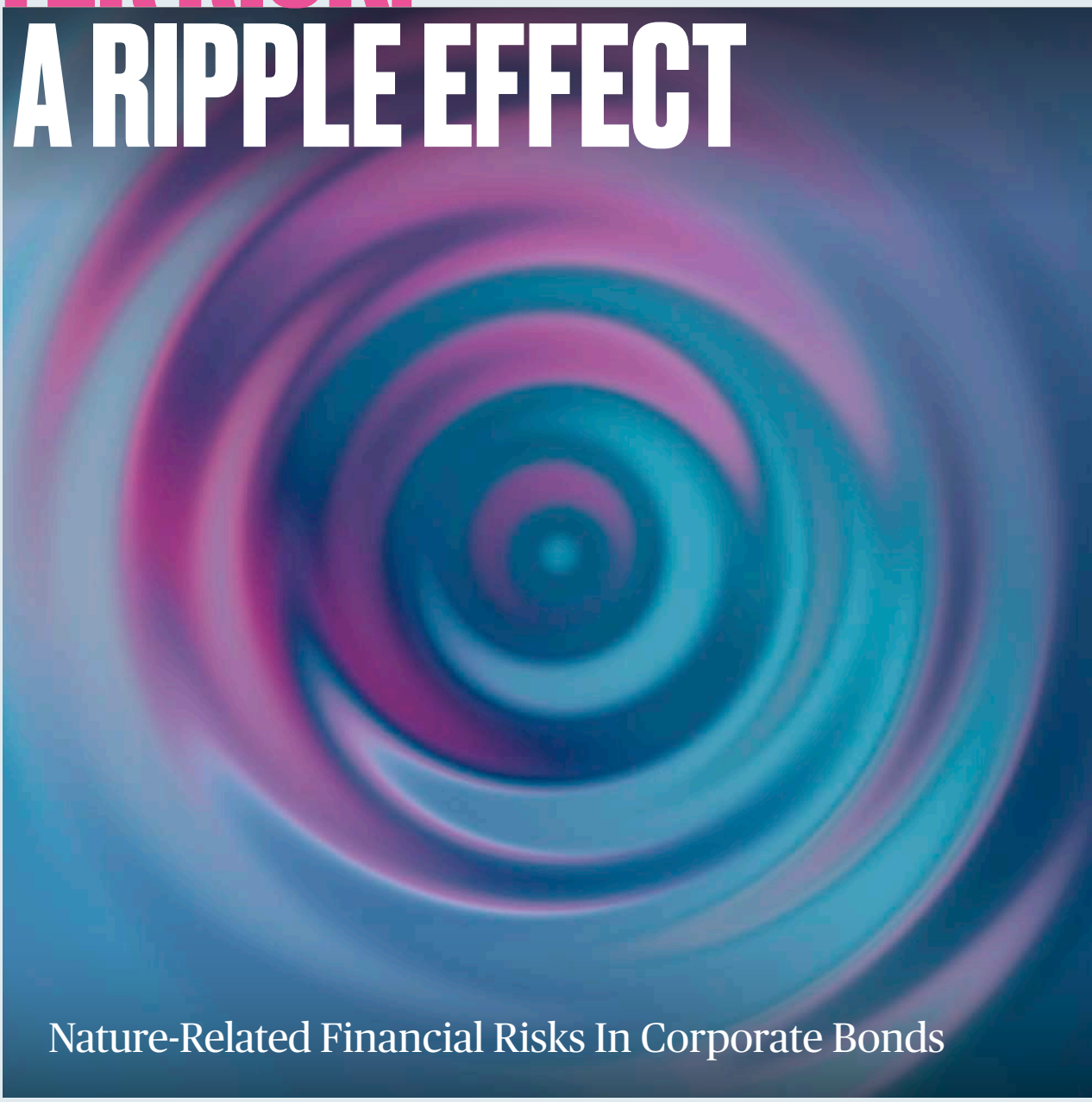
For Professional Clients and, in Switzerland, for Qualified Investors only.

