ROBECO
The Investment Engineers

WHITE PAPER

# Liquidity at risk:

## Water scarcity's impact on chemical company fundamentals

# Contents



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# Executive Summary

## Overview of the chemical industry's water dependency

The global chemical industry is fundamentally dependent on water for operational processes including cooling, steam generation, and as a critical raw material or reactant. Despite its pervasiveness, the industry's high withdrawal rates – an estimated 5-10% of world freshwater withdrawals – are intensifying its exposure to material physical and financial risks as water becomes an increasingly scarce resource.

This paper is the product of close collaboration between Robeco's Sustainable Alpha Research and Fundamental Equities teams. By combining advanced financial modelling with in-depth sustainability expertise, the analysis reflects Robeco's integrated approach to assessing how sustainability risks materially impact company fundamentals and ultimately portfolio performance. This level of specialized analysis is critical for developing insights into which companies are structurally exposed, and which are well-positioned to lead within a sector. More importantly, these are often insights that conventional ESG data fails to see and capture.

## The intensifying risk of water scarcity

Water scarcity is no longer a hypothetical concern but a defining constraint on global growth. By 2030, a 40% gap between water supply and demand is projected, leading to increased competition among industry, agriculture, and municipalities.

- **Physical risks**: Climate change is disrupting hydrological cycles, leading to prolonged droughts and intense heat that can halt companies' production processes.
- **Regulatory risks:** China's "Three Red Lines" policy and new water use taxes highlight how governments are tightening restrictions.
- **Financial risks**: Water-stress impacts global GDP, with 31% of global GDP expected to be subject to high water-stress by 2050.

## Key findings: The resilience paradox

This study analyzed four global chemical companies (Companies A, B, C, and D)[1] to assess their resilience to a hypothetical 10% water supply reduction shock in 2030. The analysis revealed a critical paradox: companies with the most stable physical operations are often the most financially vulnerable to water-related shocks.

- **Negative operating leverage**: All assessed companies exhibit a high fixed-cost structure. Consequently, even minor sales disruptions resulting from reduced water inputs (e.g., Company A) triggered a magnified collapse in EBITDA and Net Present Value (NPV).
- **Operational vs. financial fragility**: Company A demonstrated the highest operational resilience (only 0.9% production loss after water remediation tactics employed) yet suffered the worst destruction of shareholder value (-43.5% NPV) due to thin margins and high leverage.
- **Growth risks**: For high-growth entities like Company D, water scarcity may not threaten solvency but effectively reduces the alpha, transforming a high-potential investment into a low-return entity.
- **Drawbacks to recycling**: While proactive measures like municipal wastewater recycling can prevent shutdowns, the associated OPEX and CAPEX erosion can materially devalue commoditized businesses.
- **Strategic gaps**: Many companies rely too heavily on government solutions and fail to integrate water availability into their long-term expansion plans (e.g., planning new capacity in water-scarce areas).

1. Company names have been omitted as the analysis is intended to illustrate the potential impact of water-supply constraints on operational and financial performance, not to single out or discredit an individual firm.

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**Table 1 – Comparative risk matrix (2030 Projections)**

| Company | Risk profile | Equity NPV impact | EBITDA impact | Primary vulnerability |
|---|---|---|---|---|
| A | The Value Trap | -43.5% | -4.3% | Leverage & low profitability |
| B | The Broken Thesis | -42.1% | -14.8% | High operating leverage |
| C | Geography Dilemma | -22.2% | -19.3% | Basin physical scarcity |
| D | The Resilient Giant | -24.7% | -13.1% | Asset concentration |

Source: Robeco, 2025.

## The capital allocation blind spot

A significant finding of this study is the decoupling of water risk reporting from capital allocation. While companies acknowledge water availability as a risk, none currently have targets for reducing absolute water withdrawals. Furthermore, their current expansion plans prioritize raw material access and labor costs while neglecting water availability. For example, Company B continues to allocate new CAPEX to regions with extreme water-stress, indicating that water scarcity is treated as a manageable externality rather than a strategic investment hurdle.

## Strategic implications for investors

Water is a strategic resource with direct implications for revenue and stock performance. To help manage portfolio risks, investors can take the following actions:

- Active engagement: Push companies to set absolute, science-based water withdrawal reduction targets.
- Risk modelling: Incorporate localized water-stress scenarios into valuation and portfolio frameworks.
- Capital allocation: Favor companies that embed water availability as a primary criterion in site selection and long-term planning.

Our hope is that this work will contribute to establishing a systematic and forward looking water risk framework – one that encourages investors to integrate water-stress scenarios into fundamental valuations, engage companies on absolute withdrawal targets, and prioritize firms that incorporate water availability into long-term capital allocation decisions.

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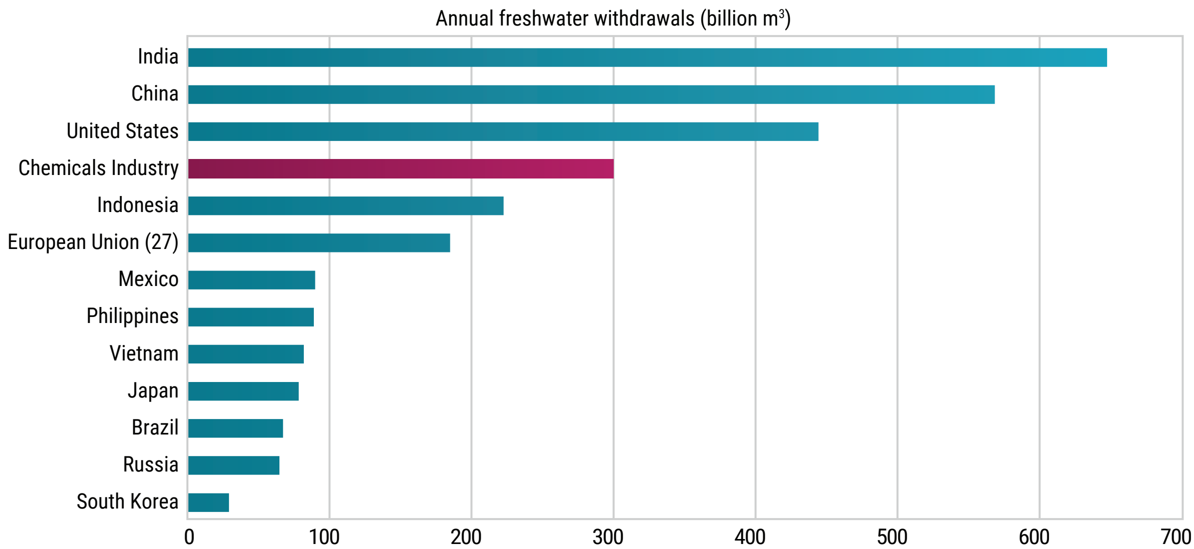
# Chapter 1: Chemicals and water – an intensifying relationship

## Chemicals underpin the global economy

The global chemical industry generated EUR 5.2 trillion revenue in 2023[2] and is expected to reach EUR 6.2 trillion by 2030.[3] Its products range from basic chemicals – including the acids and solvents used in fertilizers, food additives, detergents, biotech and pharmaceutical products – to specialized surface coatings used for automotive, aerospace, wind and solar components. It also includes polymers and plastics whose end-use applications extend across packaging and construction all the way to electronics, healthcare equipment, textiles and consumer goods.

