

HIGH AND DRY

HOW WATER ISSUES ARE STRANDING ASSETS

A report commissioned by the Swiss Federal Office for the Environment (FOEN)

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KEY FINDINGS

Water risk factors are already stranding assets throughout the coal, electric utilities, metals & mining, and oil & gas sectors. Water security is no longer a small, plant-level operational issue for companies, but has become a strategic question for senior management.



The exposure of the financial sector to water-stranded assets¹ is real and often involves a tail of potential knock-on events including:

- ▼ Non-delivery of product to offtake partners and hedging mismatches - an open liability;
- ▼ Make-good and clean-up liabilities and fines;
- ▼ Shareholder class actions; and
- ▼ Changes to loan funding and wider financial relationships, including banking and insurance.



There are likely to be more water-stranding events exacerbated by increasing thirsty growth across resource majors and the depletion of freshwater resources.



Resource majors have, to date, mostly been able to absorb the financial implications of water-stranding events. Resource minors, and the financial institutions fueling them, may not.



The concentration of equity investments suggests that action by just a small number of shareholders, (e.g., by exercising voting rights), could have a significant impact in driving resource majors to value water appropriately.



Disclosure and increased water transparency across the financial sector will help to avoid the worst consequences of the water crisis and may contribute to actively stemming it.

Financial institutions must move now to engage, identify, assess, manage, and disclose water risks across portfolios and loan books to avoid the worst consequences of the water crisis and contribute to actively inhibiting it.

INTRODUCTION



69%

of listed equities, reporting via CDP, state that they are exposed to water-related risks that could generate a substantive change in their business



33%

of listed financial institutions

were not assessing exposure of financial activities to water risks

Sixty-nine percent of listed equities, reporting via CDP, state that they are exposed to water risks that could generate a substantive change in their business. The potential value at risk tops out at US\$225 billion⁹.

These figures are set to worsen unless we radically shift our approach to how we use, treat, and manage the world's finite supply of water. The World Bank predicts that a tug of war between scarce high-quality water supply and ever-increasing demand, driven by economic growth and exacerbated by climate change, could cost some of the world's regions up to 6% of GDP by 2050 and lock in sustained negative regional growth, as well as spurring migration and sparking conflict². We are not yet close to reaching the US\$670 billion worth of annual investment the World Economic Forum says is needed to meet water-related sustainable development goals³. As the World Water Council states, "There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people – and the environment – suffer badly"⁴.

It is perhaps unsurprising therefore, that in April 2019, a report⁵ from the Network for Greening the Financial System stated, "environmental degradation [including water pollution and scarcity of fresh water] could cascade to risks for financial institutions, as reduced availability of fresh water or a lack of biodiversity could limit the operations of businesses in a specific region. These could turn into drivers of financial risks and affect financial institutions' exposures to those businesses."

Due to an increasingly concentrated group of banks, investors and insurers ultimately allocating capital towards those activities most exposed to the water crisis, the threat to financial stability may be significant. Despite this, research from CDP found that 37% (2020)

and 33% (2021) of listed financial institutions were not assessing exposure of financial activities to water risks, suggesting that many financial institutions may be underestimating their exposure and as such, over-allocating capital to high-risk activities^{6,7}.

This report, produced by CDP in collaboration with Planet Tracker, presents research highlighting how water insecurity⁸ is already impacting financial performance of companies through the stranding of assets, the implications of this for the financial sector globally, and the role disclosure plays in understanding, identifying, and managing these impacts.

By collating real-world examples of water-related stranded assets, this report aims to highlight the significance of the water crisis to the finance sector. It examines drivers of water risks and assesses the level of awareness and preparedness that exists across companies in four major sectors: coal, electric utilities, metals & mining, and oil & gas. Using this evidence, the research articulates how these issues could affect the financial performance of companies in the chosen sectors and in turn, the financial institutions financing them. The report concludes with a list of actions financial institutions should take to mitigate these risks and impacts.

We hope this report will prove particularly useful for financial institutions with capital allocated to activities that are especially exposed to water-stranding risks as well as to a larger range of stakeholders, including those policymakers promoting global financial stability through strong financial sector policies.

WATER RISK DRIVERS AND POTENTIAL FINANCIAL IMPACTS



The United Nations predicts a

40%
global shortfall

in water supply by 2030 if current consumption and production patterns do not change

Water is often considered a plentiful renewable resource, yet the world's supply of clean, fresh water is under increasing threat. The reasons are straightforward. Growing populations and increasing economic activity in many regions are resulting in increased demand for and pollution of water in both the public and private sectors.

While the term 'water scarcity' is frequently heard, we are more specifically experiencing greater competition for clean fresh water, particularly in locations where existing supplies are already in decline or water quality does not satisfy the required users' standards. The mismatch between supply and demand on what is essentially an irreplaceable natural resource consequently means that a stable supply of high-quality fresh water can no longer be guaranteed.

With the United Nations predicting a 40% global shortfall in water supply by 2030 if current consumption and production patterns do not change^{10,11}, addressing water risks becomes an imperative, along with transitioning to more water-resilient business models.

There are concerns about worsening water security in many parts of the world. India is facing an unprecedented water crisis with domestic, agricultural, and industrial shortages. Brazil has more fresh water than any other country, yet its Parana river basin, home to several hydroelectric dams and reservoirs, is facing its worst drought in more than a century¹². Agriculture is suffering, as the drought affects the production of important Brazilian crops such as coffee, corn, sugarcane, and oranges. Production of coffee beans fell by 20–30% in 2021, pushing up the global price of the commodity by 60%¹³.

Some 60% of China's groundwater is polluted and rated as unfit for human contact, posing a threat to its economic growth.

Furthermore, analysis by NASA suggests that 13 of the world's 37 largest aquifers have been depleted to the point where regional water availability is threatened^{14,15}. In particular, the most overstressed aquifer in the world – the Arabian Aquifer System – provides important water supplies to more than 60 million people.

While this threat can impact all parts of society, the private sector in particular is discovering how water insecurity can affect current outputs and constrain future growth. The reality is that this poses a strategic issue for most global businesses. Across both developed and frontier economies, increasing numbers of companies and their investors are being confronted with growing water risks that drive home the reality that water can no longer be treated as a free, endless resource.

For example, the current drought in western US, which began in 2000, has reduced water supplies, devastated farmers and ranchers and fueled wildfires across the region¹⁶. Similarly, by drying out reservoirs, a drought in California in 2021 caused a remarkable decrease in hydroelectric production and placed additional stress on the power grid, with the state only avoiding blackouts by importing additional power from other states. Farmers have also been affected, highlighting the economic consequences caused by the competing demands of agriculture and energy.



Analysis by **NASA** suggests that **13 of the world's 37 largest aquifers** have been depleted to the point where regional water availability is threatened



WATER RISK DRIVERS AND POTENTIAL FINANCIAL IMPACTS



IFPRI²³ suggests that current business-as-usual water management practices and levels of water productivity will put at risk **US\$63 trillion**, or **45%**, of the projected 2050 global GDP, equivalent to **1.5** times the size of today's entire global economy.



In 2011, the

US\$1 billion

Tía María copper mining project run by US-based Southern Copper was halted after violent protests by farmers and residents about its water use left three people dead²⁴

And in Europe, falling groundwater levels in Germany and prolonged droughts due to climate change have resulted in legal challenges that have the potential to further delay or even stop Tesla's US\$5.7 billion Brandenburg manufacturing project¹⁷.

The situation may worsen if business and investor attitudes to water and growth are not transformed. Research carried out by the International Food Policy Research Institute (IFPRI) suggests that current business-as-usual water management practices and levels of water productivity will put at risk US\$63 trillion, or 45%, of the projected 2050 global GDP, equivalent to 1.5 times the size of today's entire global economy¹⁸.

Potential consequences for companies and their investors are serious. Our analysis indicates that substantive corporate value may be at risk due to worsening water insecurity. Production could slow or halt. Disputes over water could lead to reputational damage. Assets in water-stressed regions could become stranded temporarily, or permanently, if assumptions made about water availability and

access prove inaccurate, regulatory responses are unanticipated, or if risk mitigation and stewardship plans are not put in place.

The effect on shareholder value can be dramatic. Rio Tinto walked away from the Pebble Mine copper and gold project in Alaska, in the face of growing concerns about its effect on salmon fisheries¹⁹. BHP Billiton and Rio Tinto needed to make a record breaking US\$3 billion investment in a desalination plant in Escondido, Chile, to ensure adequate water is available for its mining operations in the Atacama Desert²⁰. In January 2020, Anglo American indicated that water shortages at its Los Bronces mine in Chile had weighed on the global miner's copper output in the fourth quarter. Companies operating Chile's vast copper mines have warned that anti-government protests, strikes and road blockades had taken a toll²¹. In August 2019, the Peruvian Mining Council sent an official notice to the Mexican mining company, Southern Copper Corporation (SCC), temporarily suspending the license granted for the construction of Tia Maria copper mining project²². Other projects have been dogged by similar troubles.



The regions we operate in are projected to become generally drier. Water security is a particular risk for our operations in Limpopo (Southern Africa), especially during prolonged drought, coupled to rising community and municipal demand. A lack of water will hinder our ability to grow the mine further.

Anglo American Platinum, 2021





Source : CDP's 2021 Water Dataset



WATER RISK DRIVERS AND POTENTIAL FINANCIAL IMPACTS

Water as a driver of stranded assets

There are a wide range of current and emerging water risk factors that could result in stranded assets, where environmentally unsustainable assets suffer from unanticipated or premature write-offs, downward revaluations or are converted to liabilities. These risk factors fall into the following categories²⁵:

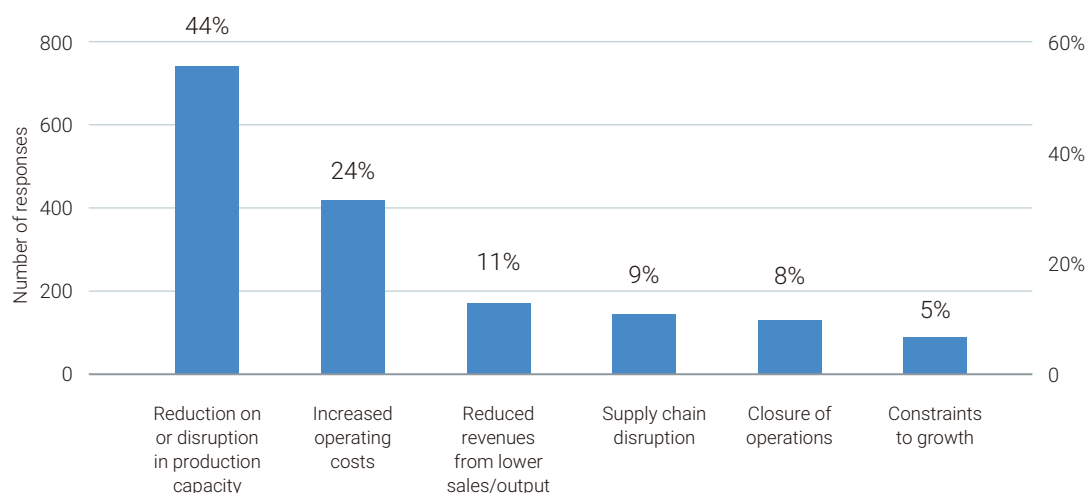
 Physical risks	Flooding, drought, declining water quality, ecosystem vulnerability, increased water scarcity and/or stress, and inadequate infrastructure.
 Regulatory risks	More stringent water withdrawals and/or discharge permits, mandatory water efficiency, recycling, conservation, or process standards, regulatory uncertainty, and higher water prices.
 Reputational & markets risk	Community opposition, increased stakeholder concern or negative stakeholder feedback, litigation, and changing consumer behavior.
 Technological risks	Data access/availability, transition to water-efficient and low-water intensity technologies and products – where companies may be left behind if not adopting these new technologies – and unsuccessful investment in new technologies.



WATER RISK DRIVERS AND POTENTIAL FINANCIAL IMPACTS

For 68% of the 1,112 publicly listed companies disclosing on water via CDP, these drivers manifest in ways that could generate a substantive impact on their business. The maximum potential financial impact was estimated at US\$225 billion⁹, while the cost of response was US\$119 billion²⁶.

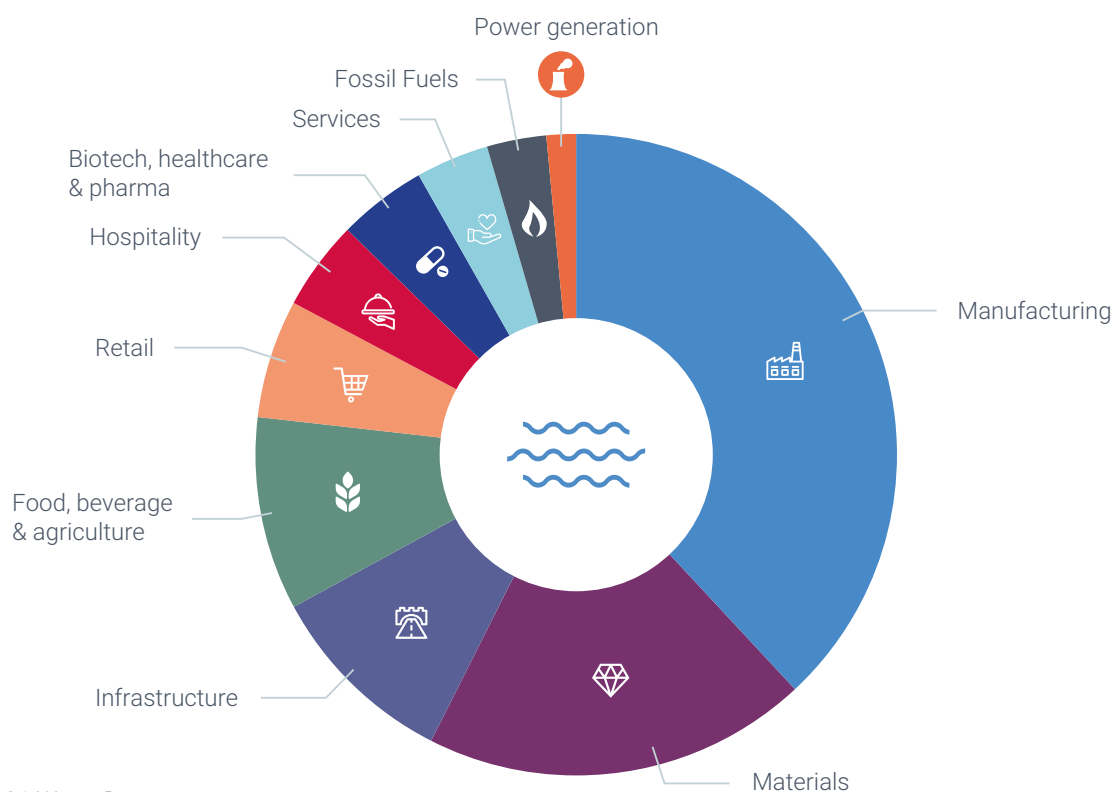
Figure 1. Top six potential impacts in direct operations and supply chain



Source: CDP 2021 Water Data set

The majority of those exposed (57%) anticipate that issues around water could limit the growth of their business (Figure 1), either by reducing or disrupting production capacity (44%), closing operations (8%) or constraining growth (5%).

Figure 2. Sectors reporting closure of operations



Source: CDP 2021 Water Data set

Companies involved in the manufacturing of chemicals, paper, and steel; those extracting oil and gas, coal and metals, and those generating power all report instances in which water risks could close operations – or in other words – strand an asset.