WATER RISK: A RIPPLE EFFECT



Nature-Related Financial Risks In Corporate Bonds

BNY | INVESTMENTS

Insight INVESTMENT

EXECUTIVE SUMMARY

Water-related impacts and dependencies will expand sharply by 2030, leading to growing risk of asset impairment and stranding. This paper sets out why water risks are material and set to increase for corporate bond issuers, how Insight* is considering these risks, and sets out a proposal for integrating analysis of water risk into investment research and decision-making.

- **Corporates depend heavily on access to clean, reliable sources of freshwater.** Increasing localised water scarcity will lead to production stoppages, revenue depression and challenges in obtaining new permits for water abstraction and discharge.
- **Water-related risks affect some industries and sectors more than others.** Some industries depend heavily on water, or can have a material impact on water supply – such as the fashion and apparel industry, technology, agribusiness and metals and mining.
- **Water-related risks are idiosyncratic.** Water risks are highly localised in nature, necessitating consideration of wider risks to supply, as well as understanding impacts of increases in the frequency and severity of supply chain disruptions. Many more locations will tip from conditions of relative water abundance into scarcity by 2030 as a result of climatic, economic and demographic changes.
- **We consider sources of water risk at the sectoral and asset levels** to highlight the range of transmission mechanisms of water risk to financial risk.

This report was written by Insight Investment. As such, it is in its voice as opposed to that of BNY Investments.

*Investment Managers are appointed by BNY Mellon Investment Management EMEA Limited (BNYMIM EMEA), BNY Mellon Fund Managers Limited (BNYMFM), BNY Mellon Fund Management (Luxembourg) S.A. (BNY MFML) or affiliated fund operating companies to undertake portfolio management activities in relation to contracts for products and services entered into by clients with BNYMIM EMEA, BNY MFML or the BNY Mellon funds.

WATER RISKS ARE MATERIAL, AND COMPANIES FACE RISING DISRUPTION

WATER RISKS ARE MATERIAL AND DIVERSE

Insight's research analysing nature risks across corporate bond portfolios using the Taskforce on Nature Related Financial Disclosure (TNFD) framework pointed to water risk as the most material source of nature risk to these holdings.[1]

From an investor perspective, water-related risks have a range of transmission mechanisms into financial impacts at both the issuer and portfolio level. Sources of risk can be broadly defined as market-based **transition risks** (e.g., tightening regulations, permitting restrictions and water prices) as well as **physical risks** (e.g., aquifer depletion leading to localised shortages for industrial users, or degraded water quality leading to operational disruption).

Historically, water prices have been very low for most users, which fails to incentivise consumers to use and discharge water efficiently given the marginal impact of water on financial performance.

TABLE 1: SUMMARY OF WATER-RELATED FINANCIAL RISKS

Sources of water risk	Micro (issuer level) impacts	Macro (system level) impacts	Financial impacts
Transition risks Misalignment with actions aimed at protecting water resources (e.g., tightening regulation and permitting as competition for water increases)	Stranded assets		Credit risk – increase in defaults, collateral depreciation
	Higher operating costs		
	Disruption to revenue streams		Market risk – repricing of assets, fire sales
Physical risks Decline in ecosystems and services derived from them (e.g., water scarcity, rising seasonal variability)	Rising insurance costs	Falling insurability of specific assets or activities	Underwriting risks – increased uninsured losses, insurance coverage gaps
		Changes in trade and capital flows, fiscal balances	Liquidity risk – shortages of liquid assets/ refinancing risk
	Disruption to operational processes	Changes in raw material input costs	Credit risk – increase in defaults, collateral depreciation

WATER RISKS ARE SET TO GROW

Global water risks are rising due to **demographic growth** and **climate change**, which in turn will lead to increased agricultural demand, pollution and groundwater depletion. The impact of such factors is already becoming clear: groundwater levels are declining in 71% of aquifer systems,[2] and overall, there could be a 40% shortfall in water supply by 2030.[3]

1 Nature-related financial risks in corporate bonds: a case study, 9 January 2024, Insight.
2 Rapid groundwater decline and some cases of recovery in aquifers globally, January 2024, Nature.
3 Water Resources Management, October 2022, The World Bank

By 2050, water use in agriculture is expected to increase by 19% from 2021 levels, with 40% of irrigated agriculture facing extreme water stress.