Given chemicals' pervasiveness, its products are vital for keeping the global economy in flow. Yet its manufacturing processes consume vast amounts of water – accounting for an estimated 5-10% of the world's freshwater withdrawals (or 200-400 billion $m^3$ annually). That is more than the water consumption of entire countries around the globe.[4]

**Figure 1 – Chemicals vs countries**




The chemical industry's water withdrawals rival those of entire nations. They exceed those of the entire EU's 27 member states as well as other developed economies including South Korea and Japan. Annual water withdrawals refers to the sum of withdrawals for agriculture, industry, and municipal uses.
Source: Our World in Data, AQUASTAT – UN FAO, World Bank data as of 2025.

## Water demand in chemical processing

Water is an indispensable input across the entire chemical production process. It's not only a universal solvent but also a critical raw material for the foundational compounds used across industries – from acids, alcohols and solvents to polymers and specialty materials. It's also used as a carrier fluid in emulsions and dispersions that typically don't mix. This ensures uniform distribution of active ingredients that not only smooth industrial processing but also ensure ease of end-use in diverse applications which span food, beverages, cosmetics, pharmaceuticals, paints, adhesives, coatings, and fertilizers.

2. https://cefic.org/facts-and-figures-of-the-european-chemical-industry/profile/
3. https://www.eea.europa.eu/publications/managing-the-systemic-use-of
4. https://cordis.europa.eu/article/id/151163-cutting-water-use-in-the-european-chemical-industry

Beyond chemical processes, water is also embedded into the operational processes of chemical manufacturing. Those include:

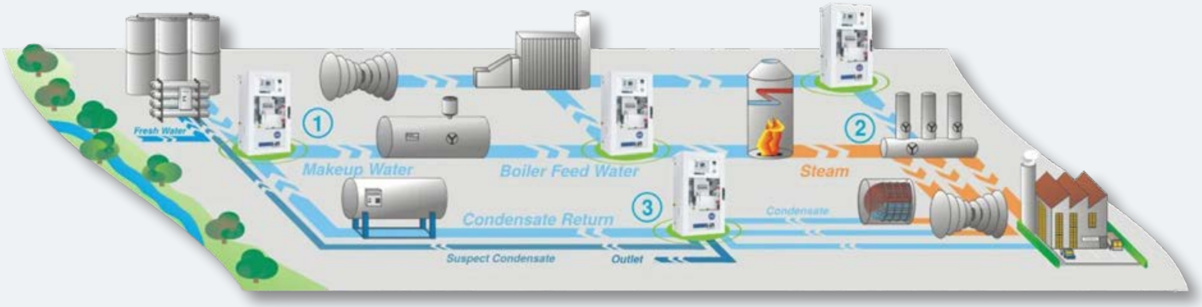
- Steam generation – where it powers reactors and distillation columns
- Cooling – where it ensures safe temperatures in energy-intensive environments
- Purification and rinsing – where it helps maintain product quality and equipment integrity
- Wastewater treatment – where it dilutes/neutralizes harmful effluents to minimize environmental impact

**Figure 2 – Diagram of the water cycle in the chemical manufacturing process**

Water Intake
Withdrawal taken from surrounding surface waters: river, lake, reservoirs, etc

Discharge
Wastewater is treated prior to discharge into environment

Storage
Water reserves via on-site water storage facilities




Purification
Treatment of raw water needed to produce high-purity water used in production and for steam

Steam reuse
Steam condensation reused after re-purification to remove minerals/ions

Steam generation
Essential for process heating and for generating electricity

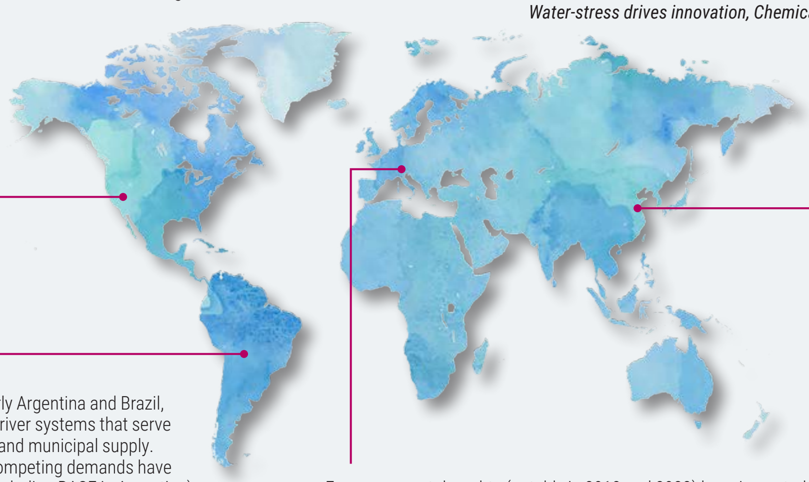
Process use
Water used as a reaction medium or solvent in chemical processes as well as a product ingredient

Source: Robeco, 2024.

## Water withdrawal – a risky reality

While some water is returned back to the environment, the industry's large-scale dependence on withdrawals is increasing its exposure to permitting risks from municipalities attempting to safeguard community water supplies and very real financial risks arising from a lack of water for production processes leading to the loss of chemical outputs and revenues. Water-stress and scarcity is intensifying due to climate change which is disrupting weather patterns and causing prolonged heat waves and droughts across many regions. Scarcity is also arising from increased industrialization and economic development as manufacturers across sectors compete for finite water resources.

**Figure 3 – Water-stress is an intensifying reality for chemical producers globally**




The companies shown are for illustrative purposes only. No inference can be made on the future development of the company. This is not a buy, sell, or hold recommendation. Source: Robeco, 2026.

The global competition for water access and rights – from Asian coastlines to European basins to Latin American agricultural hubs – illustrates a common challenge: chemical producers must share increasingly scarce freshwater resources with communities, farming sectors, other industries, and ecosystems. These pressures are not abstract or hypothetical, they are real and directly tied to operational permits from regulators, as well as production and reputational costs for chemical companies.

## Structural drivers – intensifying chemical manufacturers' water demand

Water intensity in the chemical sector is increasing, driven by structural and regulatory shifts across global production systems. The growth of specialty chemicals and advanced materials has introduced more complex processes that demand higher purity standards, extensive rinsing, and additional cooling steps – each requiring significant water inputs.[5]

At the same time, the expansion of water-intensive sub-sectors, such as petrochemicals, polymers, and fine chemicals, particularly in Asia and the Middle East, has outpaced the development of water recycling infrastructure, amplifying withdrawal volumes.[6] Moreover, the prevalence of PFAS in tap water and environmental surface waters has led to stricter environmental regulations and is also leading to increasing water use.[7] Finally, as chemical plants scale up and energy intensity rises, cooling and steam generation needs are growing.[8]

These realities underscore the necessity of sustainability research within investments – not only for long-term environmental impact but also for short-term performance considerations. A structured, consistent methodology for assessing water risk enables investment teams to thoroughly evaluate chemical companies' exposure and resilience. As a result, they can reduce the material impact of water-related risks on portfolio performance and make informed decisions that align with both financial and sustainability objectives.

