data definition
Tap	Drinkable.	Metered.	Water purchased from utilities suppliers, measured in cubic metres.
Industrial	Not drinkable, and used in large quantities by factories.	Metered, but the rate is flat as long as the amount does not exceed a prescribed limit.	Included in data on water used in operations and supply chains, and classified as "process water".
Ground	Some factories use groundwater instead of industrial water.	Usually free of charge.	Included in operational process water data, where reported by companies. Classifications for process water include groundwater, artificial reservoirs, lake, rivers & streams and tidal.
Sea	Used in power plants, oil refineries and other large plants for cooling and heat exchange purposes. Water withdrawn is discharged back to the sea.	Usually free of charge.	Trucost's Environmental Register includes tidal cooling water in the Utilities sector, where reported. Other classifications for cooling water include reservoirs, lake, rivers & streams and groundwater. However, cooling water is excluded from this study.

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