ANALYSING WATER RISKS IN INVESTMENT PORTFOLIOS

The TNFD's guidance for financial institutions[9] recommends the following approach to disclosure of nature risks across portfolios:

- screening of **exposure to material sectors** as the starting point for analysis, followed by
- screening of **exposure to sensitive locations** through assets or supply chain.

This paper outlines how we propose analysing these characteristics of corporate bond issuers.

The global population is projected to reach 9.7 billion by 2050,[4] which can be expected to significantly increase demand for freshwater. Urbanisation will exacerbate this, with urban water demand expected to rise by 80% by 2050.[5] Economic growth and improved living standards will further drive water consumption, increasing average groundwater use per person over the next two decades.

In addition to demographic developments, climate change is likely to disrupt the hydrological cycle, altering precipitation patterns and increasing droughts and floods. This variability impacts water availability, notably groundwater sources. Prolonged droughts in the Mediterranean have significantly reduced water supply and the world's first year-long breach of the 1.5ºC temperature threshold in 2023 indicates a warming trend, which is suggestive of an increasing frequency and intensity of droughts.[6]

Rising agricultural demand is particularly noteworthy, as agriculture consumes about 70% of global freshwater withdrawals.[7] Growing food production needs will raise irrigation demands, particularly in water-scarce regions like South Asia and Sub-Saharan Africa. By 2050, water use in agriculture is expected to increase by 19% from 2021 levels, with 40% of irrigated agriculture facing extreme water stress.[8]

A wide range of factors could exacerbate and complicate the situation. For example, some regions are constructing more hydropower dams due in part to the increased demand for water, but such structures can lack careful design and management, undermining long-term water security; inefficient irrigation practices can worsen water wastage; and industrial growth in emerging economies could increase both water consumption and pollution. Sectors like textiles, chemicals, and mining require substantial water inputs and discharge pollutants, degrading water quality. Untreated wastewater discharge can further exacerbate the situation, with groundwater pollution emerging as a significant concern.

Overall, the increasing significance of water risks is clear on a global basis, but they will affect specific industries and companies differently. This necessitates careful analysis for investment decision-makers.

4 World Population Prospects 2022: Summary of Results (PDF), 2022, UN.
5 Water competition between cities and agriculture driven by climate change and urban growth, January 2018, Nature Sustainability.
6 Stewardship at the Source: Driving water action across supply chains (PDF), March 2024, CDP.
7 Water in Agriculture, July 2023, The World Bank.
8 The Future of Water: Water Insecurity Threatening Global Economic Growth, Political Stability, April 2021, Office of the Director of National Intelligence.
9 Sector guidance: Additional guidance for financial institutions (PDF), September 2023, TNFD.

ANALYSING WATER RISKS AT THE INDUSTRY LEVEL

WATER RISKS AFFECT A WIDE RANGE OF INDUSTRIES IN DIFFERENT WAYS

Different economic activities will have different impacts on water resources depending on their use of water and emissions to water within the value chain although the biggest potential impacts tend to revolve around reduction/disruption in production capacity or increased operating costs. Understanding water-related risks specific to each sector can provide a starting point for deeper analysis of location and asset-specific risks.

For example, CDP maintains an annual index of water impact[10] across the value chains of over 200 industrial activities, highlighting the range of impacts companies can have on water availability or water quality. Some examples of sectoral challenges relating to water include:

1. The **fashion and apparel** industry and related activities (such as cotton farming) are well known as a major consumer of water within direct operations and supply chains, with a growing awareness of their qualitative impact on water resources through the product lifecycle, from manufacturing to product use.