5. Saur Water Solutions. Process Water website. Accessed January 2026.
6. UNEP Finance Initiative Report, Sectoral Briefings, April 2023.; Middle East water-stress, World Resources Institute, Aqueduct 4.0, 2023.
7. Multi-stage effluent treatment and dilution requirements now consume more water before discharge, PFAS 2.0 – new waves of regulation will hit more than just chemicals. Robeco, March 2024.
8. Water for hydrogen production, IRENA, 2023.

# Chapter 2: Water pressure – scarcity is reducing GDP

## More drain and strain from weaker water supplies

Water scarcity is no longer a distant concern; it is a defining constraint on global growth. Today, 72% of all freshwater withdrawals are consumed by agriculture, 16% by industry, and 12% by municipalities. Despite advances in water-saving equipment and infrastructure, the UN projects that population growth, industrial expansion, and accompanying energy needs will push global water demand to rise by 20-30% by 2050.[9]

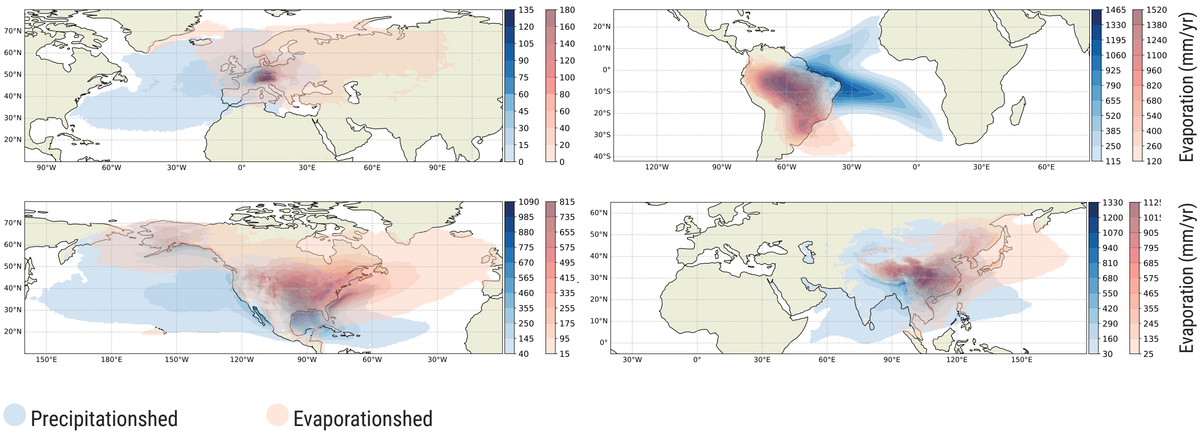
At present, four billion people already experience high water-stress for at least one month each year, and by 2050, this number will climb to five billion.[10] Economic exposure is equally alarming, as 31% of global GDP (around USD 70 trillion) will be subject to high water-stress by 2050, up from USD 15 trillion (24% of global GDP) in 2010.[11] Countries expected to deliver outsized economic growth in the coming decades are facing serious water-stress risk, including China, India, and the US. Even historically water-rich Europe has not escaped water challenges. A recent ECB study warned that surface water scarcity alone puts 15% of euro-area economic output at risk.[12]

## Climate change – exacerbating water-stress

Climate change is of course exacerbating the problem and pollution is further reducing water availability. For the first time in history, the Earth's water (hydrological) cycle is no longer in a stable historical pattern, and human activities continue to push it further out of balance. This is not just about water scarcity in certain regions but about systemic changes in how water is generated, stored, and distributed via precipitation and evaporation.[13]

Precipitation patterns, the source of all freshwater, are being reshaped by climate drivers. Large portions of land-based rainfall depend on atmospheric moisture recycling. That means evaporation from one region becomes precipitation for another. These changes in hydrological cycle are intensifying rainfall and flooding in some regions while prolonging droughts and intense heat in others. As a result, droughts and water scarcity are expected to increase in regions globally in the decades ahead.

**Figure 4 – Atmospheric moisture recycling at a global scale (2008-2017)**




Blue represents precipitation sheds from which most (90%) of a region's precipitation evaporates. Evaporation sheds in red indicate where most of a region's evaporation condense to rainfall (and other forms of precipitation). Purple indicates where these two sheds overlap. The respective country's delineations were used as 'source and sink' regions in the moisture tracking process. Values shown are annual for the time period 2008-2017.

Source: Turning the Tide: A call to collective action. The Global Commission on the Economics of Water, March 2023.

9. https://www.unwater.org/water-facts
10. https://www.wri.org/insights/highest-water-stressed-countries#:~:text=New%20data%20from%20WRI's%20Aqueduct,one%20month%20of%20the%20year.
11. World Resources Institute, Aqueduct 4.0 Technical Update. August 2023.
12. https://www.ecb.europa.eu/press/blog/date/2025/html/ecb.blog20250523~d39e3a7933.en.html
13. Turning the Tide: A call to collective action. The Global Commission on the Economics of Water, March 2023.

**Figure 5 – IPCC drought map**

Schematic map highlighting in brown the regions where droughts are expected to become worse as a result of climate change.

This pattern is similar regardless of the emissions scenario; however, the magnitude of change increases under higher emissions.

Source: Robeco, 2025.

Land use changes further contribute to the problem through loss of moisture-retaining forests and wetlands, which are integral to the moisture recycling process. These stresses not only undermine agriculture but also water supplies available for urban and industrial use, increasing the economic risks for companies, communities and in some cases, entire countries.

## Global changes, local impact

By 2030, there will be a 40% gap[14] between water supply and demand, leading to increased competition for a rapidly diminishing resource. For companies this translates into material risks including operational disruption and rising costs due to lack of water availability, stricter withdrawal caps or cancellation of permitting rights from local authorities, and potential community backlash if industrial withdrawals compromise local water access.

In Mexico, a severe drought in 2024 forced six chemical plants in the Altamira region to reduce or halt production for six weeks, illustrating the direct financial and operational consequences of water-stress and scarcity.

China's 'Three Red Lines' policy includes setting annual hard caps on water use. China also began pilot testing a water use tax in December 2024, which is expected to increase water usage costs for high water consuming industries in specific areas.[15] Elsewhere in Asia, South Korea's water disaster preparedness includes ensuring "timely water supply for advanced industrial complexes such as semiconductors and secondary batteries."[16]

Like South Korea, Taiwan is also a major hub for chipmaking and advanced electronics. In 2021, the country was hit by a major drought that forced the authorities to implement water rationing for high water-consuming sectors in order to protect residential water supplies. Semiconductors, chemicals and textiles were among the first industries to be hit with restrictions, highlighting the increased vulnerability of chemical companies in times of water-stress.[17]

14. Ibid.
15. China to pilot water tax nationwide: What does it mean for business? China Briefing, October 2024.
16. Fully committed to establishing a system for water disaster preparedness. Korea Ministry of Climate, Energy and Environment, January 2025.
17. Drought-hit Taiwan plans more water curbs for chip hubs. Reuters, May 2021. Taiwan cuts water supply for chipmakers as drought threatens to dry up reserves. Bloomberg, March 2021.