DRYING ASSETS IN RESOURCE MAJORS

During the last decade, a number of real-world instances have emerged where water risk factors have led to the stranding of assets in some of the most consequential sectors on the planet. Over the next few pages, we present an overview of the financial implications of water-related stranding events in four resource majors:



COAL

Adani Enterprises and its Carmichael Coal Mine



ELECTRIC UTILITIES

Exelon and its Oyster Creek Nuclear Power Plant



METALS & MINING

Barrick Gold and its Pascua-Lama Gold and Silver Mine



OIL & GAS

TC Energy and its Keystone XL Pipeline Extension (between Canada and the USA)

10%

of the largest responding resource majors

including Anglo American Platinum, Iberdrola SA, Suncor Energy, and Newmont Mining report that worsening water security will constrain corporate growth

Relevant announcements, annual reports and other documentation were reviewed to assess the financial impact of each of these companies' stranded assets on their balance sheet and profit and loss accounts. We have also reviewed the wider financial implications such as the impact of the stranding event on share price.

For the chosen companies, the potential 'water-related stranded assets' occupy different points on the lifecycle curve as shown in Table 1 and Appendix A. Cash flows, balance sheet valuations, and profit and loss accounts are all a function of this lifecycle, as are stranded assets. In simple terms, the more developed (i.e., the more money invested) and the less exploited (i.e., the less money extracted), the higher the financial risk.

- ▶ In two of the case studies, Pascua-Lama gold mine (Barrick Gold) and Oyster Creek nuclear power station (Exelon) – the assets became stranded as a result of a change in the regulatory/licensing landscape, with an unwillingness by management to spend or adapt, compounded by a change in the economic situation surrounding each project.
- ▶ In all four instances, significant environmental protests played an important role. In one case (Pascua-Lama gold mine – Barrick Gold) this led to a successful class action suit; while for the Keystone XL pipeline extension, it drove the US government in 2021 to deny a key cross-border permit forcing TC Energy to cancel the project.
- ▶ In all four case studies, investigation of the stranding events on the profit and loss accounts of the holding companies showed that despite possible billion-dollar balance sheet implications (with the possible exception of TC Energy in the year leading up to the non-granting of a presidential permit in 2015), these events did not have a material impact on the share prices or financial performance of the parent companies. This perhaps could be explained by their balance sheet size, asset diversification and access to capital, enabling these resource majors to absorb high levels of risk whether it be geographic, political, or regulatory. However, it may be possible that a multitude of stranding events in the medium to long term would amount to a sizeable loss that may not be "shrugged off".

RESOURCE MAJORS HIGH-LEVEL FINDINGS



The importance of the time factor (regulatory and reputational risks)

Three cases where a clear permanent water-related stranding occurred (Pascua-Lama gold mine – Barrick Gold; Oyster Creek nuclear power station – Exelon, and Keystone XL pipeline extension - TC Energy) can be linked to a change in the regulatory and licensing landscape involving water-related issues. These changes were spearheaded by sustained strong community opposition.

For long-life assets, this potential ‘change’ is important, particularly when there is significant upfront capital development spend, with the economic cash value creation happening only later in the asset’s life. Operators and assets of all sizes are at risk when unexpected regulatory or license change happens.

□ → □ → □ Further problems

In addition to the headline grabbing write-off of assets, which could impact financial performance, we observed a range of items that create a potential tail of issues. Pascua-Lama gold mine (Barrick Gold) is a particularly good example. Among others, related issues include:

- ▶ Non-delivery of product to offtake partners and hedging mismatches - an open liability;
- ▶ Make-good and clean-up liabilities and fines;
- ▶ Shareholder class action linked to the event;
- ▶ Changes to loan funding and wider financial relationships, including banking and insurance; and
- ▶ Hits to reputation and social licenses to operate.

Isolating one individual effect from a stranding event can prove difficult, but water-related issues can be an important trigger for other knock-on events as well.

US\$13.5 billion already stranded and
over **US\$2 billion** at risk on major
infrastructure projects



Environment or economics

For two of the assets that we identify as stranded because of water-related events (Pascua-Lama gold mine – Barrick Gold; Oyster Creek nuclear power station – Exelon), water is not the only factor at play. In particular, the decision not to amend plans and incur additional capex to tackle environmental concerns and revised licensing requirements, was at least in part, if not significantly, driven by a change in the underlying economics at that particular time. In the case of Pascua-Lama gold mine, this was a material drop in the gold price, while for Oyster Creek nuclear power station, it was a deteriorating power offtake pricing environment, as a result of a drop in oil & gas prices. Had the regulatory change occurred at a different time and if circumstances aligned – when the economics were less challenging and given increased awareness of planning to avoid stranded assets – the management’s attitude to either approving extra spend or leaving the asset stranded may have been different.



Size matters

The US\$7.5 billion of cumulative asset write-downs relating to Pascua-Lama gold mine (Barrick Gold) gives an indication of how large the financial impact of a stranding event at a major project can be – and this is before looking the tail of issues discussed. For the four resource majors, their balance sheet size, asset diversification and access to capital (equity and debt) have proven capable of withstanding such a stranded asset hit. This has enabled these resource majors to absorb high levels of risk, whether it be geographic, political, financing and licensing, or regulatory. Whether this is likely to continue to be the case for these firms is uncertain. As competition for water resources intensifies and community and regulator attitudes shift towards that of conserving the water we have left, resource majors that are not acting to protect freshwater resources will remain exposed to water risk factors that will strand their assets.

Certainly, for resource minors - those smaller cap companies that constitute the majority of the market in these sectors - the converse is likely to be true. These firms tend not to benefit from project-specific sponsorship (e.g., local government subsidies), and have smaller asset portfolios and corresponding balance sheets whilst carrying a high degree of water risk exposure. This issue is of particular relevance to the banking and insurance sectors, given the dependence of these resource minors on debt.



DRYING ASSETS IN RESOURCE MAJORS

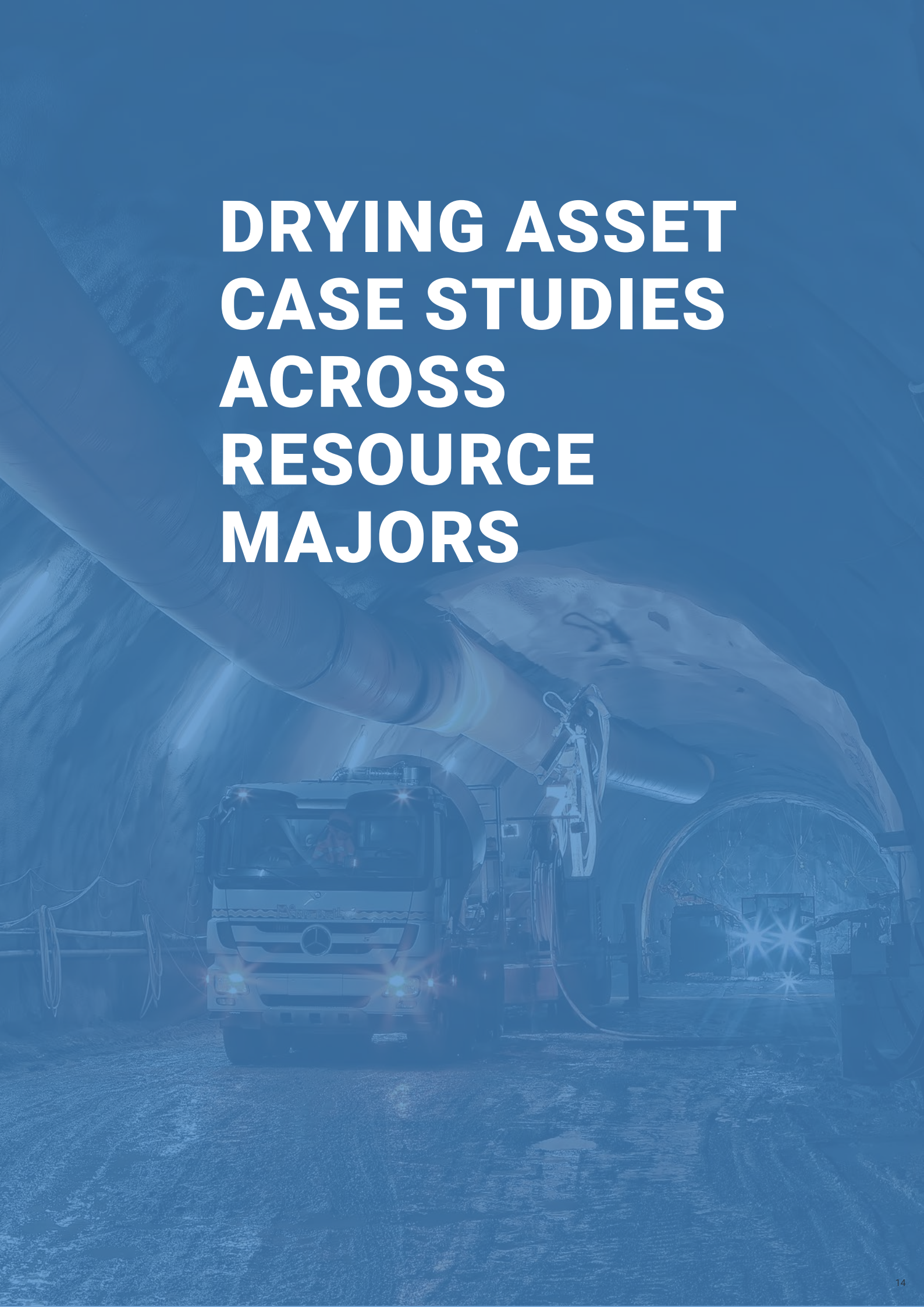
Table 1. Case studies' stranded assets summary - key water risks and key potential financial implications that appear to have affected these companies

	COAL (Carmichael coal mine)	ELECTRIC UTILITY (Oyster Creek nuclear power station)	MINING (Pascua-Lama gold mine)	OIL & GAS (Keystone XL pipeline extension)
Company (location)	Adani (India)	Exelon (USA)	Barrick Gold (Canada)	TC Energy (Canada)
Location of stranded asset	Doongmabulla Springs Wetlands, Australia	Barneгат Bay, USA	Huasco river basin, Chile/Argentina	Boreal Forest & Alberta to Nebraska, Canada
Period when stranding occurred	Currently at risk	2018	2013 production halted; 2020 government orders closure	2015 & 2021; US government denied cross-border permit
Asset type	Coal Mine and ancillaries	Nuclear facility	Gold mine	Expansion of existing Keystone (oil) Pipeline system
Life-cycle curve stage	Between the development and new asset stages, with the first export coal expected before the end of 2021 ²⁷ .	End of life-asset. Granted 20-year operating license extension in 2009, although due to changing environmental standards was decommissioned in 2018.	Late development asset; has not transitioned to producing asset.	Development stage: proposed in 2008, decade-long project – started and stalled twice.
Water risk driver for stranded asset				
Pollution		Thermal water pollution (from cooling water discharge)	Water pollution incident (US\$16 million fine)	Potential of high pollution from tar sands oil to freshwater
Ecosystem impacts/ water stress	Aquifer depletion	Ecological biodiversity impact	Glacier degradation	Aquifer freshwater pollution
Regulatory change	Increased difficulty in obtaining operation permits.	Permanent water-related asset stranding. For long-life assets this potential 'change' is important, particularly when there is high upfront capital development spend, with the economic cash value creation happening later in asset life. Operators and assets of all sizes are at risk when unexpected regulatory/license change happens.		Increased difficulty in obtaining operation permits - In April 2020, water permit withdrawn and in June 2021, denied key cross-border permit by US administration.
		Tighter regulatory standards/regulation of effluent discharge quality (temperature)	Increased difficulty in obtaining operation permits	
Unwillingness to spend/ adapt compounded by change economics (Environment vs. Economics)		Decision not to amend plans/incur additional capex to tackle environmental concerns/amend licensing requirements was at least in part, if not significantly, driven by a change in the underlying economics at that particular time.	Material drop in gold price.	Economics and energy security behind President Trump's issuance of a cross-border permit vs President Obama and President Biden's withdrawal of permit based on environmental considerations.
Community opposition	Indigenous land rights violations	Water quality concerns	Sustained Indigenous water rights	Environmental protests and legal battles
	Water-related litigation (groundwater resources)		Water-related litigation (pollution incident as above)	

DRYING ASSETS IN RESOURCE MAJORS

	COAL (Carmichael coal mine)	ELECTRIC UTILITY (Oyster Creek nuclear power station)	MINING (Pascua-Lama gold mine)	OIL & GAS (Keystone XL pipeline extension)
Financial analysis				
Summary – wider group	Adani Enterprises Limited (AEL) is listed in India on the Bombay Stock Exchange and has an equity market capitalization (stock market value) of around US\$25 billion.	The Oyster Creek nuclear power station, acquired by Exelon in 2003, started commercial operation in 1969, with a 40-year license to operate until 2009. In 2009, the plant was granted a 20-year license extension to 2029. Oyster Creek accounted for around 2% of group production capacity.	Barrick Gold (BG) is second largest global gold producer	TC Energy (previously TransCanada Corporation) is a leading North American energy company operating gas and liquid (oil) pipelines, and to a lesser extent, power and storage.
Context asset at risk/stranded	AEL owns the CCM in the Galilee Basin in Queensland via its 100% owned Australian subsidiary Bravus Mining & Resources. The wider project includes related rail projects (via 50% owned Joint Ventures) and investment in the Abbot Point coal terminal (100% owned North Queensland Export Terminal).	In 2010, Exelon decided to retire the plant early after revisions to New Jersey's water use rules would have required it to build cooling towers at an estimated cost of US\$800 million.	BG owns 100% Pascua-Lama mine	Decade-long, potentially US\$9 billion project. Pipeline extension was intended to increase capacity to transport 168 billion barrels of crude tar sands oil from Canada's boreal forest to refineries on the Gulf of Texas (USA). Gulf leg completed and operational by 2011.
Value, assets at risk/stranded	US\$1.25 billion at risk (before looking at potential losses from connected projects, amounting to ca US\$7 billion)	US\$0.9 billion at risk	US\$7.5 billion cumulative asset write-down (before looking at potential tail issues)	Total C\$7.6 billion reported balance sheet value related to Keystone XL, including C\$4.3 billion pre-2015 write-down and C\$3.3 billion pre 2021 write-down.
Impacts on financial statement of stranding asset				
Overall impact	Initial plans of 60MMT per year of coal production, had to be scaled down to 10MMT per year.	Exelon assumes 20-year license extensions will be granted for all its nuclear plants. A repeat of the stranded asset event at Oyster Creek could have a much more severe impact on the group.	By middle of 2013, Barrick Gold's market cap had fallen to US\$14 billion from US\$35 billion two years earlier. Share price has never recovered, partly due to gold sector sentiment.	C\$5 billion loss to shareholders in two tranches: C\$2.9 billion in 2015 and C\$2.1 billion in 2021. Partial C\$1.1 billion quasi equity offset from Alberta State.
Balance sheet	On a proforma basis, total assets would drop by 14% from US\$7 billion to US\$6 billion. Equity and minority interest (net worth) would drop by nearly half from US\$2.6 billion to US\$1.3 billion.	Oyster Creek was less than 1% of the group total assets and liabilities. With the subsequent sale of Oyster Creek in 2019 at slightly below book value, the balance sheet impact of early decommission was immaterial.	Total capital expenditure for the project was US\$8.5 billion. In the latest carrying value review (in 2019) Pascua-Lama stated a fair value less cost to dispose (FVLCD) of US\$398 million.	In 2015, total assets dropped by 5% and equity declined by 15%. In 2021, total assets dropped by a more modest 2% and equity declined by 7%.
Proforma Profit & Loss (P&L)	Stranded Assets Write-Off Adjustment (SAWOA) total of US\$1.25 billion. However, all non-cash in nature and exceptional, so low impact.	Minimal P&L impact, as parent company is large and diversified.	Cumulative asset write-downs of US\$7.5 billion exceeded operating profit, but cash generation not impacted.	In 2015, C\$2.9 billion net hit resulting in a reported loss of C\$1.2 billion. In 2021, C\$2.1 billion net hit, but still profitable at C\$1.8 billion. Cash generation non-impacted.
Debt, funding, and insurance	Mostly immaterial impact of event. However, investors and insurers are likely to decrease their involvement in coal mining in the future, potentially due to water concerns, among others.	Immaterial impact of event.		Despite a dip in 2015, steady leverage profile, constant cash generation and state level support have resulted in continued access to blue chip bank-supported debt funding.
Share price	Immaterial impact of event.	A review of Exelon's share price shows little linkage to the key events of Oyster Creek.	Barrick Gold's share lost more than half its value from end of 2012 to middle of 2013, when the main impairment charges were taken. These coincided with a >20% drop in the gold price. The share price is still half the price compared to 2012 although gold price is now above 2012 levels.	No obvious share price linkage to key event timings, but general de-rating evidenced ahead of 2015 decision not to grant a permit.
Potential tail-off issues			<ul style="list-style-type: none"> ▶ Non-delivery of product to offtake partners and/or hedging mismatches - an open liability ▶ VAT liability ▶ Chilean environmental fine liability (make-good/clean-up liabilities and fines) ▶ Potential for changes to loan funding and wider financial relationships, including banking and insurance 	
Investor class action			<ul style="list-style-type: none"> ▶ Shareholder class action in US and Canada linked to action/performance 	