2. The **technology** sector relies heavily on water in its manufacturing process. For example, the production of semi-conductor chips requires billions of litres of ultra-pure water to avoid contamination. Water is also a vital cooling component of many data centres which have an ever-increasing demand profile, not least with the emergence of Artificial Intelligence related demands. This leaves the tech sector highly vulnerable to localised water shortages in terms of production and operational impacts.

3. **Agribusiness** is a major source of water impact across a range of activities, both in terms of agricultural production methods and nutrient runoff. Growing impact on groundwater and freshwater resources in key emerging markets such as China and India is leading to pressure for agricultural subsidy reform, particularly with regard to groundwater pumping and fertiliser prices. Germany recently became the first major economy to introduce a law aiming to restrict agricultural fertiliser runoff but remains an outlier. This leaves the sector very vulnerable to rapid regulatory correction.

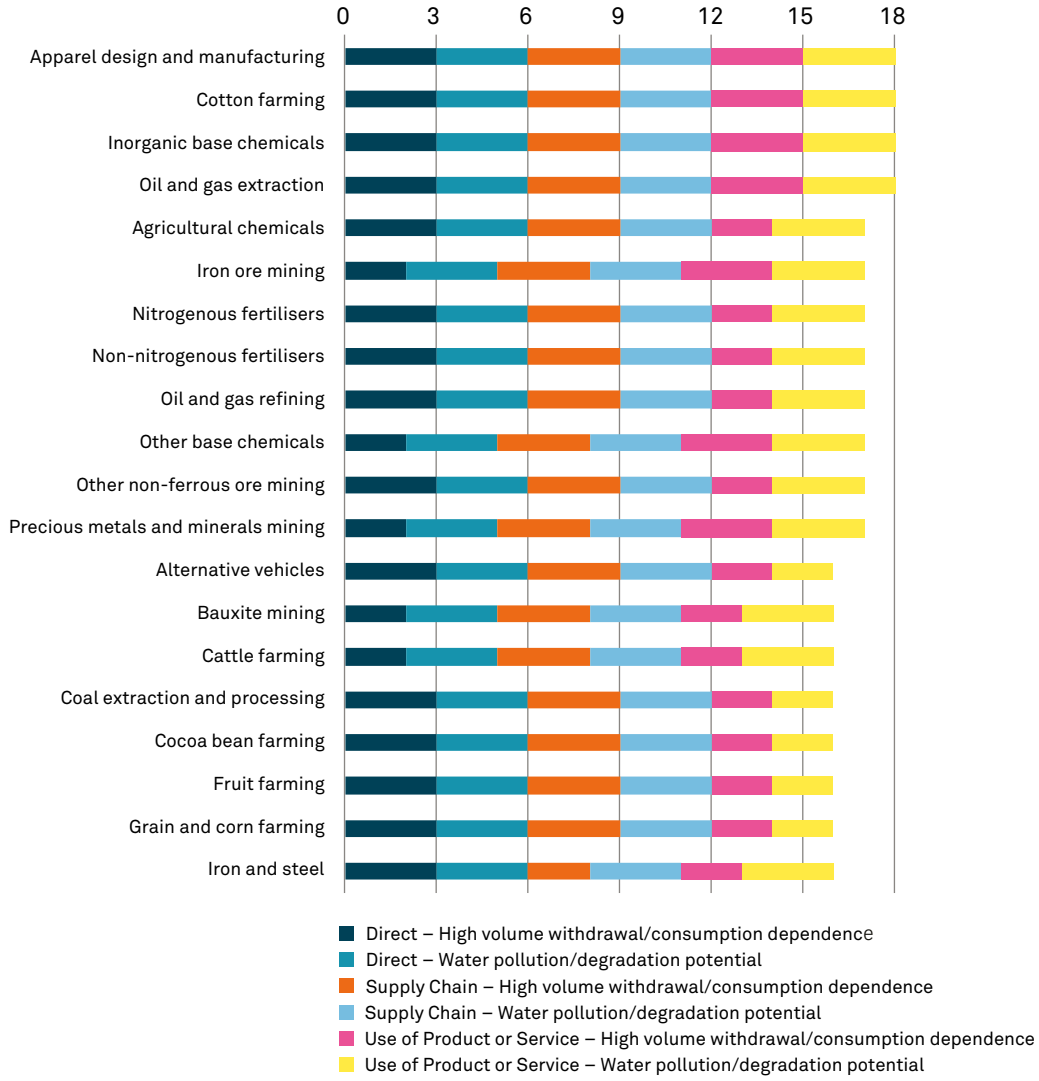
4. **Metals and mining** and other extractive sectors have a lower quantitative impact on water resources in operations but a much higher impact in terms of wastewater discharge and pollution potential, as well as supply-chain water impacts.