# Chapter 3: Purpose and rationale

The increasing frequency of drought in areas marked for outsized economic growth as well as the material impact of water scarcity for not just chemicals but other industries' products and processes makes understanding and mitigating water access risks critical for industrial companies and their investors. Water-access management influences long-term sustainability, enabling industries to operate responsibly in a resource-constrained world. In the short-term, water shortages can halt production, increase costs, and reduce profitability, as recent drought-related shutdowns and rations across Mexico, South Korea, Taiwan and China have demonstrated.

This research aims to answer the question of how resilient companies within high-dependency industries are to increasing water scarcity. Although water withdrawal and consumption risks are measured within ESG data, these metrics tend to be blunt, high-level overviews that do not adequately account for regional- / location-specific flows and stressors on the ground. In summary, we could not rely on data published by the companies or ESG data providers for the following reasons:

- Companies report total water withdrawn, discharged, and/or consumed globally, which masks potential water-stress issues in regions and at individual plant sites.
- Some data providers do proportion revenue or sites to stressed areas, but true dependency is a combination of site location and its strategic importance for the overall business.
- Providers of climate physical risk either do not quantify value at risk (VaR) from water scarcity or only present it as an overall score.

Since we could not rely on available data, we developed our methodology to provide a structured, consistent framework to evaluate water risk across chemical companies. It enables investment teams to quantify exposure, compare resilience, and integrate water risk into portfolio decisions.

## Methodology overview

To evaluate corporate resilience to water-stress, we conducted an analysis of four chemical companies with global operations. The objective was to understand how a significant water shock (defined as a prolonged period of water unavailability or regulatory restrictions) to a plant in a specific water-stressed region could impact their economic performance and equity valuations. This approach is designed specifically to be used by investors who need a consistent way of assessing which companies are proactively managing their risks versus laggards which are executing a reactive approach, managing risks only when they strike and create operational disruptions.

To conduct this research, we considered the following factors:

- Geography – Where are the main production facilities and what are the projected water scarcity risks in the countries the company operates?
- Policy environment – What are the support and imposed restrictions from governments for the industry in the specific locations?
- Company actions – What remediation measures are companies taking to mitigate the water scarcity risk in their operations? What withdrawal targets does the company have?

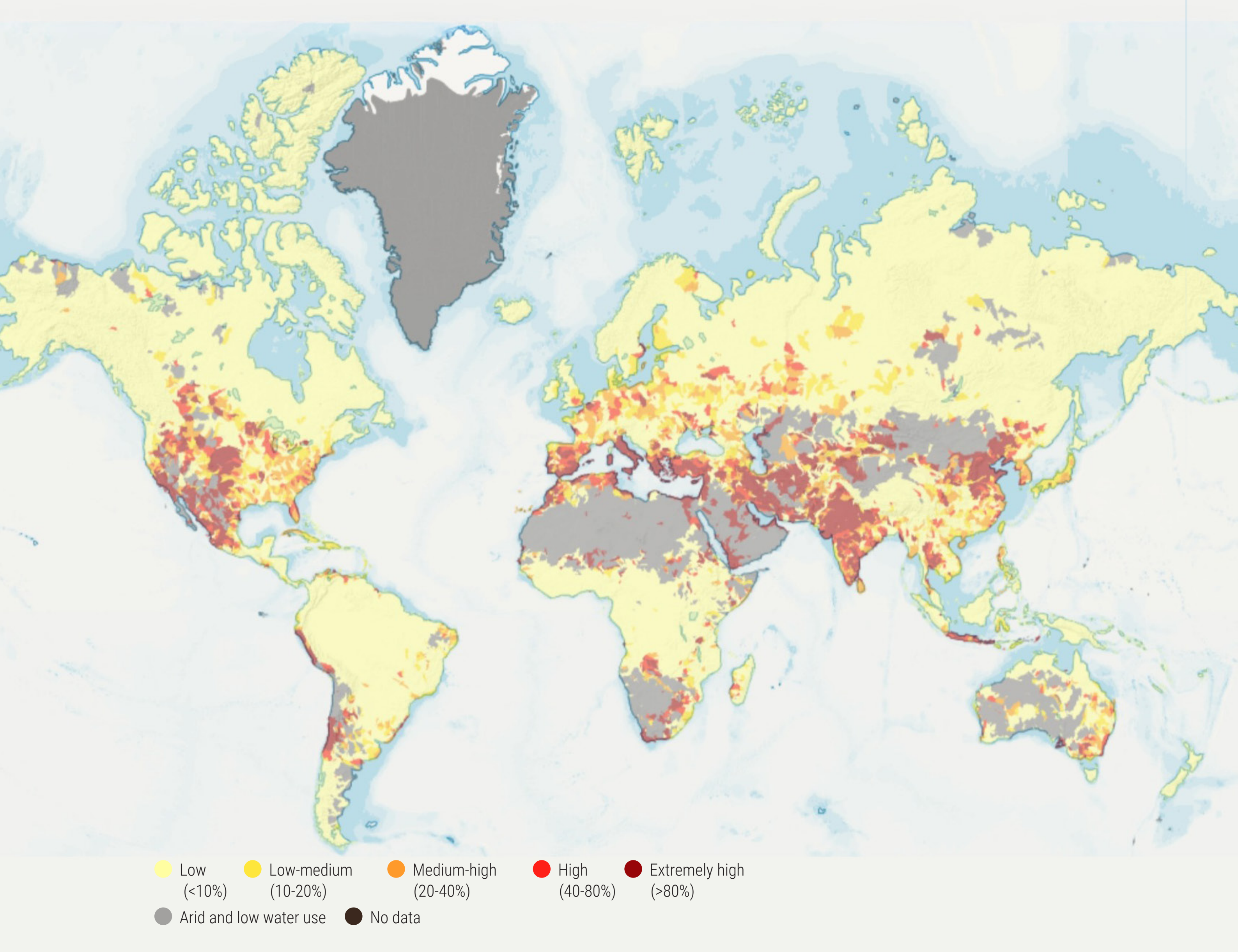
We assess the operational divergence between facilities located in water-stressed areas vis-à-vis plants situated in regions with abundant, well-managed water resources. The availability of water for cooling, steam generation, and waste discharge is the primary differentiator here.

After determining the potential degree of water-stress based on the above scenarios, we modelled a 10-year discounted cashflow for four listed companies with global operations in the chemical sector to assess the impact of a water shock in their enterprise and equity values. To assess point three – company actions – we reviewed company disclosures and had follow-up calls with company representatives to clarify data and information inputs and understand their risk mitigation strategies.

## Water-scarcity information

We recognize that water availability is basin specific. However, due to the availability of granular information, we relied on country level forecast for 2030 from the World Resources Institute (WRI) and made local adjustments based on the location of company production sites.