DRYING ASSET CASE STUDIES ACROSS RESOURCE MAJORS





COAL

Adani Enterprises Limited, AEL (India)

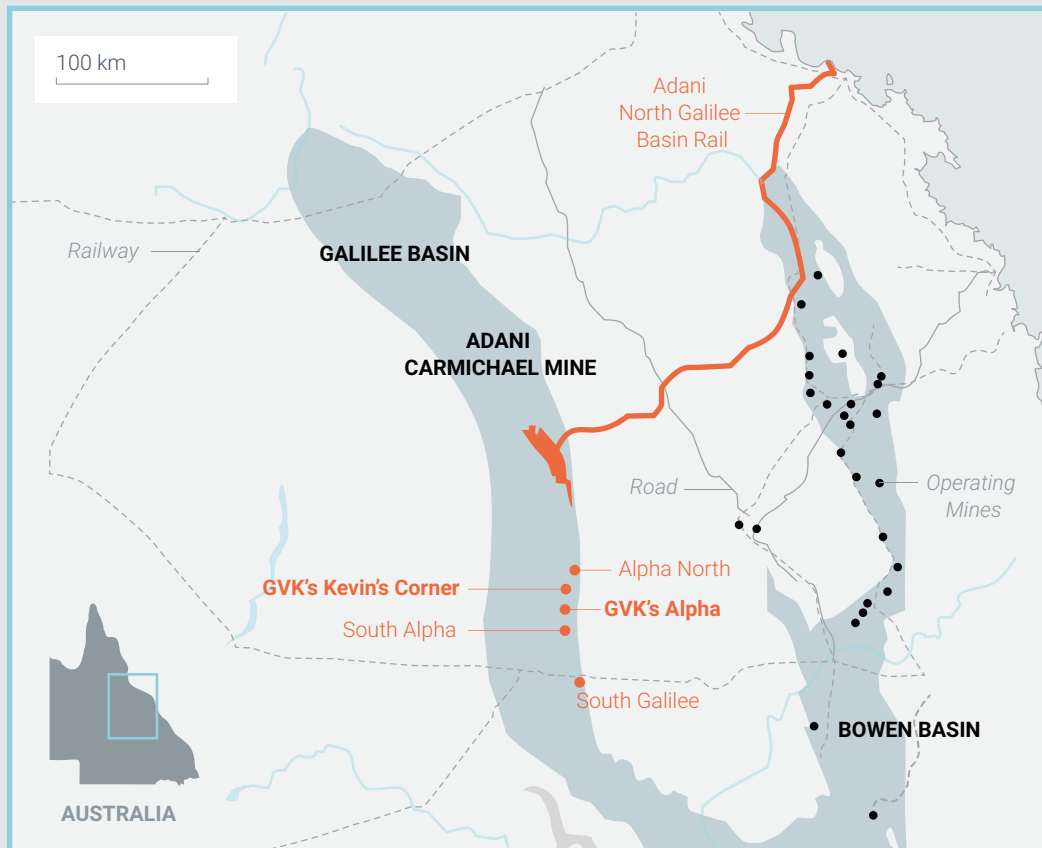
 Location	Australia Doongmabulla Springs Wetlands
 Asset stranding	Coal mine and related infrastructure believed to be economically stranded
 Risk drivers	<ul style="list-style-type: none"> ▾ Aquifer depletion ▾ Increased difficulty in obtaining operations permits ▾ Community opposition ▾ Water-related litigation ▾ Indigenous land rights

Carmichael Coal Mine (CCM) in Queensland, Australia is one of the most famous global examples of a current asset in the process of becoming stranded by the transition to a low-carbon economy and changing attitudes to coal as a source of energy. There has been much publicity around investors and banks backing away from the project one by one²⁸.

The associated carbon emissions and financial viability of coal energy are the principal concern for most investors and the driving force behind the stranding of the CCM²⁹. However, approval and construction of the project took 10 years from when Adani Enterprises Limited (AEL) purchased the lease in 2010, largely because of roadblocks and litigation related to local groundwater resources, including Doongmabulla Springs Wetlands.

Coal ambitions

Adani undertook controversial coal mine project



Sources: Adani, Queensland Government



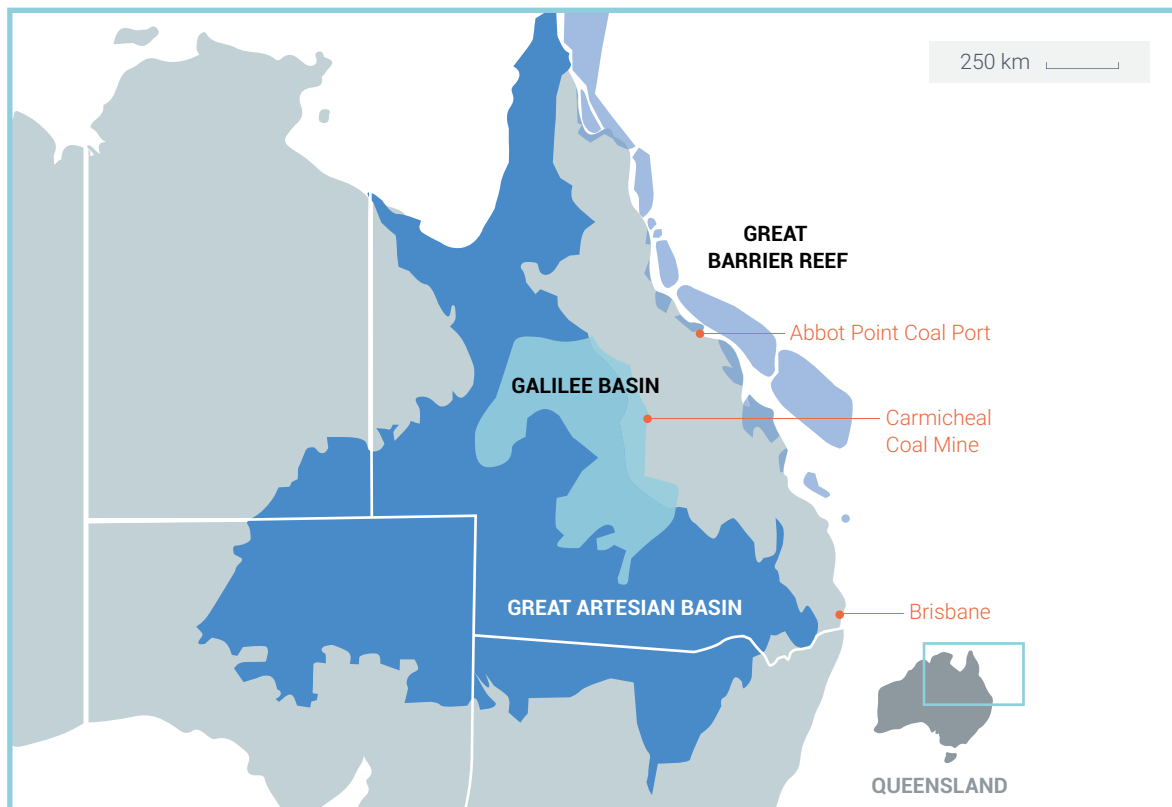
COAL

CCM can therefore be seen as an example of an investment where delays due to water-related issues have meant that the external environment has significantly changed compared to when the investment decision was originally taken. If CCM does become a stranded asset – as now seems likely – AEL's US\$5 billion outlay and their additional investment in Abbot Point Coal Port, at a further US\$2 billion, which relies on the CCM operating to be economically viable, will be stranded alongside it³⁰.

CCM commenced operations during the current financial year (2022/2023 financial year) and going forward is expected to produce 10 MMT per year. Reportedly, it shipped its first coal cargo in late December 2021³¹. This is a significantly scaled down project compared to AEL's initial plans to construct a 60 MMT per year mine at a cost of US\$11 billion.

Under pressure

Adani Group's coal mine has sparked opposition on environmental grounds



Sources: Geoscience Australia, Great Barrier Reef Marine Park Authority



COAL

Coal mining is notoriously water intensive and can have massive impacts on local water resources. This is the case for the CCM. Studies have shown that aquifer levels have dropped significantly at nearby protected wetlands ‘Doongmabulla Springs’ since 2019³². As with many environmental impacts, changes such as these could prove to be irreversible. The water issues resulted in delays obtaining permits and in litigation, which slowed the process down considerably.

The Australian Conservation Foundation launched two legal challenges related to water use during the approval process, alleging that Adani’s data obtained from drilling into the water table was insufficient to determine risks of collapse in the groundwater systems³³. Other legal challenges related to the land rights of indigenous communities. This included the traditional indigenous owners’ challenge to Australia’s native title system on the need for an Indigenous Land Use Agreement (ILU) for the project to proceed³⁴.

The CCM eventually cleared all the regulatory hurdles to its construction and has now struck coal. But the investment environment is very different today compared with 2010. Most of the world’s largest banks, investors and insurers are moving towards making net-zero commitments, and away from financing coal³⁵; more are factoring water risks into investment decisions³⁶. The project has become a reputational risk for banks that have

continued to support it – notably, State Bank of India is coming under pressure from investors in its green bonds³⁷. AEL has had well publicized difficulties refinancing as possible investors have distanced themselves from the deal³⁸. Further, falling prices for renewable energy, and with water scarcity rising, means coal may soon be economically and environmentally unviable as an energy source. Research from Ember shows that coal generation in India, where most of Carmichael’s product is planned to be exported to, may have already peaked³⁹.

After 10 years of delays due to water issues, a project that looked profitable to AEL in 2010 is now looking like an enormous stranded asset. A commonly held view is that the project may only work commercially because of subsidies: from the Australian government in the form of a royalties holiday, the Indian government offering tax exemptions, and the Bangladeshi Government purchasing power at above the market rate⁴⁰.





COAL

AEL financial impact summary





- ▶ CCM is material in AEL's balance sheet terms, but small in a group value context.
- ▶ Share price not driven by balance sheet (Price to Book Ratio 10x) nor earnings (Price to Earnings Ratio 200x).
- ▶ Clear effects on access to banking and insurance, at this stage most likely prompted by coal-related considerations rather than issues of water scarcity.
- ▶ CCM's access to wider financial resources creates a complex picture.

AEL is the flagship company of the Adani Group. It is listed in India on the Bombay Stock Exchange and has an equity market capitalization (stock market value) of around US\$25 billion⁴¹. AEL acts as an incubator of assets that support domestic Indian economic development.

It is a conglomerate, with subsidiaries in a diverse range of activities including resources (mining, integrated resource management), transport & logistics (airports, road, rail), utilities (water, datacenters), solar, and food. The CCM is a constituent of the integrated resource management division.

As of October 14, 2021, the wider Adani Group had a combined market capitalization of US\$123 billion⁴². The Adani Family Trust owns 56.5% of AEL; a controlling majority. It also owns a majority stake in all other listed Adani Group businesses, with the exception of Adani Gas⁴³.




AEL owns the CCM in the Galilee Basin in Queensland via its 100% owned Australian subsidiary Bravus Mining & Resources. The wider project includes related rail projects (via 50% owned Joint Ventures) and investment in the Abbot Point coal terminal (100% owned North Queensland Export Terminal).

 <p>Balance sheet</p>	<p>The analysis shows that, in the event of stranding, on a proforma basis total assets would drop by 14% from US\$7 billion to US\$6 billion. Equity and minority interest (net worth) would drop by nearly half from US\$2.6 billion to US\$1.3 billion. This latter drop is relatively alarming, as it could prompt a requirement to raise additional capital.</p>
 <p>Profit & Loss (P&L) account</p>	<p>Our calculations show a Stranded Assets Write-Off Adjustment (SAWOA) total of US\$1.25 billion. While this amount is relevant in absolute terms, it is important to note that all this is non-cash in nature and exceptional, so the impacts on operating numbers may be low.</p>
 <p>Debt, funding and insurance</p>	<p>The company does not seem to be adopting particularly high levels of borrowing, especially in view of its status as an incubator taking advantage of inter-company loans from other Adani Group companies. Significantly, we have not been able to establish any debts that are linked or secured against the CCM assets, including no debt participation by the Australian-focused resource banks. This may be linked to avoidance of mining funding, particularly coal, rather than specific water concerns for this project. However, many experts have identified water as a material risk for mining projects⁴⁴, thus leading to the consideration that these risks may have been considered in the decision to avoid mining funding.</p> <p>Importantly, it appears that insurance companies are also avoiding CCM. In 2020, Apollo announced it would be ending insurance cover from September 2021 and this was followed by others including Travelers Europe and Brit in 2021⁴⁵.</p>
 <p>Share price</p>	<p>Any concerns over the risk of a potential stranding of the CCM asset appear not to have had a negative impact on share price. We suspect that, when it comes to valuing the CCM asset, investors seem not to apply a water-related discount.</p>



ELECTRIC UTILITIES

Exelon (USA)

 Location	Oyster Creek nuclear power station USA Barnegat Bay
 Asset stranding	Power station retired eleven years early in 2018
 Risk drivers	<ul style="list-style-type: none">▼ Tighter regulatory standards▼ Regulation of effluent discharge quality (temperature)▼ Ecological aquatic life impact▼ Community opposition

The Oyster Creek nuclear power station started commercial operation in 1969, with a 40-year license to operate until 2009. Exelon acquired Oyster Creek in 2003, as part of its acquisition of AmerGen, which in turn had acquired the plant in 1999 for US\$10 million. In 2009, the plant was granted a 20-year license extension (to 2029). However, in 2010, Exelon decided to retire the plant early after revisions to New Jersey's water-use rules would have required it to build cooling towers at an estimated cost of US\$800 million⁴⁶.

This change in the water-related regulatory position (regulatory ratcheting) and the resulting extra capital cost burden were Oyster Creek's 'stranding event', removing 10 years of extended-life optimal return.

Oyster Creek nuclear power station





ELECTRIC UTILITIES

Oyster Creek is situated on Barnegat Bay, an estuary covering 42 miles of New Jersey shoreline and home to rich marine biodiversity in several public wildlife refuges. The wider Barnegat Bay watershed is also home to 500,000 permanent residents; that number can double in the summer. The power station operated a boiling water reactor, which meant a vast amount of cooling water was required from Barnegat Bay; each day 1.4 billion gallons were drawn, used as coolant, and discharged back into the bay at substantially warmer temperatures, thus causing thermal pollution in the receiving waters. This process was linked to ecological harm such as fish and turtles being pinned against grates at the plant's water intake pipes, and fish and crab eggs killed as they





traveled through the super-heated discharge water⁴⁷. A scientific study since the decommissioning has pointed to a rebounding of populations including zooplankton, crucial for maintaining healthy ecosystems, and estuarine fish species⁴⁸.