10 Water Watch Impact Index 2023, June 2023, CDP.

A full value-chain lens of water impacts is important because some of the major sources of water risk (regulatory, reputational, and technology-related) may not be within the direct control or operations or these sectors. This mirrors the growing regulatory and market importance of companies' Scope 3 emissions.

Critically, many companies have multiple areas of influence on water risks through upstream supply chains (e.g., water abstraction associated with raw material sourcing) and downstream (e.g., impacts on water quality arising from the use or disposal of products) as well as operations.

FIGURE 1: ACTIVITIES WITH THE MOST MATERIAL WATER IMPACTS AND DEPENDENCIES[11]



11 Source: Water Watch Impact Index 2023, June 2023, CDP. For each impact or dependency, 0 = no materiality and 3 = highest materiality. Financial services are excluded.

UNDERSTANDING HOW WATER RISKS IMPACT SECTOR VALUE CHAINS: APPAREL MANUFACTURING

Below, we consider the relevance of water for the value chains of one of the sectors with the highest impacts and dependencies – apparel manufacturing.

APPAREL MANUFACTURING

The ranking of the apparel design and manufacturing sector as having the highest water impact reflects the large withdrawals and emissions associated with the sector.

The apparel industry withdraws around 215 billion cubic meters of water per year,[12] roughly equivalent to the total annual withdrawals of Indonesia, and is responsible for around 20% of all annual freshwater pollution.[13] Raw-material sourcing, such as cotton production, is often a major consumer of water in regions with high local water stress and has additional indirect pressures on freshwater through agricultural runoff. Dyeing processes in manufacturing are linked to the discharge of toxic chemicals into water bodies. Despite this, the disclosure of water impacts beyond direct operational consumption remains low in the sector, with limited disclosures to the CDP Water Survey.

Manufacturers are increasingly required to absorb the external costs of impacts on water scarcity and quality, both through rising capital and operational expenditure requirements to access alternative water supplies or higher costs for raw materials, litigation over impacts on downstream water quality or groundwater depletion, or loss of social or legal licences to operate and water permitting restrictions.

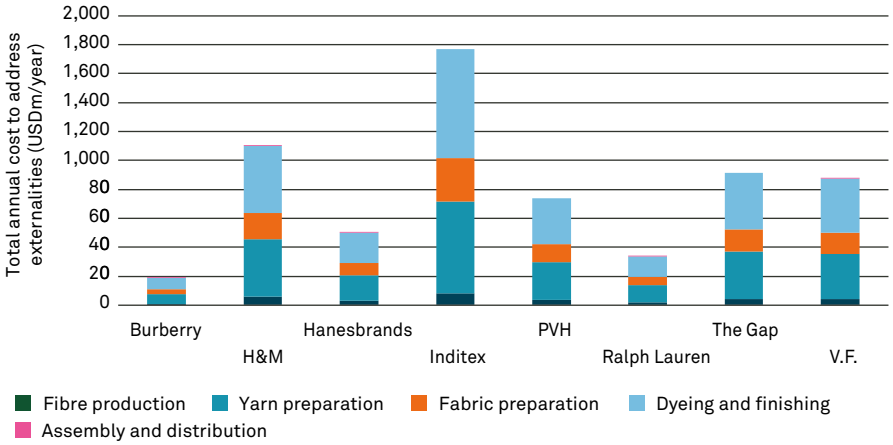
Nonetheless, the majority of these costs are not directly reflected in the price paid for water abstraction and discharge for companies, pointing to a growing 'unpriced gap' of water externalities.