**Figure 6 – Global water-stress levels**




Source: WRI, Aqueduct 4.0, Water Risk Atlas, 2023.

We have prepared a 3-step scenario analysis for each company for 2030:

1. We established a baseline 'business as usual' scenario to function as our base case; one in which there are no water scarcity issues. Water availability in 2030 remains unchanged, and we account only for changes to actual business fundamentals.

2. We then apply a shock of 10% reduction in water availability in 2030. The impact of this 10% drop in water supply on companies is applied by considering the risk level of water-stress per country of production. For that, we use the mid-range 'business as usual' 2030 scenario probability from the WRI Aqueduct 4.0 tool (see Table 2).

3. We measure the final operational and financial impact after adjusting to account for mitigation measures companies have in place or have committed to enforcing. Only specific and quantifiable plans were applied; general statements were not considered.

**Table 2 – Assessing a country's water risk based on the WRI probability modelling**

| Country | Baseline (current water-stress) | 2030 Business as Usual |
|---|---|---|
| Brazil | Low (<10%) | Low – Medium (10-20%) |
| China | High (40-80%) | High (40-80%) |
| Germany | Medium – High (20-40%) | Medium – High (20-40%) |
| India | Extremely High (>80%) | High (40-80%) |
| Mexico | High (40-80%) | High (40-80%) |
| Morocco | High (40-80%) | Extremely High (>80%) |
| Mozambique | Low (<10%) | Low (<10%) |
| Poland | Low – Medium (10-20%) | Low – Medium (10-20%) |
| Saudi Arabia | Extremely High (>80%) | Extremely High (>80%) |
| South Africa | High (40-80%) | Extremely High (>80%) |
| South Korea | Medium – High (20-40%) | Medium – High (20-40%) |
| United States | Medium – High (20-40%) | Medium – High (20-40%) |
| Vietnam | Low – Medium (10-20%) | Medium – High (20-40%) |

Source: WRI, Aqueduct 4.0, 2023.

# Chapter 4: Results and analysis of the 3-step 'stress-test'

## RESULTS - COMPANY A

**Table 3 – Company A data**

| Company description | |
|---|---|
| Products | Chemicals, Polymers, Biopolymers |
| Production location | Latin America, US and Europe |
| Water usage | Mainly cooling, plus steam generation, production process |
| % withdrawal from stressed areas | About half, mainly for operations in 2 countries |
| Water withdrawal reduction targets | Withdraw water from safe sources, reduce water consumption intensity |
| Mitigation measures in place or planned | • Efficiency improvements<br>• Long-term contracts for treated municipal wastewater<br>• Replacement of steam turbines with electric motors |

**Table 4 – Water-stress impact on financials for Company A**

| Value driver | Sales CAGR 10Y | Production in 2030 | Sales in 2030 | EBITDA in 2030 | EBITDA margin in 2030 | PV | NPV |
|---|---|---|---|---|---|---|---|
| Pre-stress test | 6.8% | 19,990 | 110,173 | 13,032 | 11.8% | 74,041 | 18,141 |
| After test | 6.6% | 19,612 | 107,822 | 11,364 | 10.5% | 63,309 | 7,409 |
| Initial impact | -0.3% | -1.9% | -2.1% | -12.8% | -1.3% | -14.5% | -59.2% |
| Impact after remediation | -0.1% | -0.9% | -1.0% | -4.3% | -1.0% | -10.7% | -43.5% |
| Final result | 6.7% | 19,800 | 109,106 | 12,471 | 10.8% | 66,146 | 10,246 |

Source: Robeco analysis, 2025.

### Present insights and future risks

Company A sees only a 0.9% decline in production and 1% in sales after considering all risk mitigators. This is a strong operational outcome relative to peers. It reflects the fact that Company A's physical assets are located in regions with better water security and that it has adopted effective mitigation actions. Those include the withdrawal of water from safe sources, strategic plans that set specific targets to reduce water intensity, and the use of wastewater alternatives as substitutes that prevent massive shutdowns during a drought.

However, stress testing also reveals that despite company actions, a degree of financial vulnerability remains. While Company A's physical operations (production and sales) are to some extent resilient, its equity value is highly sensitive to shocks. That can be explained by a combination of low profitability and financial distress.

The decline in sales triggers EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) to fall 4.3% and its margin to drop 1%, highlighting its negative operating leverage. In addition, production impact is in North America, the region where it enjoys the best operating margins and where it has been expanding capacity. In our conversations with company management, they stated they are planning to address the water scarcity issues. However, in our view, they maybe be running out of time.

The lower production and operating cash generation has an impact of 10.7% in the enterprise value of the company. When looking at the NPV (Net Present Value) of its equity however, the impact is materially amplified to -43.5%, reflecting the company's financial vulnerability and excessive leverage. For a financially stressed company like company A, a good water risk management policy provides some buffer and alleviates some of the financial fallout from a water shock. Still, it would be beneficial for the company to address water-related risks.

## RESULTS - COMPANY B

**Table 5 – Company B data**

| Company description | |
|---|---|
| Products | Chemicals, Polymers, Advanced Materials, and Life Sciences |
| Production location | East Asia, US, North Africa and Southern Asia |
| Water usage | Production process, cleaning, cooling towers, boiler water, scrubbers |
| % withdrawal from stressed areas | Less than 10%, mainly for operations in two countries |
| Water withdrawal reduction targets | No, but plan to set targets in the next two years. Current water related targets are to reduce pollution in discharged water |
| Mitigation measures in place or planned | • Efficiency improvements/internal recycling<br>• Treated municipal wastewater<br>• Access to desalinated water from a municipal plant<br>• Consortium of local government, water supply company, other companies to agree to withdrawal limits |

**Table 6 – Water-stress impact on financials for Company B**

| Value driver | Sales CAGR 10Y | Production in 2030 | Sales in 2030 | EBITDA in 2030 | EBITDA margin in 2030 | PV | NPV |
|---|---|---|---|---|---|---|---|
| Pre-stress test | 10.3% | 20,723 | 109,540,621 | 21,204,164 | 19.4% | 90,453,246 | 71,365,344 |
| After test | 9.9% | 20,018 | 105,698,462 | 17,520,037 | 16.6% | 56,439,620 | 37,351,718 |
| Initial impact | -0.4% | -3.4% | -3.5% | -17.4% | -2.8% | -37.6% | -47.7% |
| Impact after remediation | -0.2% | -3.0% | -1.4% | -14.8% | -2.6% | -33.2% | -42.1% |
| Final result | 10.2% | 20,101 | 107,966,075 | 18,056,208 | 16.7% | 60,383,879 | 41,295,977 |

Source: Robeco analysis, 2025.

### Present insights and future risks

While its physical operations face a moderate disruption (loss of 3% of volume), its financial structure amplifies this loss significantly. The stress test reveals that a mid-sized operational hit translates into a severe 14.8% drop in profits and wipes out one-third of the company's enterprise value and 42% of its equity value.