In addition to regulation, community opposition to the water risks posed by the plant played a role in its stranding. Environmental groups had been engaged throughout the re-licensing process, and although the license was ultimately granted, their pressure contributed to the proposed requirement of building cooling towers, and the shutdown of the plant in the face of Exelon's refusal to do so⁴⁹.

Exelon financial impact summary

At the start of 2018, Exelon announced that it would cease power generation at Oyster Creek early in September 2018. Exelon completed the sale of the Oyster Creek nuclear plant to Holtec International in 2019 at a small 'immaterial' loss. Holtec and its partner are responsible for decommissioning the plant.

In terms of the financial implications to Exelon caused by the Oyster Creek nuclear facility closing earlier than expected, there are two stages of impact. The first is triggered at the time of the change in the life-expectancy of the asset (i.e., re-estimations of the income, costs, and value of the asset), and the second is during its closure (i.e., remeasurement of assets and liabilities at close).

 <p>Balance sheet</p>	<p>The most significant impact to Exelon's balance sheet was driven by the decommissioning of the nuclear power plant, with liabilities associated with the Asset Retirement Obligation (ARO) and the Nuclear Decommission Trusts (NDT) stacking up to nearly US\$1 billion⁵⁰. Compared to overall group assets and liabilities, Oyster Creek was immaterial at less than 1% of Exelon's group total, and with the subsequent sale of Oyster Creek in 2019 at slightly below book value, these assets and liabilities were removed. However, locally there has been lobbying for the sale to be reversed and for the Oyster Creek decommissioning liability to be returned to Exelon⁵¹. There are also concerns about the transfer of Oyster Creek's ownership from Exelon, a company with a market capitalization of US\$55 billion⁵², to Holtec, a relatively small limited-liability company⁵³.</p>
 <p>Profit & Loss (P&L) account</p>	<p>The overall impact on Exelon's profit & loss (P&L) statements from 2008 to 2020, as per amounts disclosed in its annual reports, sum up to roughly US\$270 million (assuming top end of range given for years 2011-15). In the context of an entity generating earnings of approximately US\$25.2 billion in the same 2008-2020 period (based on an annual historic average of US\$2.1 billion⁵⁴) this is an immaterial amount in both P&L and balance sheet terms.</p>
 <p>Debt, funding and insurance</p>	<p>Despite large capital projects carrying significant debt, minor impacts on debt funding are assumed given the Oyster Creek nuclear plant outlived its original 40-year life in 2009, and therefore minimal debt is expected at closure.</p>
 <p>Share price</p>	<p>There is little evidence to support a clear linkage between the Oyster Creek nuclear plant asset stranding and Exelon's share price performance.</p>

Although financial analysis indicates the Oyster Creek nuclear plant stranding event was not material to Exelon, it is an important example of how increasing environmental standards related to water can impact businesses. Of the 13 nuclear power stations that Exelon operates, seven are facilities that are without closed-cycle recirculating systems (i.e., cooling systems), like Oyster Creek, and therefore are at increased risk of changing regulation. Finally, while Oyster Creek is considered a lower risk end-of-life asset because it should have already delivered its budgeted returns, other assets at earlier stages of their life cycle may result in more severe financial impacts.



METALS AND MINING

Barrick Gold (Canada)

 Location	Pascua-Lama gold mine Chile/Argentina Huasco River Basin
 Asset stranding	US\$8 billion mining project permanently stranded
 Risk drivers	<ul style="list-style-type: none"> ▾ Water pollution incident ▾ Increased difficulty in obtaining operations permits ▾ Community opposition ▾ Water-related litigation

The Pascua-Lama Mining Project has been an ongoing saga for owner Barrick Gold since it acquired the project through its takeover of LAC Minerals in 1994⁵⁵. Straddling the Chilean-Argentinian border in the high Andes, concessions in the area owned by Barrick contain 21 million ounces of gold and 736 million ounces of silver⁵⁶. However, Barrick, the world's second largest gold miner, has not been able to exploit the resources and develop the project into a producing mine, due to ongoing environmental issues – primarily water-related – and an inability to obtain environmental permits.

Pascua-Lama mining project





METALS & MINING

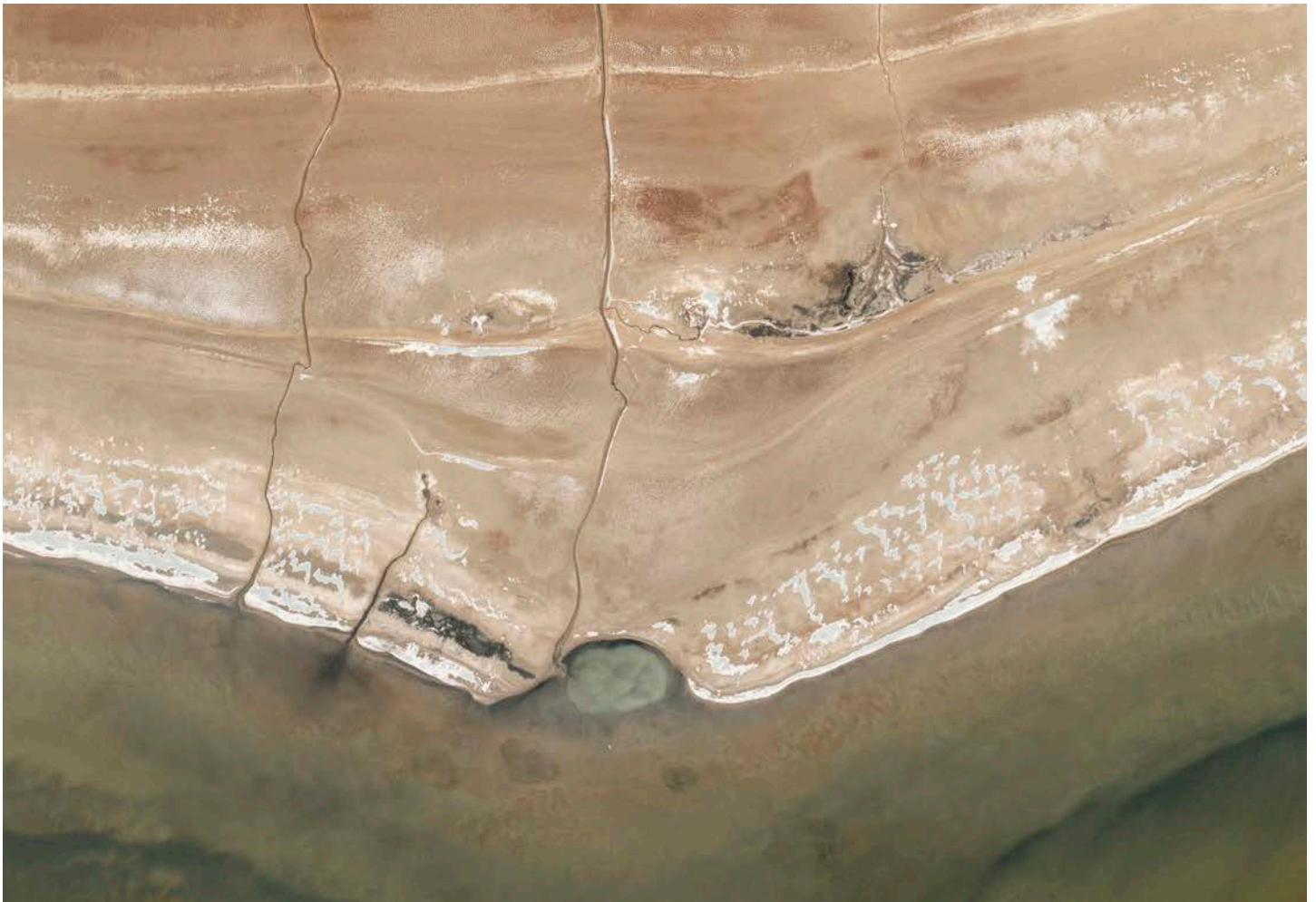
Full-scale construction and development of the mine commenced in 2004, ahead of initial environmental approval, which was granted by both Chile and Argentina in 2006. However, this decision was reversed by Chile in 2013, with the Supreme Court ordering a halt to construction and a review of the project's environmental permit. By then, estimated costs for building Pascua-Lama had risen to US\$8 billion⁵⁷; far above earlier projections.

The Supreme Court of Chile's ruling was in response to legal action taken by individuals living in the Huasco river basin, including Indigenous Diaguita communities. Meltwater from glaciers near Pascua-Lama feed the Huasco river via tributaries including the Estrecho and El Toro rivers. This water resource is relied upon for irrigation by 70,000 small-scale farmers of the fertile Huasco valley, in the otherwise arid environment of the Atacama Desert of northern Chile⁵⁸. Initial plans for the mine envisaged removing glaciers altogether to a different location, and Barrick even began referring to them as 'ice reservoirs' to de-emphasize their significance in the public's view. The court found that mining operations were contaminating the Estrecho water course and Barrick had not complied with conditions in the Environmental Impact Assessment, linked to the earlier approval, which were aimed at preventing pollution. As well as halting the project until protections could be complied with, the court handed Barrick Gold a US\$16 million fine⁵⁹.

The legal action was one part of a relentless opposition to the project, from local indigenous communities arranging organized resistance, to targeted protests striking at Barrick's headquarters in Canada. This is indicative of a wider growing environmental movement that is driving the conversation on resource extraction, bringing water demand and pollution, and impact on indigenous communities, forward in the debate on a just transition.

It is clear to see a confluence of water risk drivers led to the closure and stranding of the mine. These include water pollution incidents, community opposition, water-related litigation, and difficulty obtaining water abstraction permits.

Barrick have been fighting the case and exploring ways to make Pascua-Lama productive since Chile's decision in 2013, launching legal challenges up until as recently as 2020⁶⁰. However, the long-running story was ended in September 2020 when Chile ordered the **"total and definitive closure"** of the project⁶¹. Since acquiring the asset, an investment of US\$5 billion has been sunk into the project⁶², which is now permanently stranded, with the operations transitioning from care and maintenance to closure.





Barrick Gold financial impact summary

In terms of the financial implications to Barrick caused by the stranding of Pascua-Lama earlier than expected, there are historic and ongoing areas of impact.

- US\$7.5 billion of related cumulative write-down, but company still financially strong⁶⁴.
- Complex, ongoing tail of potential liabilities: class action, offtake, VAT, local fines.
- By the middle of 2013, Barrick's market cap had fallen to ca US\$14 billion from over US\$35 billion just two years earlier. Shares have never recovered their spark, but much of this appears due to gold sector equity sentiment.
- Spend continues as the company looks to develop Lama, the Argentinian portion.



Balance sheet

Barrick started 2013 with balance sheet assets related to Pascua-Lama of US\$6.3 billion and during the year it spent a further US\$2.2 billion of capex, taking the total invested to US\$8.5 billion. While a very significant amount, it still represented less than 20% of the company's market cap at the start of 2013.

A material (>20%) drop in the gold price in 2013 prompted a review of carrying values across the wider portfolio as a result of the impact of changing economics. This was compounded at Pascua by the environmental concerns, the temporary halt order, and the costs of addressing these.

After a valuation methodology switch, the Fair Value Less Cost to Dispose (FVLCD) was estimated at US\$1.2 billion for Pascua-Lama. The overall net result was a US\$6.1 billion write-down relating to Pascua-Lama.

The latest carrying value review was in Q4 2019, when the company concluded that it 'does not have a plan that meets our investment criteria' under its current assumptions. Following a US\$296 million related impairment charge, Pascua-Lama stated a FVLCD of US\$398 million.

The large carrying value adjustment is not necessarily a function of environmental issues, but rather due to periodic changes to long-term commodity price assumptions. For Pascua-Lama, without access to company assumption data, distilling the adjustment into gold price and environmental issues elements is impossible.



Profit & Loss (P&L) account

The company took an impairment charge of US\$6 billion in 2013. Combined with additional charges in the following years, the cumulative write-down was US\$7.5 billion. However, with a significant non-cash element to these charges, the group has consistently generated meaningful levels of operating cash flow, and too much emphasis should not be placed on the P&L numbers⁶³.

Following the decision to move the Pascua portion to 'closed' status, with corresponding write-downs taken in FY2020, there is a tail of possible contingent liabilities that may yet add to the tail of Pascua-Lama's impact on the financial performance of Barrick.



Share price

The asset impairment charges of 2013 (mainly in Q2) coincided with a large (>20%) drop in the gold price. Barrick's share price showed an even more marked drop: from over US\$40 at the end of 2011 to below US\$20 by the middle of 2013. Whereas the leverage to commodity price moves is not a surprise, the continued decline to a share price low of roughly US\$5 by 2016 is clearly linked to more than just commodity price moves. How much is attributable to the Pascua-Lama saga is more difficult to ascertain. With the gold price now well above end 2012 levels, but the shares at half the price they were at the end of 2012, there seems to have been a change of investor attitude.




OIL & GAS




Regulatory agency responsible for the water supply of more than **13 million people** voted to permanently ban gas drilling and fracking, citing "significant immediate and long-term risks" from gas extraction, saying in a resolution that drillers have "adversely impacted surface-water and groundwater resources, including sources of drinking water, and have harmed aquatic life in some regions"



In 2018 the USA produced

18% 
of global oil and

20% 
of global dry natural gas

Exploration and production companies in the oil & gas industry face two water obstacles:

- ▶ Obtaining water, and the associated license/permit, needed for drilling wells; and
- ▶ Finding a place, and securing the license/permit, to put the large volumes of wastewater that come up from the well after oil & gas is extracted.

The rapid growth in unconventional oil & gas (UOG) has made energy more available and affordable globally, but has also brought environmental concerns, especially related to water. Over the past decade there have been a large number of high-profile events during which, concerns over water have resulted in governments rescinding licenses, banning exploration and stranding oil & gas assets.

The USA makes for an interesting case to explore, particularly given that analysis in the Environmental Science and Technology publication found that water issues could constrain future energy production, especially in arid or semiarid oil plays⁶⁵.

The USA's hydraulic fracturing (HF) market size is estimated to be worth US\$18 billion⁶⁶ and consists of more than 3,000 businesses, with the biggest companies being Halliburton and Schlumberger. According to the paper, owing to UOG resource development, the USA became the largest global oil (18% of global total) and dry natural gas (20% of global total) producer in 2018, with UOG production accounting for ~60% of its domestic oil and ~70% of its domestic natural gas supplies. The rapid growth in energy supplies decreased the USA's dependence on energy imports, enhancing energy security. However, those benefits come with water-related challenges that may reduce future growth in supply and the envisioned role of the

USA in global energy markets. A total of ~95,000 horizontal wells were registered in the USA for HF through 2018. Increasing quantities of water used for HF have led to concerns about water scarcity, especially in the semiarid western United States, where the major unconventional oil plays are located.




As recently as February 2021, the Delaware River Basin Commission, responsible for the water supply of more than 13 million people, voted to permanently ban gas drilling and fracking citing "significant immediate and long-term risks" from gas drilling and fracking, saying in a resolution that drillers have "adversely impacted surface-water and groundwater resources, including sources of drinking water, and have harmed aquatic life in some regions⁶⁷."

A report from environmental non-profit Ceres⁶⁸ found that 57% of the 109,665 wells that were hydraulically fractured during 2011 and 2016 were located in regions with high or extremely high water stress, including basins in Texas, Colorado, Oklahoma, and California. The research went on to find that nine of the top 10 companies analyzed, including **Anadarko Petroleum, Apache, Encana** and **Pioneer**, operated 70% or more of their wells in regions with medium or higher water stress, suggesting that water-related obstacles to UOG exploration may continue.