Analysis by Ceres has indicated that a scenario where companies were required to absorb the full external costs of water could have significant negative impacts as a result of higher costs (see Figure 2), with the impact on company EBITDA ranging from -21% for Burberry and Inditex to -47% for PVH. Four major apparel companies would see their profitability (as measured by cash return on capital invested) fall below their cost of capital.

12 Measuring Fashion: Insights from the Environmental Impact of the Global Apparel and Footwear Industries study, 2018, Quantis.
13 Global Assessment of Private Sector Impacts on Water, April 2022, Ceres.

Dyeing processes in manufacturing are linked to the discharge of toxic chemicals into water bodies. Despite this, the disclosure of water impacts beyond direct operational consumption remains low in the sector, with limited disclosures to the CDP Water Survey.

FIGURE 2: ESTIMATED TOTAL ANNUAL COST TO ADDRESS VALUE-CHAIN WATER EXTERNALITIES FOR SELECTED APPAREL COMPANIES[14]



FOR MOST INDUSTRIES THE COST OF MITIGATING WATER RISKS IS MUCH LOWER THAN THE POTENTIAL NEGATIVE IMPACT

For most activities, the costs of responding to water risks are significantly lower than the maximum financial impacts firms could be forced to absorb from rising water scarcity or degrading water quality. CDP estimates that for the 1,112 publicly listed companies disclosing on water, the maximum potential financial impact is US$225bn whilst the cost of response is almost 50% lower at US$119bn.[15]

For many industries, particularly materials, food and beverage, retail and pharma, these costs arise in the value chain (e.g., through supply-chain disruptions and rising raw-material input costs) rather than in direct operations. Industries will vary in their ability to mitigate these costs depending on their degree of supply-chain diversification potential, ability to hedge commodity prices and general capacity for supply-chain risk management, but as water risks are likely to become increasingly systemic for many of these activities, fully mitigating these risks may not be feasible.

14 Financial implications of addressing water-related externalities in the apparel sector (PDF), December 2021, Ceres.
15 High and dry: how water issues are stranding assets (PDF), May 2022, Planet Tracker and CDP.

ANALYSING WATER RISKS AT THE ASSET LEVEL

THE IMPORTANCE OF LOCATION WHEN ANALYSING WATER RISKS

Water risks – particularly water stress[16] – are often highly location-specific and contextual, so even sectors with a lower water risk profile may include assets with very high localised scarcity risks.

The exposure of corporates to water risk (including water stress, changes in seasonal and interannual variability, groundwater depletion and drought risk) will be determined by both their activities and the geographical footprint of their operations. For example, whilst some companies in the chemical production value chain experiencing rising competition for water resources may be able to shift their operational exposure, other companies with large, fixed assets (e.g., utilities or mining companies) may be more exposed.

This is particularly the case for many metals and mining assets, often located in isolated, arid regions or regions with high localised competition for water resources, depending on local resource availability. Notably, many metals that are crucial for the low-carbon transition, such as copper and lithium, are concentrated in regions such as the Western US, Western Australia or Chile, that are projected to see significant increases in annual water stress by 2030 as a result of climate change, economic and population growth.