To the company's credit, the 3% decline in production resulted only in a 1.4% drop in sales. That is explained by the fact that most of the remediation measures are for products with higher aggregated value. Still, Company B is physically more exposed to water-stress relative to Company A (which only lost 1% in sales). The overall impact reflects the fact that, despite some protection of high-aggregate value products (e.g., such as advanced materials), they have a meaningful portion of their manufacturing footprint located in water-scarce basins. Moreover, they are expanding capacity in areas that suffer from scarcity.

Those results showcase the company's stewardship policy is not incorporating appropriate water risks into their capacity expansion plans, particularly for high-value products. In the future, this increases the overall risk of Company B, which is reflected in enterprise and equity value declines.

## RESULTS - COMPANY C

**Table 7 – Company C data**

| Company description | |
|---|---|
| Products | Chemicals, Polymers, Specialties and Agri-nutrients |
| Production location | Middle East, North America, East Asia, Europe |
| Water usage | Cooling, production |
| % withdrawal from stressed areas | Less than 5% |
| Water withdrawal reduction targets | Intensity-based targets expire in 2025. No details of potential future targets |
| Mitigation measures in place or planned | • Efficiency improvements/internal recycling<br>• Seawater and desalinated water |

**Table 8 – Water-stress impact on financials for Company C**

| Value driver | Sales CAGR 10Y | Production in 2030 | Sales in 2030 | EBITDA in 2030 | EBITDA margin in 2030 | PV | NPV |
|---|---|---|---|---|---|---|---|
| Pre-stress test | 1.9% | 55,100 | 152,568 | 33,541 | 22.0% | 250,849 | 253,859 |
| After test | 1.1% | 51,054 | 141,430 | 24,616 | 17.4% | 170,950 | 173,960 |
| Initial impact | -1% | -7.3% | -7.3% | -26.6% | -5% | -31.9% | -31.5% |
| Impact after remediation | -0.2% | -1.6% | -1.6% | -19.3% | -3.6% | -22.4% | -22.2% |
| Final result | 1.8% | 54,208 | 150,085 | 27,058 | 18.4% | 194,543 | 197,554 |

Source: Robeco analysis, 2025.

### Present insights and future risks

Remediation efforts are very effective in Company C, especially in their chemical businesses, which is reflected by the lower production and sales impact after mitigating measures. The company uses saline water for cooling, which reduces the freshwater withdrawal needs.

However, margins are widely impacted by the fact that part of their highly profitable product line (agri-nutrients) remains exposed to water-stressed areas with unmanaged risk. This is reflected in the almost 22% impact on enterprise and equity value. Company C's manufacturing footprint is located in highly water-stressed basins, where physical water shortages can force partial shutdowns or capacity curtailments in the agri-nutrient business. It is not just about water becoming expensive; it is about water becoming unavailable.

Due to cheap feedstock access, Company C has a higher proportion of fixed costs. When production volume drops by 7%, the fixed costs (plant maintenance, labor, overhead) remain, causing profitability to plummet much faster than revenue. That creates a big dilemma. While they operate in an area with abundant resources for their chemical and fertilizers business, the lack of water availability could force the company to look for alternatives to avoid water withdrawals. A possible solution for their business is to invest in a desalinization plant that could convert seawater into freshwater to be used in the agri-nutrient part of the business.

While the company remains solvent, the water-stress scenario effectively removes the competitive advantage of being a low-cash cost producer from the company's valuation.

## RESULTS - COMPANY D

**Table 9 – Company D data**

| Company description | |
|---|---|
| Products | Chemicals, Mining and Energy |
| Production location | Southern Africa, Europe, US |
| Water usage | Cooling, steam generation |
| % withdrawal from stressed areas | Over 80%, concentrated in one country |
| Water withdrawal reduction targets | Intensity based targets to reduce/maintain current levels expire in 2025. We expect the targets will not be achieved. The main priority is water quality. |
| Mitigation measures in place or planned | • Efficiency improvements/internal recycling |

**Table 10 – Water-stress impact on financials for Company D**

| Value driver | Sales CAGR 10Y | Production in 2030 | Sales in 2030 | EBITDA in 2030 | EBITDA margin in 2030 | PV | NPV |
|---|---|---|---|---|---|---|---|
| Pre-stress test | 4.0% | 12,956 | 315,538 | 51,905 | 16.4% | 205,257 | 131,250 |
| After test | 3.3% | 12,065 | 296,131 | 44,065 | 14.9% | 155,578 | 81,571 |
| Initial impact | -1% | -6.9% | -6.2% | -15.1% | -2% | -24.2% | -37.9% |
| Impact after remediation | -0.6% | -6.3% | -5.1% | -13.1% | -0.9% | -15.8% | -24.7% |
| Final result | 3.4% | 12,145 | 299,291 | 45,108 | 15.5% | 172,831 | 98,824 |

Source: Robeco analysis, 2025.

### Present insights and future risks

For Company D, the stress test presents a significant physical hit, second only to Company C. Company D has major manufacturing hubs in high-risk water basins. The water scarcity scenario forces them to curtail output significantly, as they likely lack sufficient backup water supplies to maintain 100% capacity during a severe drought.

In discussions with company management, they acknowledge the risks but put too much reliance on the local governments to solve supply issues that may arise. Over reliance on external controls is perhaps why they do not have sufficient internal targets for reducing future water withdrawals.

Fortunately, the fact that their energy business is located in an area of low water risk attenuates the water risk impact on their core chemical and mining operations. The danger is that the operational resilience of its energy units masks the water risks that are not being sufficiently addressed in other parts of the business.

Under stress, the EBITDA margin softens from 16.4% to 14.9%. This is a manageable deterioration compared to peers, as next-to-low-risk energy assets enables them to maintain some pricing power due to a dominant market position.

Overall, we conclude that in the pre-water-stress world, Company D looks like an attractive performer (high growth, high upside). However, under water-stressed conditions, it becomes an average, low-return entity. The water risk doesn't kill the company, but it kills the alpha (excess return) an investor would expect for this business.

# Chapter 5: Aggregated comparison across companies

## CHARACTERIZING FUTURE INVESTMENT SCENARIOS

### Company A: The Value Trap – low physical risk, but high financial volatility

With the smallest declines in EBITDA, production and sales, Company A is resilient operationally. This is explained by the location of its production facilities in less water-stressed areas. The company also has good mitigation strategies in place, due to the proximity of some of its operations to urban areas. Despite robust operations, Company A loses 44% of its NPV. This is a critical finding, which is explained by the fact that Company A has a more commoditized product line and operates on very thin margins. Its finances are therefore more vulnerable to a higher cost of capital. Consequently, even a small decline in EBITDA is enough to wipe out a large portion of its shareholder value.

The Upshot: The company looks safe on an operational report (factories keep running). However, its business model operates on such thin margins that the added cost of water mitigation destroys its free cash flow. It is a dangerous investment because the risk is hidden in the profits and loss statements, not the production line.

### Company B: The Broken Thesis – moderate physical risk + financial risk equals high valuation risk

Company B is less impacted in production and sales but severely impacted in margins and cashflows. That reflects their high operating leverage and the fact that the production operations can be disrupted due to high scarcity in some of the most profitable operations. They also allocate new capital expenditures in areas that have water scarcity. That shows water-risk materiality is not sufficiently considered in capital allocation decisions. As a consequence, the company suffers the highest impact in its enterprise value, losing one third of its present value (-33%), driven by a combination of moderate operational losses and high sensitivity to cash-flow disruptions.