OIL & GAS

TC Energy

 Location	Canada's Boreal Forest ⁶⁹ & Alberta to Nebraska
 Asset stranding	C\$5 billion ⁷⁰
 Stage of asset life cycle	Development stage
 Risk drivers	<ul style="list-style-type: none"> ▲ Increased difficulty in obtaining operations permits ▲ Community opposition (freshwater pollution) ▲ Water-related litigation ▲ Aquifer freshwater pollution

Another famous stranding event where strong community opposition forced significant regulatory changes is that of the Keystone XL Pipeline (northern portion).. The Keystone XL pipeline extension, proposed by TC Energy (then TransCanada) in 2008, was initially designed to transport tar sands oil to market. As an expansion of the company's existing Keystone pipeline system (Southern portion or Gulf coast project), which has been operating since 2010, the pipeline promised to dramatically increase capacity to process the 168 billion barrels of crude oil locked up under Canada's boreal forest. It was expected to transport 830,000 barrels of Alberta tar sands oil per day to refineries on the Gulf Coast of Texas. Tar sands oil is thicker, more acidic, and more corrosive than lighter conventional crude, increasing the likelihood of leaks. It has been estimated that the original pipeline system (southern portion) has leaked more than a dozen times since it went into operation in 2010. Complicating matters, leaks can be difficult to detect and more difficult to clean-up than conventional crude. People and wildlife coming into contact with tar sands oil are exposed to toxic chemicals, and rivers and wetlands are at particular risk from a spill.

Keystone XL pipeline extension



Sources: keystonexl.com



OIL & GAS

In 2021, TC Energy posted a
C\$2.51 bn
loss from its oil pipelines

The Keystone XL pipeline extension (northern portion) was to traverse Nebraska's Sandhills region. Concerns that a pipeline spill could threaten the Ogallaia aquifer prompted widespread protests. This and indigenous land concerns delayed the approval process. As a result, this decade-long US\$9 billion project became the epicenter of environmental protests, drawn-out legal battles, and flip-flopping executive orders spanning three presidential administrations⁷¹. In April 2020, a critical water permit for the pipeline was withdrawn by a federal US judge and in June 2021⁷², the project's corporate backer—the Canadian energy infrastructure company **TC Energy**—formally cancelled the project following President Joe Biden's denial of a key permit on his first day in office. TC Energy swung to a loss in the first

quarter, hit by C\$2.2 billion (US\$1.81 billion) impairment charge related to the suspension⁷³. According to Reuters⁷⁴, the company posted a C\$2.51 billion loss from its oil pipelines in March 2021, of which Keystone is the biggest contributor, compared with a C\$411 million profit in the same period the previous year.

While the final nail in the coffin was the loss of a cross-border permit, there is very clear evidence that community concerns relating to freshwater contamination played a significant part in temporarily stranding the asset while the political wrangling played out. Community sentiment towards such projects remains hostile and is likely to worsen as concerns over climate change and the destruction of freshwater resources grow.





TC Energy Financial Impact Summary^{75, 76}

In 2015 and 2021, the financial implications for TC Energy include

C\$5 bn

of related cumulative write-downs

Hit by two rounds of write-downs, in 2015 and 2021, the financial implications for TC Energy (previously TransCanada Corporation) as a result of the stranding of the of the Keystone XL pipeline include:

- ▼ C\$5 billion of related cumulative write-downs,
- ▼ A year-long decline in the share price ahead of being denied a permit in 2015.
- ▼ It seems like the write-downs have not had a major effect on the company's financials. Despite a 2015 dip, it has continued to receive blue chip bank, investor and local state government support.



Balance sheet

In December 2015, as a result of the denial of the USA presidential permit in November 2015, TC Energy evaluated its investment in Keystone XL and determined that the balance sheet carrying amount of C\$4.3 billion (C\$3.2 billion at end 2014 plus spend in 2015) far exceeded its fair value of C\$621 million (estimated sale value). This led to a write-down of C\$3.7 billion pre-tax or C\$2.9 billion after tax.

While the amounts involved are substantial, in a group context the 2015 write-down accounted for only 5% of start of year group assets of C\$58 billion. The equity hit was however more material; equivalent to 15% of opening equity, resulting in a year-on-year drop in equity value to C\$16 billion. This and continued balance sheet expansion led to a more marked increase in financial leverage.

With a more supportive political backdrop in place, construction of Keystone XL recommenced in 2020. However, the withdrawal of the USA presidential permit in early 2021 prompted a decision to terminate the project and a reversion to a valuation based on the sale value of assets. In this instance, a valuation of C\$526 million net of contractual recoveries and legal obligations compared to a carrying value of C\$3.3 billion. This led to a write-down of C\$2.8 billion pre-tax or C\$2.1 billion after tax.

While the amounts involved are still substantial, with the balance sheet having nearly doubled in size by 2020, the Keystone XL write-down of 2021 resulted in a more modest impact; a 2% hit relative to opening assets and a 7% hit relative to opening equity. This is on the verge of immaterial and illustrates the benefit that large companies have in taking on projects of a riskier nature.



Profit & Loss (P&L) account

The 2015 Keystone XL net impairment of C\$2.9 billion resulted in a full year loss of C\$1.2 billion. While still profitable in 2021, the Keystone XL C\$2.1 billion net impact led to a 59% drop in reported earnings. In profit and loss account terms, both write-offs were material events. In contrast, cash generation, a key value creation metric, remained largely unaffected.



Debt, funding and insurance

The Keystone XL driven loss of 2015 caused a 14% year on year drop in shareholder equity to C\$16 billion in 2015. This and a 21% increase in net debt from C\$28 billion (2014) to C\$34 billion (2015) led to an increase in leverage (net debt/equity ratio) to rise from below 1.5x (146%) in 2014 to over 2.0x (209%) in 2015. In general, a company with excessive leverage, demonstrated by its high gearing ratio, could be more vulnerable to economic downturns than one that is not as leveraged⁷⁷.

With an expanded balance sheet, the impact in 2021 was more modest, with the Keystone write-down of 2021 causing a modest tick-up in net gearing from 153% to 157% (1.6x). Asset backing has remained strong throughout 2014 to 2021 (typically, at 2.0x), aside from a blip to 1.8x in 2015, again linked to the asset write-down in that year.

This financial robustness has, despite the significant publicity linked to Keystone XL, led to ongoing support by leading financial institutions and in 2020, with the support of the Government of Alberta, a Keystone XL specific project loan facility was arranged⁷⁸.



Share price

Our examination of TC Energy's share price at the time of key events relating to Keystone XL points to some, but only limited, single digit, impact in 2015. Over the year leading up to the denial of a USA presidential permit, which effectively put an end to the project, we note a continued period of underperformance, culminating in a 4% drop at the time of the permit denial in November 2015.

PREPAREDNESS OF RESOURCE MAJORS FOR WATER-STRANDING EVENTS

The case studies demonstrate that water-related issues have already stranded assets across the coal, electric utilities, metals & mining, and oil & gas sectors. They illustrate that community opposition and shifts in water-related regulation are real and are having significant implications for firms, particularly at the project level.





With water insecurity set to grow and with it, increased community and regulatory scrutiny, it is clear that a lack of access to a stable supply of water will threaten the growth plans for these sectors if business-as-usual approaches to water management and business planning are followed.

This section delves into sector-specific water data disclosed to investors via CDP in 2021, to establish whether or not resource majors are well placed to manage the risk of assets becoming stranded as a result of water risk factors. We have adopted a traffic light system to indicate sensitivity to each risk factor⁸⁰.

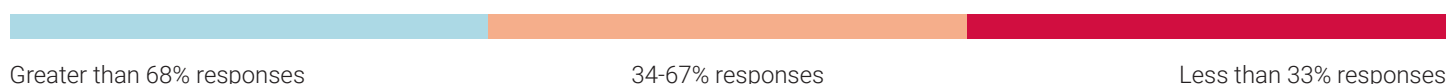
Are they aware?

When companies disclose via CDP, each is asked to disclose whether they are considering water-stranding risk factors in their water risk assessments. Analysis of this data is somewhat encouraging, showing that most of the resource majors seem to be considering relevant water-stranding risk factors in their risk assessments for their operations, while to a lesser extent on their key raw materials and commodities (Table 2). Oil & gas majors present cause for concern, appearing not to consider water-stranding risk factors in risk assessments as frequently as other resource majors.

Table 2. Water risk assessments responses from resource majors

Water-stranding risk factors always considered in water risk assessments	 COAL	 ELECTRIC UTILITIES	 METALS & MINING	 OIL & GAS
Access to fully-functioning, safely managed WASH ⁷⁹ services for all employees	Light Blue	Light Blue	Light Blue	Orange
Implications of water on your key commodities/ raw materials	Orange	Orange	Orange	Orange
Stakeholder conflicts concerning water resources at a basin/catchment level	Light Blue	Light Blue	Light Blue	Orange
Status of ecosystems and habitats	Light Blue	Light Blue	Light Blue	Light Blue
Water availability at a basin/catchment level	Light Blue	Light Blue	Light Blue	Orange
Water quality at a basin/catchment level	Light Blue	Light Blue	Light Blue	Orange
Water-related regulatory frameworks	Light Blue	Light Blue	Light Blue	Light Blue

Note: Responses to addressing contextual issues (W3.3b_C1) from 6 coal, 70 electric utilities, 61 metals & mining and 52 oil & gas companies.










PREPAREDNESS OF RESOURCE MAJORS FOR WATER-STRANDING EVENTS


Are they exposed?

Importantly, CDP also asks companies to provide detailed information relating to each water-stranding risk factors and the corporate response to it. This data includes risk location, driver, impact, magnitude, timeframe, likelihood, and response.

Twenty five percent of resource majors report exposure to water-stranding risk factors that could close operations, disrupt production capacity, and/or constrain growth (i.e., coal 5%, electric utilities 37%, metals & mining 40%, and oil & gas 18%). Below, we map the magnitude of impact of each dominant risk factor driving these outcomes.

Table 3. Magnitude of substantive risk factors across four sectors

Water-stranding risk factors - magnitude		 COAL	 ELECTRIC UTILITIES	 METALS & MINING	 OIL & GAS
 Physical	Increased water stress	High	High	High	No data
	Increased water scarcity	No data	High	High	Medium
	Drought	High	Medium	High	No data
	Flooding	Medium	Medium	High	High
	Declining water quality	No data	High	No data	No data
	Severe weather events	No data	High	High	Medium
 Regulation	Statutory water withdrawal limits/changes to water allocation	High	Medium	Medium	High
	Tighter regulatory standards	No data	No data	High	No data
 Reputation & markets	Community opposition	No data	No data	Medium	No data



No data Low-magnitude impact Medium-magnitude impact High-magnitude impact

PREPAREDNESS OF RESOURCE MAJORS FOR WATER-STRANDING EVENTS

Points worth noting:

- ▼ The coal sector provided very limited data in response to this data request.
- ▼ While acknowledging that increasing water stress and scarcity are high-magnitude risk factors, electric utility firms seem to perceive regulatory responses to these, in the form of statutory water withdrawal limits or tighter regulatory standards, as having limited impact.
- ▼ Respondents in the electric utilities and metals & mining sector perceive changes in water allocation to present low magnitude risks, interesting given it was precisely this risk factor that led to the stranding of the Oyster Creek nuclear facility and Pascua-Lama gold mine.
- ▼ The four sectors perceived reputational risk (community opposition) to be of low magnitude or did not provide responses. Interesting given the significant role this risk factor played in the stranding of assets in the case studies.

It is important to note that the mapping above reflects the magnitude of risks as perceived by the companies themselves. Perception is informed by the comprehensiveness of the water risk assessment process carried out. CDP's analysis suggests that, with the exception of the oil & gas majors, the risk assessment processes many respondents are pursuing

do account for material water-stranding risk factors (Table 2). However the perception results in Table 3, particularly around community opposition and tighter regulatory standards appear at odds with the real-world examples presented earlier. Further research in this area would no doubt elucidate further insight on these discrepancies.











PREPAREDNESS OF RESOURCE MAJORS FOR WATER-STRANDING EVENTS

When will they be affected?

Many of these risk factors are anticipated to play out over a variety of time scales. Table 4 shows the anticipated timeframes of each risk factor as reported by the companies themselves.

Table 4. Average anticipated timeframes of realization of water-stranding risk factors

Water-stranding risk factors - timeframe of realization		 COAL	 ELECTRIC UTILITIES	 METALS & MINING	 OIL & GAS
 Physical	Increased water stress	Medium term (4-6 years)	Medium term (4-6 years)	Medium term (4-6 years)	No data
	Increased water scarcity	No data	Medium term (4-6 years)	Medium term (4-6 years)	Medium term (4-6 years)
	Drought	Medium term (4-6 years)	Medium term (4-6 years)	Medium term (4-6 years)	Short-term (0-3 years)
	Flooding	Short-term (0-3 years)	Short-term (0-3 years)	Medium term (4-6 years)	Short-term (0-3 years)
	Declining water quality	No data	Short-term (0-3 years)	Short-term (0-3 years)	No data
	Severe weather events	No data	Short-term (0-3 years)	Short-term (0-3 years)	Short-term (0-3 years)
 Regulation	Statutory water withdrawal limits/changes to water allocation	No data	Medium term (4-6 years)	Short-term (0-3 years)	Short-term (0-3 years)
	Tighter regulatory standards	Short-term (0-3 years)	No data	Medium term (4-6 years)	No data
 Reputation & markets	Community opposition	No data	No data	Short-term (0-3 years)	No data



No data
 Long term (>6 years)
 Medium term (4-6 years)
 Short-term (0-3 years)

PREPAREDNESS OF RESOURCE MAJORS FOR WATER-STRANDING EVENTS

Points worth noting:

- ▶ Water-related regulatory responses are perceived, in particular changes to water allocation and withdrawal permits, as medium-to-long term issues for all resource majors. This is despite evidence of regulatory shifts stranding assets within all sectors across a range of geographies.
- ▶ The same can be said of community opposition, again a risk driver by all resource majors as a risk factor that they cannot afford to wait to address.
- ▶ Coal firms seem unable to identify a timeframe for a large proportion of water-stranding risk factors. In part, this may be due to a lack of robust data, but does suggest that there may be further short-term risks currently unaccounted for.

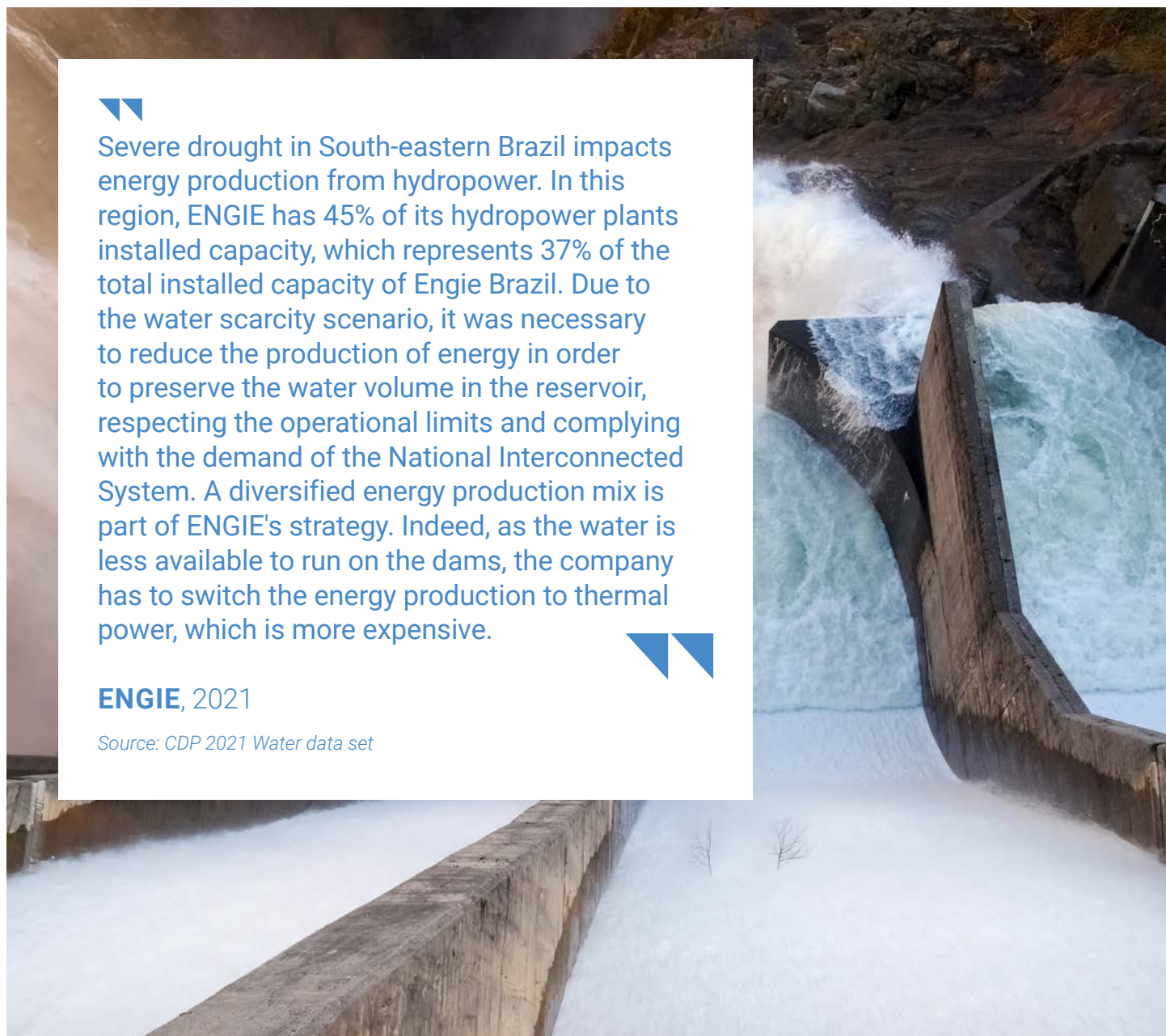


Severe drought in South-eastern Brazil impacts energy production from hydropower. In this region, ENGIE has 45% of its hydropower plants installed capacity, which represents 37% of the total installed capacity of Engie Brazil. Due to the water scarcity scenario, it was necessary to reduce the production of energy in order to preserve the water volume in the reservoir, respecting the operational limits and complying with the demand of the National Interconnected System. A diversified energy production mix is part of ENGIE's strategy. Indeed, as the water is less available to run on the dams, the company has to switch the energy production to thermal power, which is more expensive.