Changes in seasonal and absolute variability in water resources are likely to increasingly impact economic output and operating costs, so greater detail from corporates on how these risks are managed and mitigated at the asset level are expected to become increasingly important to investors (e.g., encouraging corporates to set facility-level context-based water targets).

Comparing exposure of company assets to the highest levels of projected water stress in 2030 shows that gold, copper and zinc mining assets in the Americas appear to have the highest likelihood of experiencing water stress, followed by some oil and gas processing and refining activities and automobile component manufacturing. Such large industrial water users are likely to face the most acute pressures owing to their high water dependence in operations, more frequent and severe drought conditions and rising competition for water resources. The industrial utilisation of water resources is often constrained in many countries before the water demands of other sectors, such as agriculture.

16 Water stress: total annual water withdrawals expressed as a % of total annual available freshwater resources. Higher values indicate greater competition across water users.

17 Impact of water curtailment on the credit rating of heavy industry – Nature-related financial risk: use case, April 2022, University of Cambridge Institute for Sustainability Leadership.

Analysis by HSBC and the Cambridge Institute for Sustainability leadership has explored the relationship between water supply shock scenarios[17] (in this case a three-month curtailment of water supplies for a sample of 50 East Asian industrial facilities). This study highlighted the potential transmission of localised water stress into credit risk, with revenue reduced by around a quarter and variable costs adjusted accordingly. Most of the companies within the sample were subject to credit rating downgrades of at least 1 notch, with cases of extremely severe downgrades also occurring. Whilst companies with lower fixed costs and higher geographical diversification were less impacted, a significant share of companies within the sample would be expected to move from investment grade to speculative grade credit ratings.

SYSTEMIC WATER RISKS ARE INCREASING AT THE BASIN LEVEL

Many major river basins are projected to shift from periods of relative abundance today to frequent periods of water stress by 2030. Nearly a fifth of global GDP is currently generated in river basins with 'very high' water risk, and much of this is concentrated in Asia: the lower floodplains of major south Asian rivers, including the Ganges (India), Chao Praya (Thailand) and Yellow River (China) are both major contributors to global GDP growth and have high water risk. Rapid economic and population growth in these river basins is contributing to wider pressure on local water resources, with industrial consumers typically facing more immediate pressure.

Around a quarter of the world's GDP is projected to be generated within the world's 10 most populous river basins by 2050 – but only if local water resources are more effectively managed and allocated. In many large river basins, virtually all available water is already used for irrigation and urban use, leaving little available to maintain environmental flows and potentially jeopardising the long-term sustainability of these water resources.

CASE STUDY: RIVER BASIN SCENARIOS AND TARGET-SETTING – THE COLORADO BASIN

The Colorado river basin in the US is one of the most acute examples of climatic, economic and population pressures putting assets at growing risk of stranding. The states encompassing the river basin have seen rapid economic and population growth in the past decade, a trend that is set to continue out to 2030. Some 40 million people in seven US states and two Mexican states depend on the river basin, and $1.4trn in economic output and 16 million jobs depend on the river.[18]

Many multinational company value chains depend on the river, including Danone, Nestle, Coca Cola, Intel, Marriott and Microsoft. Nonetheless, agricultural uses, including livestock and crop irrigation represent the bulk of water consumption within the basin (80%) with commercial and industrial users only equating to 4% of consumption. This points to the fact that whilst industrial consumers are a small share of total consumption, water availability and water quality is heavily influenced by agricultural and domestic use patterns that are outside of companies' direct control.

Physical risks (increasing incidences of drought) and water scarcity as a result of growing competition for water resources have been cited by companies operating in the basin as major challenges in the past decade. Companies have also cited increasing water prices, difficulties in obtaining permits and growing regulatory and reputational difficulties in CDP disclosures.