The Upshot: The company is priced for growth (high upside), but water-stress turns it into a mediocre performer. The 42% drop in value (NPV) represents the risk that the high-growth story is no longer viable in a water-scarce world.

### Company C: The Geography Dilemma – high physical risk meets strong financial position

Company C shows a similar trend, with its margins suffering a hard hit. However, it has a different cost structure as a result of access to cheap feedstock, which reduces its variable costs. This explains why the operational impact is high, but the financial impact on enterprise value is moderate. The company has room to absorb operational shocks, yet savings could be much higher if they were taking the appropriate precautions. There is some evidence that their comfortable financial position could lead them to waste resources. Though they are not facing the same degree of financial difficulties as others in this analyzed peer group, that buffer doesn't shield their shareholders from suffering a 21% drop in equity value.

The Upshot: This is a geography problem. The margin drop that stems from negative operating leverage indicates valuable assets located in high-risk basins. Company C doesn't just face higher fixed costs; a water-stress event could wipe out their competitive advantages. Remediation actions are key to reducing significant operational risks.

### Company D: The Resilient Giant – high physical risk, moderate financial absorption

Company D is the most vulnerable from a production volume perspective. It sees a decline in EBITDA, production and sales. This is explained by a production profile characterized by high exposure to water-scarce regions where few remediations are taking place. The company doesn't have a policy to mitigate water scarcity and relies fully on local government-provided solutions. However, their dominant market position and diversified businesses enables Company D to absorb the water-stress shock. The outcome for shareholders is that the alpha this company could generate is wiped out by lack of risk-minimizing policies and action plans.

The Upshot: Like Company C, it faces unfavorable geographics. However, Company D absorbs the shock better than anyone else due to its market dominance and asset diversification. Its valuation drops the least (relatively) because it has better tools to offset costs and likely lower initial growth expectations.

**Table 11 – Company summary of financial results**

| Company | Sales CAGR 10Y | Production in 2030 | Sales in 2030 | EBITDA in 2030 | EBITDA margin in 2030 | PV | NPV |
|---|---|---|---|---|---|---|---|
| A | -0.1% | -0.9% | -1.0% | -4.3% | -1.0% | -10.7% | -43.5% |
| B | -0.2% | -3.0% | -1.4% | -14.8% | -2.6% | -33.2% | -42.1% |
| C | -0.2% | -1.6% | -1.6% | -19.3% | -3.6% | -22.4% | -22.2% |
| D | -0.6% | -6.3% | -5.1% | -13.1% | -0.9% | -15.8% | -24.7% |

Source: Robeco analysis, 2025.

## Summary analysis

In summary, Companies C and D have operational risk, being highly exposed to the physical reality of water scarcity. Company D is the most balanced, though still facing a 22% value reduction. Companies A and B have financial difficulties, which suggests that they should carefully evaluate and mitigate their water-risk exposures to avoid abrupt increases in cost of capital and loss of value to shareholders.

The most striking finding of this study is the inverse relationship between operational resilience and financial resilience. The companies that are best at keeping their factories running during a drought (Companies A and B) are ironically the ones that suffer the greatest destruction of shareholder value.

All four companies exhibit negative operating leverage, explained by the high fixed-cost structure of chemical manufacturing (e.g., depreciation, maintenance, labor). Such a structure means a small drop in top-line sales due to water constraints which triggers a magnified drop in bottom-line profit.

The overall outcome is that even in the most resilient companies, the NPV drop is significant, showing the financial materiality of water risks and the lack of adequate mitigation measures that help companies avoid water withdrawal disruptions.

# Chapter 6: Addressing water-related risks in portfolios

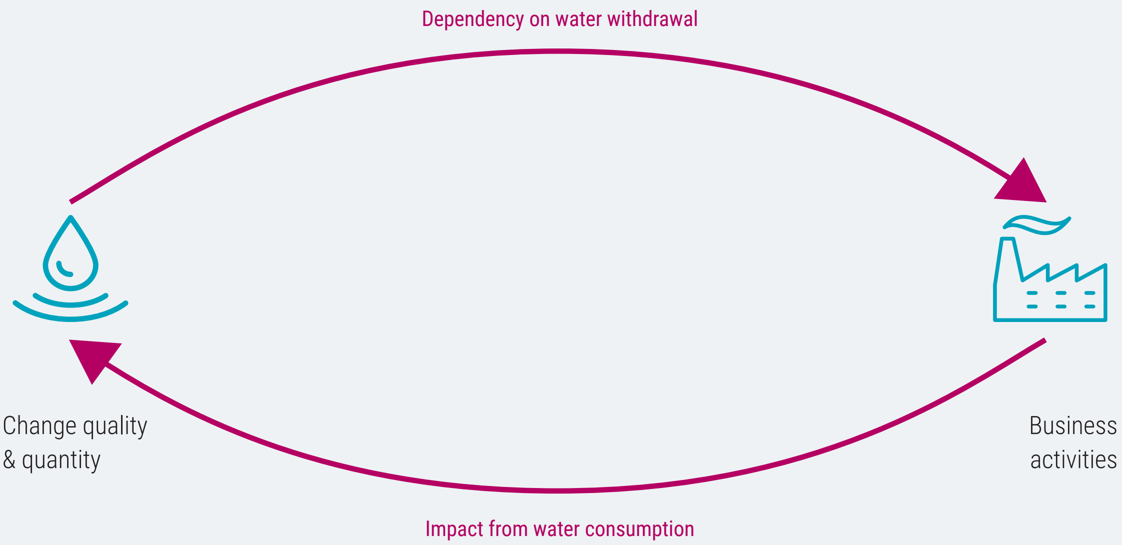
The Sustainable Alpha Research team plays a central role in helping Robeco's investment teams understand and integrate financially material sustainability risks and opportunities into their portfolios. Their work focuses on protecting portfolios against material downside risks while identifying areas where sustainability-driven structural shifts can generate alpha. In this section, we examine the degree of alignment between financial materiality arising from corporate dependency on water and impact materiality as captured by our Biodiversity Traffic Light Framework.

## Double materiality of water

The research presented here focuses on one type of sustainability risk that can arise as companies interact with the natural environment. In this case, we created a likely but hypothetical scenario to test a company's resilience in the event of real water scarcity. It is a financially material risk that arises from the dependence chemical companies have on water withdrawal from the surrounding environment. As we have seen, insufficient access to water is a significant risk that can impact a company's operations and financial performance. Water is a resource provided by nature and the lack of it poses a risk from nature toward companies.

In the other direction, companies impose material risks on nature. For example, overconsumption of water by companies can impact the ongoing sustainability of the surrounding environment. This type of risk is also present when companies fail to adequately clean discharged wastewater which can negatively impact environmental water quality. Over time, such practices can result in poor water quality and reduced availability in a region which can subsequently impact the availability of freshwater for companies operating in those locations.