ENGIE, 2021

Source: CDP 2021 Water data set



AVOIDING STRANDED ASSETS

In a world where extreme weather events are increasingly frequent, assets are more likely to be stranded than not.

Water-related regulatory responses, in particular changes to water allocation and withdrawal permits, are perceived as medium-to-long term issues for all resource majors. Indeed, as the case studies make evident, water security is no longer a small, plant-level operational concern for these companies but has become a strategic question for senior management.

In some cases, companies may be able to engineer solutions that secure their own water needs; indeed, in many circumstances, it is likely that technological innovation and material capital expenditure may be the saviors of these sectors.

Since 2011, companies have spent more than US\$84 billion worldwide to improve the way they conserve, manage, or obtain water⁸¹. This trend suggests that the issue will capture a larger part of the capital expenditure bill at many companies.

The US\$283 billion global water market⁸² – covering everything from water treatment plants to pipelines – is projected to reach a value of almost US\$500 billion by 2028 at a compound annual growth rate (CAGR) of 7.3% in the 2021 to 2028 period. But it is growing much faster in some industries: as high as 14% a year for the oil & gas sector and 7% for the food & beverages industry.

The water for mining market is currently experiencing a wave of investment as new mine developments, increased production of key commodities, and operational challenges force miners to focus on their water-related activities. Global Water Intelligence (GWI)⁸³ estimates water-related capital expenditures for the

mining industry will reach US\$11.2 billion in 2021, up US\$740 million on the previous year. At the end of 2019, Rio Tinto declared closure provisions of US\$11.1 billion, an increase from US\$10 billion the year before, demonstrating the large amount of capital being spent on asset closure and planning. Following incidents in Brumadinho (Brazil, 2019), Samarco (Brazil, 2015), and Mount Polley (Canada, 2014), mine tailings have come to the public eye as a major safety and environmental issue within the mining industry. Following these disasters, the world's largest mining companies have released information on the integrity and safety of their dams, with Vale SA, the world's largest producer of iron ore, setting aside US\$1.9 billion to decommission mine-waste sites, just within Brazil's Minas Gerais state.

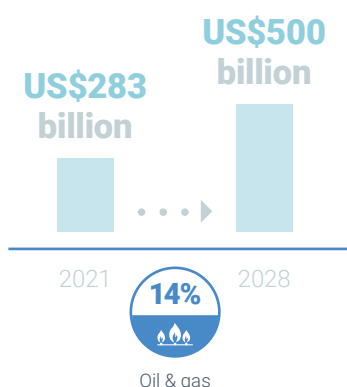
As our analysis so far suggests, miners are not the only ones at risk. Regulators in many markets where oil & gas groups, food & beverage companies, chemicals firms and others operate are revisiting, re-evaluating and re-positioning water management regulations, often tightening requirements, and thus increasing the costs of compliance for companies operating in or buying from these markets. In the past, companies undertook a project and spent more money on water if a problem later arose. Now, as demonstrated with Barrick Gold, they have to establish a plan that demonstrates how they will not affect local water supplies over the lifetime of the project before they can start operating.

For miners at least, the result is that **“projects will take longer to complete, be costlier and riskier, with credit-negative implications for the entire industry”** according to Moody's Investors Service⁸⁴.



The global water market

is projected to reach a value of almost US\$500 billion by 2028. It is growing much faster in some industries.



Despite successful efforts to manage water usage more efficiently, mining companies face substantial headwinds when it comes to securing reliable sources of water⁸⁵



AVOIDING STRANDED ASSETS

The International Energy Agency's World Energy Outlook 2021 (Figure 3) demonstrates that the share of energy supply infrastructure in high water stress areas is set to increase. Their research showcases that around one-third of global refining capacity is currently located in high water stress areas, with this share set to increase to 55% by 2040. Over 40% of freshwater-cooled thermal and nuclear fleets are projected to be in high-risk areas by 2040. And over half of today's global copper production is concentrated in high water stress areas, a situation that looks set to remain in the future.

Resource majors that hope to thrive in such a future must consider how they can grow differently so that dependence and impact upon this irreplaceable and finite resource is minimized. Companies that fail to take a comprehensive stewardship approach – that is, one that considers and addresses the context within which a company's water use and discharge takes place – may be overlooking substantive (future) risks, and missing opportunities.

WRI's research

WRI's research⁸⁶ of Indian thermal power companies found that water shortages caused electricity generation outages that resulted in quarterly impacts to earnings as high as 17.4% from FY 2014-2017. Thermal energy, which constitutes more than 70% of India's total electricity generation and 60% of its installed power capacity, is highly dependent on freshwater for cooling, with the industry growing thirstier. Projections show that more than two-thirds of the country's power plants will face high water stress by the end of the decade.

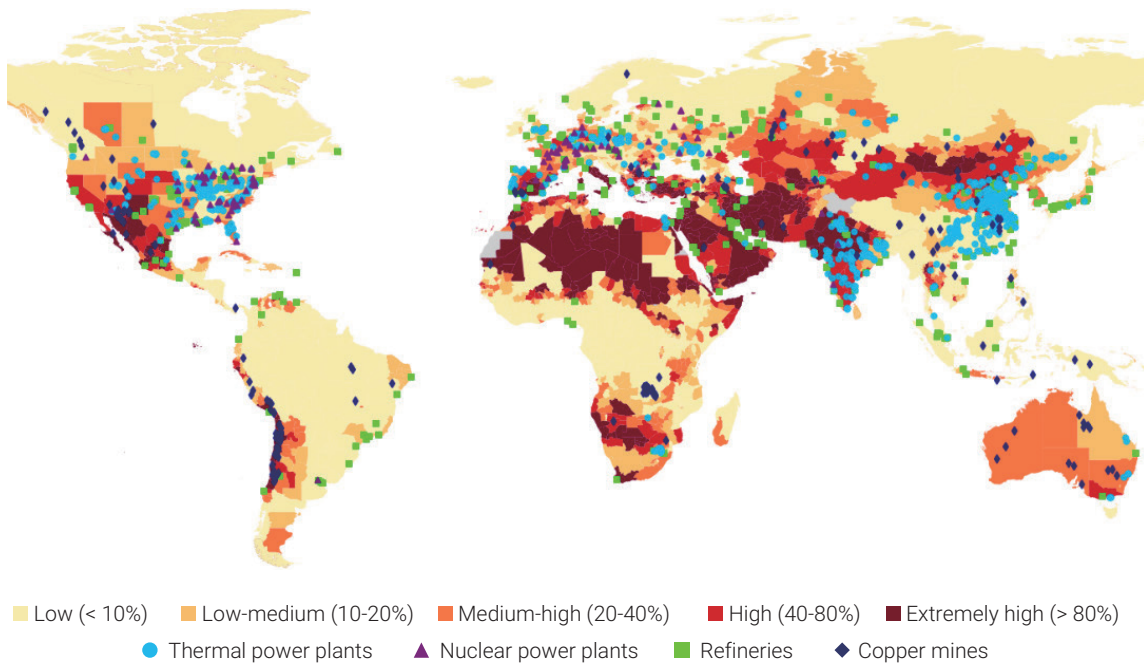
In 2016, during one of the country's worst droughts, water-related outages in thermal power plants were enough to cover the annual demand of Sri Lanka, costing utilities billions in lost revenue. Since then, and despite years with more precipitation, data from India's energy ministry show that between 2017 and 2021, there have been approximately 8.2 terawatt-hours (TWh) in lost energy production due to a lack of water. That's enough electricity to power 1.5 million Indian households for five years.

With 40% of India's thermal power plants located in water scarce areas, forward-looking climate scenarios project significant uncertainties in India's future water availability. Stress-testing thermal power companies' exposures to water risks is essential to ensure prudent investment decisions.

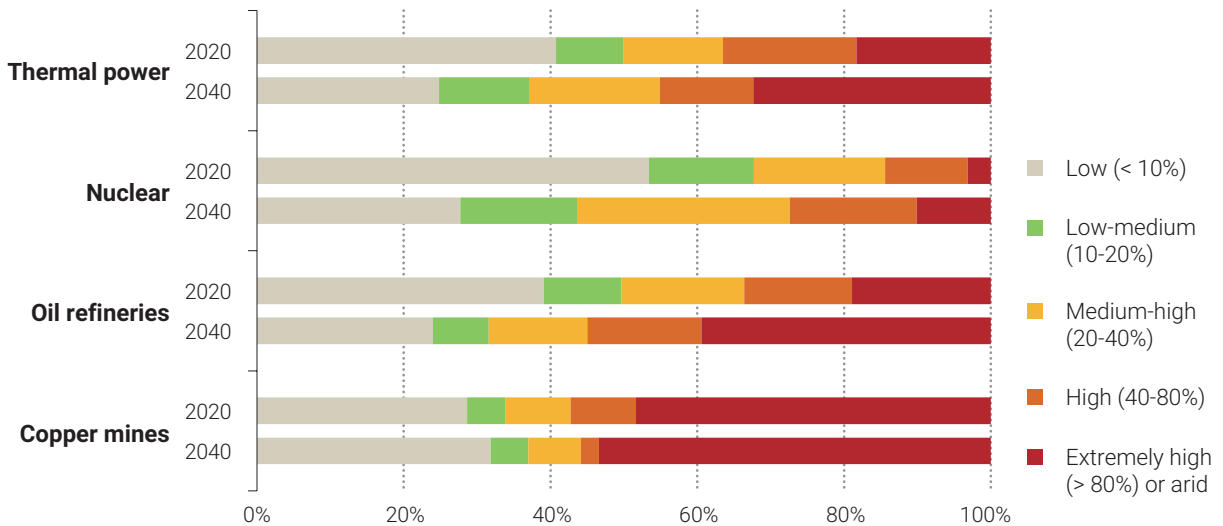
AVOIDING STRANDED ASSETS

Figure 3: Water Stress exposure of freshwater – cooled thermal and nuclear power plants, refineries and copper mines⁸⁷

Location of selected energy-related infrastructure and water stress levels, 2020



Share of capacity by water stress level



IEA. All rights reserved.

The share of energy supply infrastructure in high water stress areas is set to increase as changing precipitation affects water availability in many regions.

Notes: Water stress levels are as defined in the Aqueduct 3.0 dataset according to the ratio of total water withdrawals over the total available surface and groundwater supplies. In the bottom chart, power plants include those estimated to use freshwater cooling and the share of copper mines is based on production.

Source: IEA analysis based on WRI Aqueduct 3.0 (2019) and S&P Global (2021).

IMPLICATIONS FOR FINANCIERS

The financial system is exposed to resource majors and, therefore, to water-stranding risks via a plethora of arrangements including equity and debt holdings as well as loan financing underwriters. It is essential that relevant financial institutions understand their exposure and take steps to mitigate the risks that water-stranding events negatively impact their financial performance.

To support this endeavor, we have identified those i) Global Ultimate Owners (GUOs), ii) Funders, iii) Bond holders, and iv) Underwriters (for loan financing) most closely linked with the 42 largest resource majors (**Appendix B**). Our analysis found that the largest concentration of risk lies within big global asset managers and governments through their shareholdings, whereas the exposure related to lending activities is spread among the large global banks.

For example, our analysis of GUOs found that the single largest holder of equity is not surprisingly the Kingdom of Saudi Arabia, with its holding in Saudi Arabia Oil Co of US\$1.8 trillion. This is more than six times the second largest shareholder, the Chinese government, and 40 times larger than the correspondent holdings of France. To ease analysis of the research, we have removed the Kingdom of Saudi Arabia from the graph in **Figure 4⁸⁸** which shows that **BlackRock, Vanguard** and **State Street** are the asset managers with the largest exposure to resource majors (e.g., Blackrock has a combined US\$28.5 billion in Exxon Mobil and Chevron, and Vanguard a combined US\$37.5 billion in Exxon Mobil and Chevron), while the Chinese government holds US\$143 billion in PetroChina Co Ltd. Most of these holdings are managed under passive mandates.

Looking at bond holdings (**Figure 5**), **Vanguard** and **BlackRock** once again stand out, with each holding more than double the amount of the third largest bondholder. The value of their bond holdings is about 5% of that of their shareholdings in these sectors.

Figure 5 shows that Citigroup, Deutsche Bank AG and **JP Morgan Chase & Co** are the top financiers. **E.ON SE** (power generation) receives their top financing with a combined US\$180 billion.

Figure 6 refers to underwriters (i.e., which financial institutions are facilitating the financing of these sectors). The importance of the debt maturity/refinancing distribution is that it indicates whether central banks, policymakers or NGOs can influence those financial institutions which finance the companies in these sectors. For example, if all debt maturity was in 10 years' time, there is little the banks can do about their exposure as they are locked into 10-year contracts (they could try selling on this exposure but would probably have to take a financial penalty to do so). On the other hand, if there are many loans maturing in a few years, then this can be highlighted to the banks, and they should be reminded about water-stranding risks. In this latter case, the issue of stranding will be more relevant to the banks as they consider their own debt negotiations in these sectors. In this chart, it shows that over the next five years a lot of financing arrangements will be discussed in these sectors (US\$185 billion bonds and US\$142 billion loans). Therefore, while the debt carried by financial institutions from companies having water-stranding risk may have limited effect in the short-term, companies in the four majors shall be seeking refinancing in the medium to long term. Financial institutions should therefore consider water risk due diligence in their assessments.

The financial analysis in this section seeks to raise awareness of the potential implications for the top global financial institutions of investing in the resource majors, given their exposure to water-stranding risks, and thereby the need to incorporate water risk management in their portfolios. The concentrated equity investments suggests that action by just a small number of shareholders, (e.g., by exercising voting rights), could have a significant impact in driving resource majors to value water appropriately. However, most of these holdings are managed under passive mandates, a growing market considered incompatible with sustainability integration⁸⁹. Given bond holdings in the sectors are more spread out, a critical mass of financial institutions acting on water and driving improvements with resource majors is needed and could deliver significant outcomes for a water secure future.