Analysis by the Pacific Institute has highlighted that whilst most major companies operating in the basin have set water-related targets such as reductions in total withdrawals or improvements in water use efficiency, few of these made specific reference to the basin or local hydrological conditions and tracking the volumetric outcomes of these targets by companies was scarce.[19]

18 Corporate Water Stewardship in the Colorado River Basin, 2020, Pacific Institute; Saving Great Rivers, June 2017, The Nature Conservancy.
19 Scaling Corporate Water Stewardship to Address Water Challenges in the Colorado River Basin (PDF), April 2020, Pacific Institute.

WATER-STRANDED ASSETS: A KEY RISK

Stranded assets are physical assets recorded on a corporate balance sheet whose investment value cannot be recouped and must be written off. The factors that cause stranded assets are typically unanticipated or arrive sooner than expected. A working definition established by the Stranded Assets Programme at the Smith School of Enterprise and the Environment at the University of Oxford identifies a stranded asset as financial value that has sustained "unanticipated or premature write-downs, devaluations or conversion to liabilities" due to environmental issues.[20]

Asset stranding is typically driven by the convergence of physical, reputational, and regulatory water risks. Some examples include the following:

CONSTELLATION BRANDS: MEXICO BREWERY

Constellation Brands is a New York-based brewing company that produces beverages around the world. In 2016, it announced plans to build a state-of-the-art brewery in Mexicali, Mexico, to export beer brands to the US. But local residents voted in 2020 to remove water permits for the company, which had planned to export beer amid persistent water shortages. The company has since opted to build a brewery in another region with more water.[21]

PEPSICO: COLORADO FACILITIES

In 2022, PepsiCo had four convenient-foods manufacturing facilities in high water risk areas within the Moctezuma watershed in Colorado. Prolonged drought conditions and increasing demand for fresh groundwater in the area are expected to lead to high water stress for years to come, affecting water availability for all stakeholders, including the company's facilities. The company's own analysis states that "failure to procure groundwater in this area would result in delays in production and potentially stopping production all together". If just one facility in the area shuts down due to groundwater depletion, the company said it could lead to a financial impact of over US$640m.[22]

20 Stranded Assets and Scenarios: Discussion Paper (PDF), January 2014, Smith School of Enterprise and the Environment, University of Oxford.

21 Constellation Brands announces agreement to purchase brewery in Obregon, Mexico, 31 October 2016, Constellation Brands; Constellation Brands: Referendum in Mexicali tears down plans to build brewery in Mexico, 23 March 2020, El Universal; Mexico says Constellation brewery to be built by river after water dispute, 7 January 2022, Reuters.

22 Source: PepsiCo CDP Water Security Questionnaire 2023 (PDF), 26 July 2023, PepsiCo.

The value of investments can fall. Investors may not get back the amount invested.

IMPORTANT INFORMATION

This is a financial promotion. For Professional Clients and, in Switzerland, for Qualified Investors only.

Any views and opinions are those of the investment manager, unless otherwise noted and is not investment advice. This is not investment research or a research recommendation for regulatory purposes. BNY, BNY Mellon and Bank of New York Mellon are the corporate brands of The Bank of New York Mellon Corporation and may be used to reference the corporation as a whole and/or its various subsidiaries generally. **Issued in the UK** by BNY Mellon Investment Management EMEA Limited, BNY Mellon Centre, 160 Queen Victoria Street, London EC4V 4LA. Registered in England No. 1118580. Authorised and regulated by the Financial Conduct Authority. **Issued in Switzerland** by BNY Mellon Investments Switzerland GmbH, Bärengasse 29, CH-8001 Zürich, Switzerland. **Issued in Europe (ex-Switzerland)** by BNY Mellon Fund Management (Luxembourg) S.A. (BNY MFML), a public limited company (société anonyme) incorporated and existing under Luxembourg law under registration number B28166 and having its registered address at 2-4 Rue Eugène Ruppert L-2453 Luxembourg. BNY MFML is regulated by the Commission de Surveillance du Secteur Financier (CSSF).

Doc ID: 2059133 Exp: 30.06.2025. T12806 09/24