**Figure 7 – The 'Double Materiality' of water risks**




Material risks work in both directions. A company's dependency on water has risk implications for its operations, whereas the company's water discharge impacts freshwater quality and availability in the environment.
Source: Robeco, 2026.

## Robeco's Biodiversity Traffic Light

The Biodiversity Traffic Light uses sector-specific models to capture the impacts companies have on biodiversity through relieving or maintaining pressures on the drivers of biodiversity loss. The IPBES define five key drivers of biodiversity loss; impacts to water availability fall under the category of 'overexploitation of natural resources' (see Figure 8).

**Figure 8 – Five major drivers of biodiversity loss**

**Land and ocean use change**
Deforestation, land degradation, and changes in ocean use that lead to habitat destruction.

**Overexploitation of natural resources**
Water overconsumption, overfishing, and other forms of resource depletion.

**Pollution**
Untreated wastewater, pesticides, plastics, and other pollutants that harm ecosystems.

**Invasive species**
Non-native species that disrupt local ecosystems by outcompeting native species or introducing diseases.

**Climate change**
Changes in climate patterns that affect species survival and distribution.

Source: IPBES, Robeco 2025.

Based on their current and future performance (which is measured by forward-looking commitments) companies are categorized as 'aligned', 'aligning', 'partially aligning' and 'misaligned' to indicate the extent to which they are leading or lagging as their sectors transition toward more nature-friendly operations (see Figure 9). To become a transition leader, a company must have both a current performance and future plans that are average to strong. If a company's current and future performance is weak, it is assessed as misaligned. Partially aligned companies exhibit both strengths and weaknesses in current and future performance.

**Figure 9 – Robeco Biodiversity Traffic Light Scoring**

| | | | | |
|---|---|---|---|---|
| Future performance | Strong | Partially aligning | Aligning | Aligned |
| | Average | Misaligned | Partially aligning | Aligning |
| | Weak | Misaligned | Misaligned | Partially aligning |
| | | Weak | Average | Strong |
| | | Current performance | | |

Source: Robeco, 2025.

As previously mentioned, the assessment is based on sector-specific KPIs. For chemical companies, the most relevant drivers are pollution and overexploitation of natural resources (see Table 12).

**Table 12 – Biodiversity KPIs for the Chemicals Industry**

| Driver | KPI |
|---|---|
| Pollution | Hazardous materials<br>Hazardous Waste<br>Air emissions<br>Production of N & P fertilizers (where relevant) |
| Overexploitation of natural resources | Water<br>Recycled or renewable feedstock |

## Companies' water impact performance in the Biodiversity Traffic Light

The water consumption impact shows that three of the four companies have material consumption in stressed areas and based on their consumption intensity and related targets, all three are classified as 'Partially Aligning'. Company A has a low impact exposure and is also the most operationally resilient with good mitigation measures in place which can be replicated elsewhere.

**Table 13 – Company performance on water consumption**

| Company | Water exposure | Assessment |
|---|---|---|
| Company A | Immaterial – Low exposure to water scarce areas | N/A |
| Company B | Material – High exposure to water scarce areas | Partially aligning |
| Company C | Material – High exposure to water scarce areas | Partially aligning |
| Company D | Material – High exposure to water scarce areas | Partially aligning |

Water consumption is one of the key indicators measured in the Biodiversity Traffic Light for chemical companies.
Source: Robeco, 2025.

**Company A** – is assessed as 'Partially Aligning' overall. This is due to the company's high air emissions balanced with good performance on hazardous waste and low exposure to substances of very high concern. The company has targets for some of the impacts such as waste and water, but not all.

**Company B** – performed the strongest with an 'Aligning' traffic light, driven by strong performance in hazardous waste management and low air emissions. It also plans to reduce future waste (zero waste to landfill targets) as well as substances of very high concern in its products. While it has operations in areas of high-water-stress, its water targets partially offset that risk.

**Company C** – is 'Partially Aligning'. Its weak current performance is driven by high hazardous waste, air emissions, and water consumption. However, the company has reasonable targets to reduce its material impact in the future.

**Company D** – has weak current performance with high air emissions and hazardous waste relative to the industry and some products containing substances of very high concern. The company has set some targets for water and waste, but only for select facilities. Policies exist but are insufficient to meaningfully reduce its impact, which is reflected in the ultimate traffic light assessment of 'misaligned'.

**Figure 10 – Biodiversity Traffic Light performance matrix**

| Future performance | | | | |
|---|---|---|---|---|
| | Strong | Company C | Company B | |
| | Average | Company D | Company A | |
| | Weak | | | |
| | | Weak | Average | Strong |
| | | Current performance | | |

The table reflects how well the chemical companies in our sample are performing on metrics related to biodiversity loss.
Source: Robeco, 2025.

# Chapter 7: Conclusion

Our analysis highlights a critical gap between current corporate water strategies and the long-term resilience required to navigate increasing water-stress. While companies in the chemical industry recognize water as a material issue and have implemented measures to improve operational efficiency, these efforts remain largely incremental and reactive. The prevailing reliance on government intervention to secure water resources signals a systemic underestimation of the financial and operational risks associated with water scarcity.

Our research has found that while most companies have water stewardship policies, these are primarily focused on pollution control and consumption management rather than addressing absolute water withdrawal. The absence of measurable, time-bound targets for reducing water use underscores a lack of accountability and ambition. Furthermore, strategic planning for future operations neglects water availability as a key criterion, prioritizing raw material access, customer proximity, and labor supply instead. This approach risks concentrating production in water-stressed regions, amplifying exposure to supply disruptions, regulatory constraints, and reputational damage.

While short-term shocks may be absorbed, the cumulative impact of water scarcity on production costs, asset utilization, and growth prospects could erode shareholder value over time. Companies that fail to integrate water risk into capital allocation and expansion decisions may face production curtailments and lost revenues, or even the revocation of water access and diminished competitiveness.

Moreover, future water-stress represents a material blind spot which is not currently captured in ESG scores. To help reduce the material downside to equity values, investors must begin to consider forward-looking, water-adjusted CAPEX which identifies which companies fail to integrate local basin scarcity into site selection plans.

Investors can also use stress-test results to improve the positioning of investments in the short, medium, and long-term via the following actions:

- Active Engagement: Actively engage with companies to set clear, science-based targets for water withdrawal reduction.
- Risk Assessment: Incorporate water-stress scenarios into valuation models and portfolio risk frameworks.
- Capital Allocation: Favor companies that embed water availability into site selection and long-term planning

A significant systemic risk identified in this research is the disconnect between corporate expansion plans and water-stress in those regions. Our findings show that chemical companies prioritize access to raw materials and customer proximity, while treating water availability as a manageable operational externality. This has led to a dangerous concentration of new production capacity and future growth plans in water-stressed regions.

Water is not just a sustainability or environmental issue. Rather, as illustrated throughout this paper, in industries with high dependency, water is a strategic resource with direct implications for a company's revenues and stock market performance. Companies in industries such as chemicals that treat water resilience as a core business priority will be better positioned to deliver stable (and sustainable) returns in an increasingly resource-constrained world.

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