IMPLICATIONS FOR FINANCIERS

Figure 4. Top 20 global ultimate owners (GUOs) by active vs passive holdings (US\$ million)

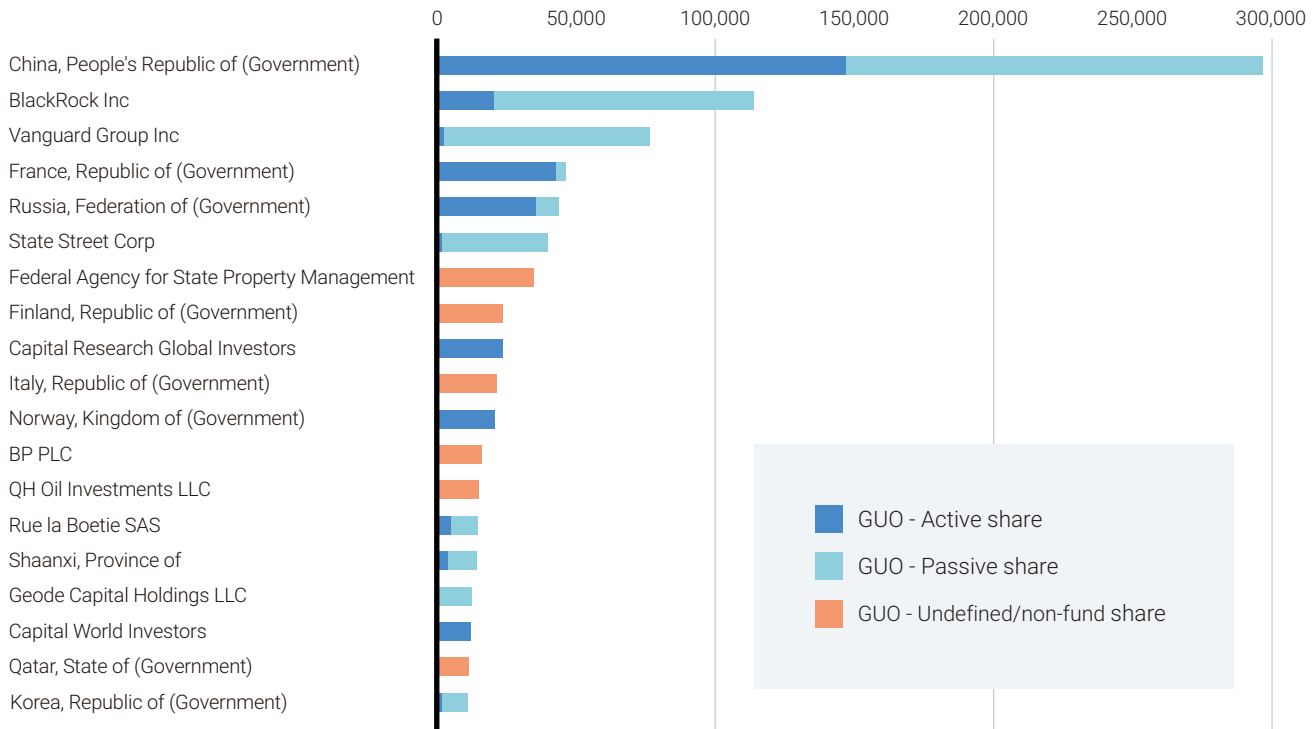
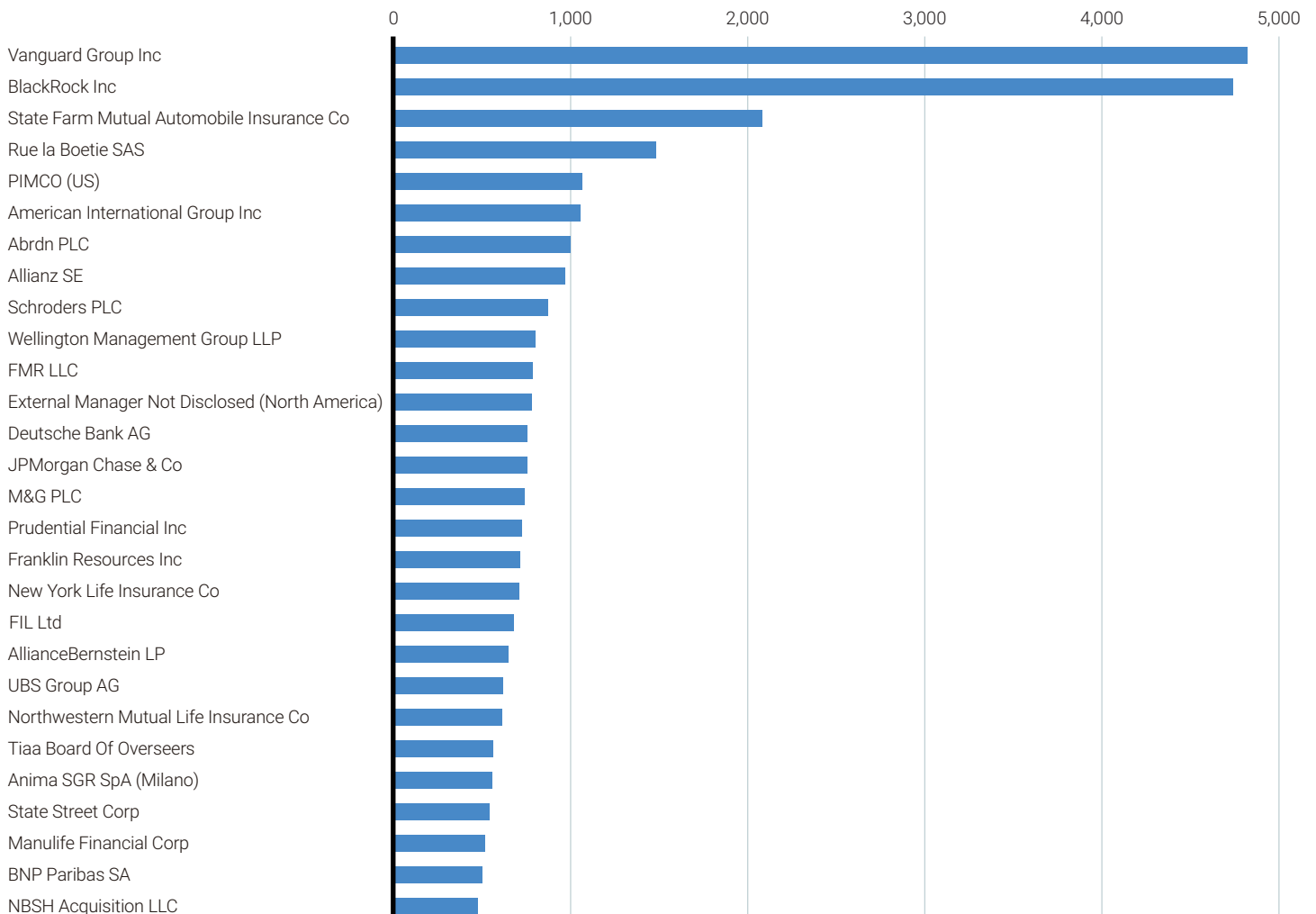
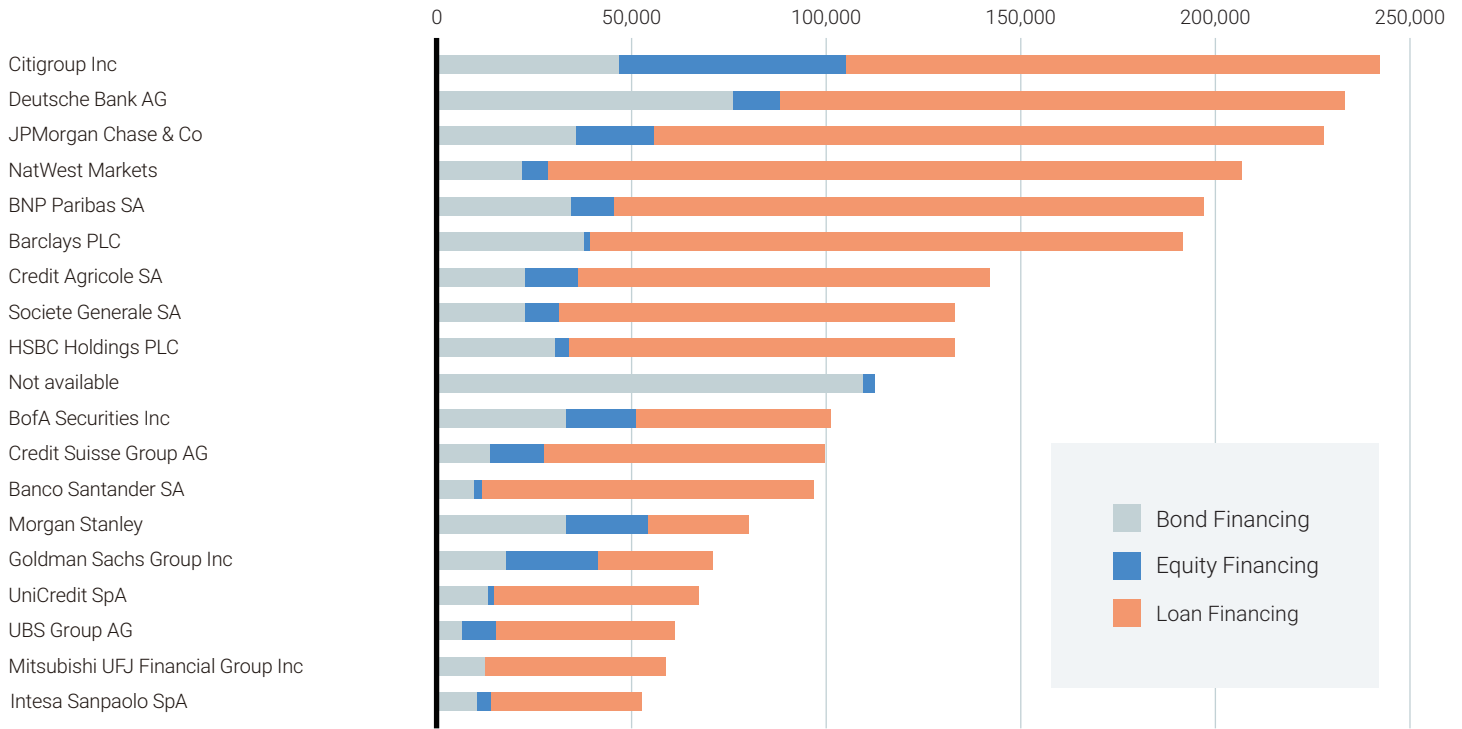


Figure 5. Top 28 global ultimate owners (GUOs) - debt holders by holdings (US\$ million)



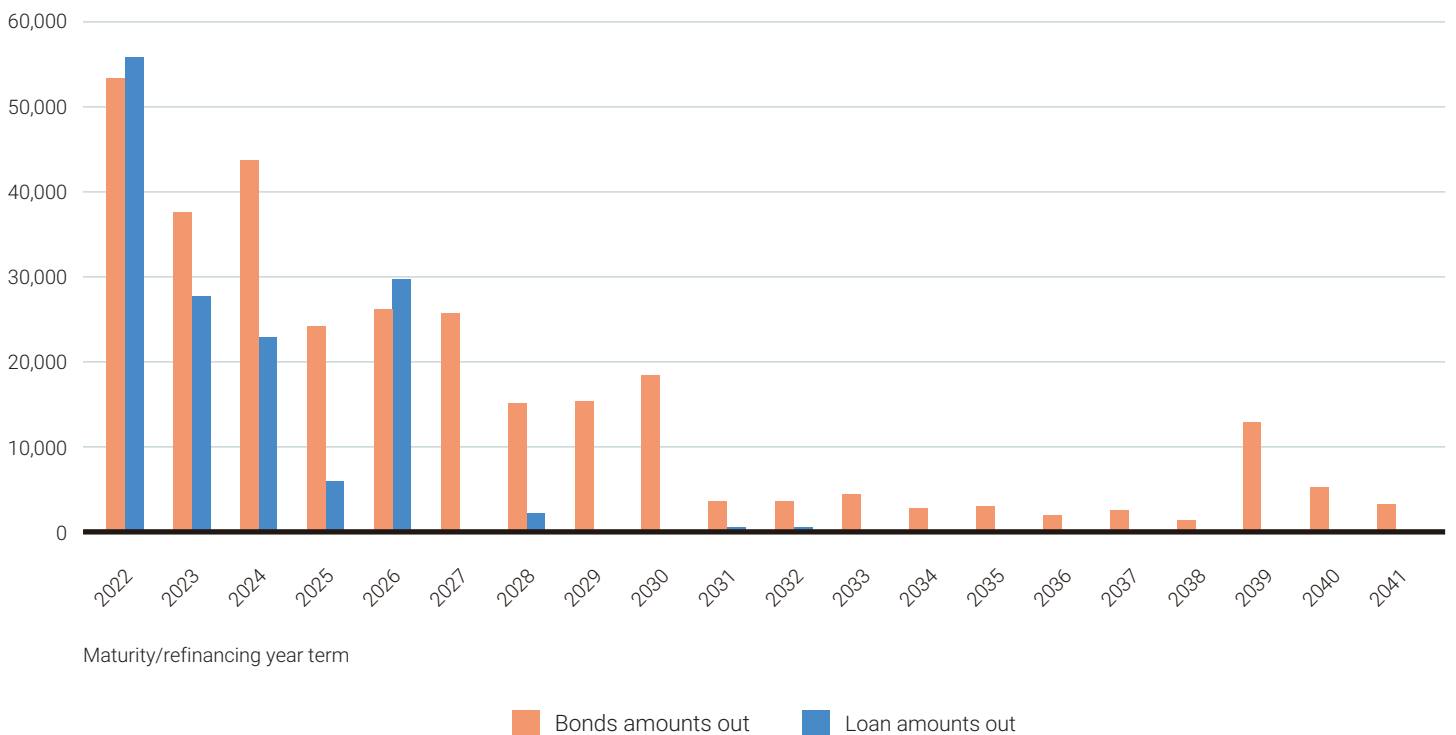
IMPLICATIONS FOR FINANCIERS

Figure 6. Top 20 financiers by amount underwritten in last 10 years (US\$ million)



Note: The top financiers are unknown (have been removed from graph) – their total financing constitutes US\$599 billion (loans, bonds, and equity). The total financing of these group (excluding unknown and not available) is US\$2.4 trillion.

Figure 7. Debt maturity/refinancing distribution (US\$ million)



Note: The outstanding amount for Total bonds is US\$302.7 billion and for Total loans is US\$145 billion

ACTIONS FINANCIAL INSTITUTIONS SHOULD TAKE

This report marks the fourth in a series commissioned by the Swiss Federal Office for the Environment (FOEN) to advance the methodological development of tools and metrics to enable financial institutions to accelerate the transition to a resource-efficient economy, nationally and internationally, including the management of water resources.

The first study, conducted by South Pole, provides an overview of the available tools, databases and methods to assess water risks for the real economy and the financial market⁹⁰. The second presents a holistic methodology to quantitatively assess water risks in an equity portfolio⁹¹. And the third aims to support investors to engage with investees to achieve SDG 6 through river-basin water security⁹². All reports align on the fundamental principle that water risks are not only material for the real economy, but they

also lead to implications in the financial system due to decreased revenues and increased costs within invested companies, and interdependency of affected financial institutions. This report has clearly demonstrated that this is the case and as such financial institutions must move now to identify, disclose, assess, and manage water risks across portfolios and loan books to avoid the worst consequences of the water crisis and contribute to actively stemming it.



Assess risks and impacts

In response to the increasing awareness surrounding the interaction between water risks and the financial system, several tools and methodologies to enable financial institutions to assess water risks and impacts are emerging. Many of these methods take a stepped approach, starting with water risk assessments at the portfolio level and narrowing in on companies within the portfolio that constitute high-risk holdings.

For example, a recent report by the Stockholm International Water Institute⁹³ provides guidance for investors assessing water risk in their portfolio. First, a materiality assessment is conducted at the industry and sub-industry level, using tools such as Water Watch - CDP's Water Impact Index⁹⁴ – to identify industries in the portfolio that have a material water impact or risk. Assessing impact as well as risk is critical given the two are strongly interlinked and impacts must be addressed to create change on the ground. Once priority industries and sub-industries have been identified, equity or company-based assessments can then be conducted utilizing CDP Water Scores and/or Sustainalytics' ESG Risk Ratings data.

An alternative guide developed by South Pole⁹⁵ is unique as it links equity portfolios and water risks with a geographical component

for the first time. Including local context in assessments is crucial as water issues and risks vary depending on local factors, including geography. The methodology also takes a stepped approach, starting with portfolio water risk analysis that combines top-down industry-based analysis with bottom-up geographical risk information. The second step is water risk analysis of individual stocks. To effectively manage and better understand companies associated with high water risks, investors need to consider more granular data and should, therefore, analyze water risks at an individual stock level using, for example, CDP's corporate water data set.

These methodologies, alongside the growing number of tools designed for the financial sector, serve as important resources for financial institutions on their journeys in assessing water risks and impacts. Assessments at the portfolio level are useful in understanding the aggregated water risks, highlighting areas of the portfolio for deeper analysis, and providing the basis for financial institutions to align their portfolios with global water targets or goals. Assessment of water risk at the company or stock level is highly relevant in determining the basis for engagement with portfolio companies and identifying where enhanced policies are required.

ACTIONS FINANCIAL INSTITUTIONS SHOULD TAKE



Disclose

Disclosure is a critical step in understanding and managing water risks. A study by Banque de France showed that investors subject to climate reporting reduced their financing of fossil fuels by 40%⁹⁶. This is proof of the powerful impact that disclosure can have on real-world outcomes. To date, water-related disclosure has been the remit of industrial water users, in particular those sectors that form the focus of this report. Financial institutions have been the beneficiaries of the data provided and have not needed to disclose the steps they are taking to manage this risk across their portfolios, loan books or underwriting. Given the scale of the challenge before us and the potential to trigger substantive real-world outcomes, regulators are moving to address this and are exploring ways in which current climate-related reporting policies can be adapted to incorporate water. To aid the market in preparing for this change, CDP will issue its first ever water-related information request to over 1,200 publicly listed financial institutions. It is hoped that the process of disclosure will catalyze dialogues and action on water that, to date, have been nascent within the sector, and that the data disclosed will be used to make more informed capital-allocation decisions.

This disclosure request is now publicly available to view at the end of the [Climate Change 2022 questionnaire](#) alongside [reporting guidance](#). Companies will be asked to disclose the following:

- ▶ Governance of water-related issues, including establishing board-level oversight;
- ▶ If and how they assess their portfolio exposure to water risks and opportunities;
- ▶ How water-related issues are incorporated into the organization's business strategy, e.g., establishing water-related requirements for clients/investees via their policy framework or launching financial products that support water security;
- ▶ Their engagement strategy with clients and investee companies on water-related issues; and
- ▶ If and how they assess and measure the organization's portfolio impact on water security.



Manage risks across portfolios and loan books

Engagement is one of the most effective strategies to influence clients and investees. A report by South Pole lays out clear steps that financial institutions can employ to drive positive impact via engagement⁹⁷.

When developing an engagement strategy, financial institutions should clearly communicate their approach and commitments to fostering water security. External disclosure of the water-related policy is key in holding companies accountable. The engagement policy should be closely aligned with the investment policy, and financial institutions should consider including their expectations of clients or investees as they relate to promoting water security.

When it comes to the engagement itself, this can be done by interacting directly with clients/investees or indirectly, for instance by exercising voting rights. Either way, the primary aim is to communicate the need for companies to understand and disclose their water risks and work strategically to minimize impact. Given water-related data availability and quality challenges, one of the most fruitful pathways for engagements is to advocate for increased transparency and disclosure⁹⁸. Water-related transparency is a fundamental step in avoiding the risk of water-

related stranded assets and the reasons are straightforward. Less information means less certainty for investors. When a company is not transparent about how it is addressing water-security issues, investors can never be sure about a company's real fundamentals and true risk. For instance, a firm's growth prospects are intrinsically tied to its ability to secure reliable access to a stable supply of water; to its efforts to eliminate pollution and avoid infrastructure failings; not to mention its success in gaining and maintaining the trust and confidence of the local communities housing each asset. How the firm accounts for water issues in its growth strategies and whether it invests in solutions is vital information. It is difficult, if not impossible, to evaluate a company's investment performance if its investments in, and governance of, water security issues are hidden from view. Financial institutions should put pressure directly on their portfolio companies, and can also become a signatory to CDP to support enhanced water disclosures.

Finally, measuring the impact of engagement is a crucial step in ensuring engagement is having positive impacts on water resources. Financial institutions should consider defining meaningful metrics and targets, both quantitative and qualitative, to assist with this process.

CONCLUSIONS

The aim of this report is to present an outline of the water risks to companies, and the financial institutions that finance/insure them, from increasing water insecurity and the potential for stranded assets.

Our analysis indicates that resource majors have already experienced water-related stranding events and are exposed to a variety of risk factors that may lead to a repeat of these events into the future. These risks are driven by the physical effects of worsening water security, the impacts the companies themselves have on water security, and the regulatory, community, and civil society response to this.

There are five main conclusions that we emphasize:

- ▶ Water risk factors include already-stranded assets throughout the coal, energy, metals & mining, and oil & gas sectors.
- ▶ The exposure of the financial sector to water-stranded assets is real and often exposed to a tail of potential knock-on events including⁹³:
 - a) Non-delivery of product to offtake partners and hedging mismatches - an open liability;
 - b) Make-good and clean-up liabilities and fines;
 - c) Shareholder class actions; and
 - d) Changes to loan funding and wider financial relationships, including banking and insurance.
- ▶ There are likely to be more water-stranding events exacerbated by increasing thirsty growth across resource majors and the depletion of freshwater resources.
- ▶ While resource majors have, to date, mostly been able to absorb the financial implications of water-stranding events, resource minors, and the financial institutions fueling them, may not.
- ▶ The concentration of equity investments suggests that action by just a small number of shareholders, (e.g., by exercising voting rights), could have a significant impact in driving resource majors to value water appropriately. Financial institutions must move now to engage, identify, assess, manage, and disclose water risks across portfolios and loan books to avoid the worst consequences of the water crisis and to contribute to actively stemming it.

APPENDIX A

DEFINITIONS OF TYPICAL ASSET LIFE-CYCLE CURVE PLANNING

Unless acquired in a fully formed state (e.g. mergers and acquisitions "M&A"), assets, including resource assets, have a fairly typical life-cycle: planning, development, usage and end-of-life. Financing and, in the case of publicly listed companies, equity valuation follow.

Cash flows, Balance Sheet values and Profit and Loss are all a function of this life-cycle, as are Stranded Asset possibilities. The more developed (money spent) and the less exploited (money extracted) the higher the financial risk.

Table A. Balance sheet relevance

Balance sheet items	E-Dev	L-Dev	New	Mid	End
Assets					
Intangible work in progress	✓	✓			
Capital work in progress		✓			
Intangible asset			✓	✓	
Capital			✓	✓	
Liabilities					
Borrowing		✓	✓	✓	
Remedial provisions				✓	✓

"Dev" – In the planning and development stage, cash outflows are typically funded by a balance sheet capital and external debt, often project specific debt. This spend is capitalised and treated as either an intangible work in progress asset (in the case of scoping/proving/permit type spend) or a non-current capital work in progress asset. Asset at risk balance sheet exposure will build during this period. We have tried to reflect this in our simplified balance sheet by showing early ('E-Dev') and late ('L-Dev') numbers. As debt lines are drawn down to fund the development, borrowers' exposure will also rise.

"New" – when the asset starts producing or operating, the related capital work in progress amounts are transferred to their appropriate non-current asset categories. If the asset is complete at this stage, e.g. a non-modular power station, this will represent the time of greatest balance sheet and debt provider risk, with amounts at their maximum. If however the project becomes operational and is then enlarged, e.g. a mine, the value at risk will continue to build. Furthermore, the contingent liability for any remediation/return to normal state obligation will at the new stage be unfunded.

"Mid" – after a period of production, the asset will reach the mid-point of its productive life. The carrying value will have been amortised or depreciated in the interim period and the debts partially repaid. Assets at risk will have declined, cash generated and extracted and borrowings partially or even fully repaid.

"End" – by the end-of-life stage, balance sheet carrying values should have reached zero and debt been fully repaid; asset value at risk in balance sheet and borrowing terms should therefore be zero. However, provisions for the costs associated with remediation will ahead of that remediation taking place be at their highest.

APPENDIX B

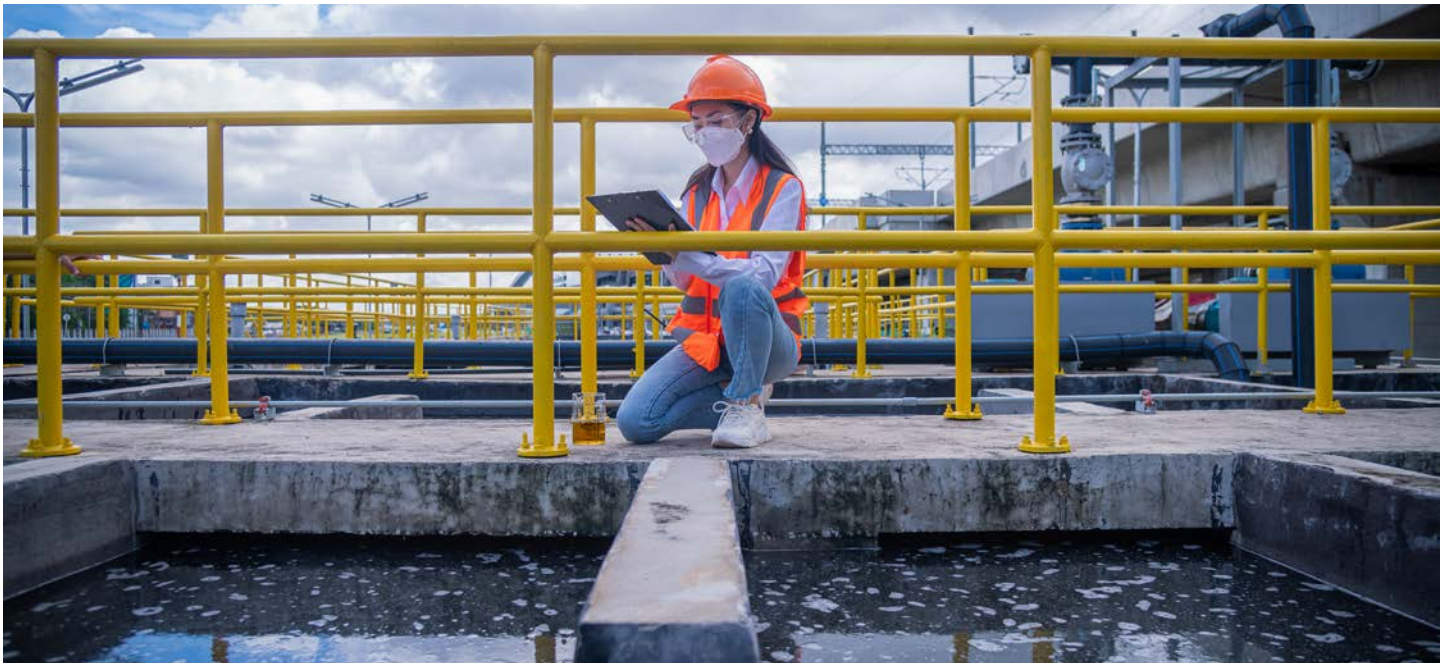
TOP 10 COMPANIES BY MARKET VALUE IN FOUR SECTORS

Table B presents the top 10 largest public companies in each of the four industry sectors investigated in this report, along with their disclosure status to the CDP 2021 water questionnaire and their responses to W3.3 – Does your organization undertake a water risk assessment?

The Refinitiv Equity Screener was used to identify the Top 10 companies by latest reported revenues (converted into US\$). The percentage of these top companies that both disclose to CDP and assessed water risks in 2021 were electric utilities at 60%, followed by metals & mining at 33% and lastly both coal and oil and gas at 20%.

Table B. Top 10 largest (US\$) public companies per sector

No.	Entity name	Country	Sector	Disclosure to CDP	Public CDP disclosure status	Is water risk assessed? W3.3
1	China Shenhua Energy Co Ltd	China	 COAL	Submitted	No	Yes
2	Yankuang Energy Group Co Ltd	China		Submitted	No	Yes
3	China Coal Energy Co Ltd	China		Not submitted	No	
4	Shaanxi Coal Industry Co Ltd	China		Not submitted	No	
5	Coal India Ltd	India		Not submitted	No	
6	Inner Mongolia Yitai Coal Co Ltd	China		Not requested	N/A	
7	Shanxi Coking Coal Energy Group Co Ltd	China		Not requested	N/A	
8	Shan XI Hua Yang Group New Energy Co Ltd	China		Not requested	N/A	
9	United Tractors Tbk PT	Indonesia		Not requested	N/A	
10	Shanxi LuAn Environmental Energy Dev Co Ltd	China		Not requested	N/A	
11	Glencore PLC	Switzerland	 METALS & MINING	Not submitted	No	
12	BHP Group Ltd	Australia		Not submitted	No	
13	BHP Group PLC	United Kingdom		Not submitted	No	
14	Posco	Republic of Korea		Submitted	Yes	Yes
15	ArcelorMittal SA	Luxembourg		Submitted	Yes	Yes
16	Jiangxi Copper Co Ltd	China		Not submitted	No	
17	Rio Tinto PLC	United Kingdom		Not submitted	No	
18	Rio Tinto Ltd	Australia		Not submitted	No	
19	Nippon Steel Corp	Japan		Submitted	No	N/A
20	Baoshan Iron & Steel Co Ltd	China		Not submitted	No	
21	Vale SA	Brazil		Submitted	Yes	Yes
22	thyssenkrupp AG	Germany		Submitted	No	N/A



No.	Entity name	Country	Sector	Disclosure to CDP	Public CDP disclosure status	Is water risk assessed? W3.3	
23	Electricite de France SA (EDF)	France	 ELECTRIC UTILITIES	Submitted	Yes	Yes	
24	E.ON SE	Germany		Not requested	N/A		
25	Engie SA	France		Submitted	Yes	Yes	
26	Uniper SE	Germany		Not submitted	No		
27	Fortum Oyj	Finland		Not submitted	No		
28	Enel SpA	Italy		Submitted	Yes	Yes	
29	Korea Electric Power Corp	Republic of Korea		Not submitted	No		
30	Tokyo Electric Power Company Holdings Inc	Japan		Submitted	Yes	Yes	
31	Iberdrola SA	Spain		Submitted	Yes	Yes	
32	Exelon Corp	United States of America		Submitted	Yes	Yes	
33	China Petroleum & Chemical Corp	China		 OIL & GAS	Not requested	N/A	
34	PetroChina Co Ltd	China			Not submitted	No	
35	Saudi Arabian Oil Co	Saudi Arabia	Not submitted		No		
36	Royal Dutch Shell PLC	Netherlands	Not submitted		No		
37	Exxon Mobil Corp	United States of America	Not submitted		No		
38	BP PLC	United Kingdom	Not submitted		No		
39	Total Energies SE	France	Submitted		Yes		
40	Chevron Corp	United States of America	Not submitted		No		
41	Gazprom PAO	Russian Federation	Submitted		Yes	Yes	
42	NK Rosneft' PAO	Russian Federation	Submitted		No	N/A	

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