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Climate Smart Mining

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Building Climate Resilience *in the* Mining Sector

Guidance Note

September 2024

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Publication Collaborators

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Palladium works with mining companies globally to improve their social performance, predominantly through identifying opportunities to finance and transform frontline community business ecosystems in a climate smart fashion.

ICMM

ICMM is an international organization dedicated to improving the social and environmental performance of the mining and metals industry.

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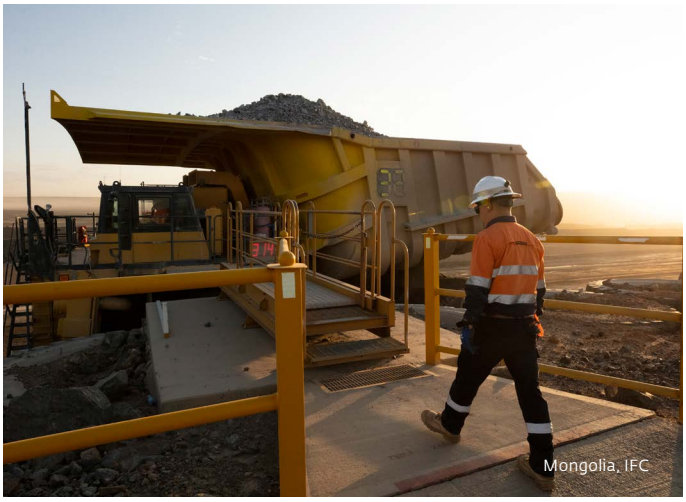
Foreword

The mining industry is critical for decarbonization efforts and enhancing global economic growth. Today, it faces unprecedented challenges due to climate change. But within these challenges lie unique business opportunities for miners to: manage climate risks, embrace climate adaptation, and build resilience across assets, supply chains, communities, and ecosystems, helping to secure their own future while also reducing social inequalities in host communities.

The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) reveals a new norm of extreme weather events and shifting climatic conditions while highlighting the urgency of climate action.[1]

These changes present significant risks to mining operations, including disrupted supply chains and damaged infrastructure. The IPCC AR6 developed the concept of Climate-Resilient Development to describe an approach that includes reducing greenhouse gas emissions to avoid unmanageable climate change (decarbonization), while enhancing capacity to moderate harm from unavoidable climate change (adaptation). The Climate-Resilient Development framework aims to improve the capacity of social, economic, and ecological systems to anticipate, avoid, respond, and transform in the face of climate change.

In 2023, the International Finance Corporation (IFC) launched the Net Zero Roadmap for Copper and Nickel Mining Value Chains, a guide for decarbonizing the mining of critical minerals. By offering guidance to the critical minerals and metals sector on decarbonization, the Roadmap offered



Mongolia, IFC

ideas on the first part of the Climate Resilient Development solutions framework. This note complements the net zero work with guidance on the second aspect: climate risk and how to respond through enhanced adaptation in mining operations, value chains, and communities.

Drawing on the scientific findings from the IPCC AR6, it provides information on climate risk assessments, ensuring that stakeholders have a comprehensive understanding of the realities and future projections of climate impacts. Such understanding underpins the well-informed and participatory development of effective adaptation strategies to protect assets, ensure operational continuity, and build long-term resilience.

The guidance note also highlights practical, action-oriented adaptation commitments and offers an overview of innovative financial instruments for mobilizing financial

resources—allowing investors to support climate resilience while achieving favorable returns, combining financial interests with environmental stewardship. In addition, it details good practices for navigating the complexities of climate resilience and adaptation, tailored to the unique challenges faced by the mining sector.

By integrating climate risk analysis, adaptation strategies, and innovative financing, the note equips industry leaders, investors, and policymakers with the knowledge and ideas to enable meaningful change and presents a comprehensive approach to fostering a resilient mining sector.

More than a guide, the note provides a call to action for the mining industry to commit to a sustainable and resilient future. By embracing the insights and recommendations presented, the mining sector can set an example, proving that economic growth and climate action can go hand in hand.

On behalf of the World Bank Group's Climate-Smart Mining (CSM) initiative, we are pleased to bring you this new resource. Established in 2019, the CSM initiative is a public-private partnership co-led by the World Bank and IFC to support the responsible extraction, processing and recycling of minerals needed the for the energy transition by scaling technical assistance, advisory, and investments in mineral-rich developing countries. We hope that this resource will support mining companies in identifying physical climate risks and building resilience across mining operations, value chains, and communities.

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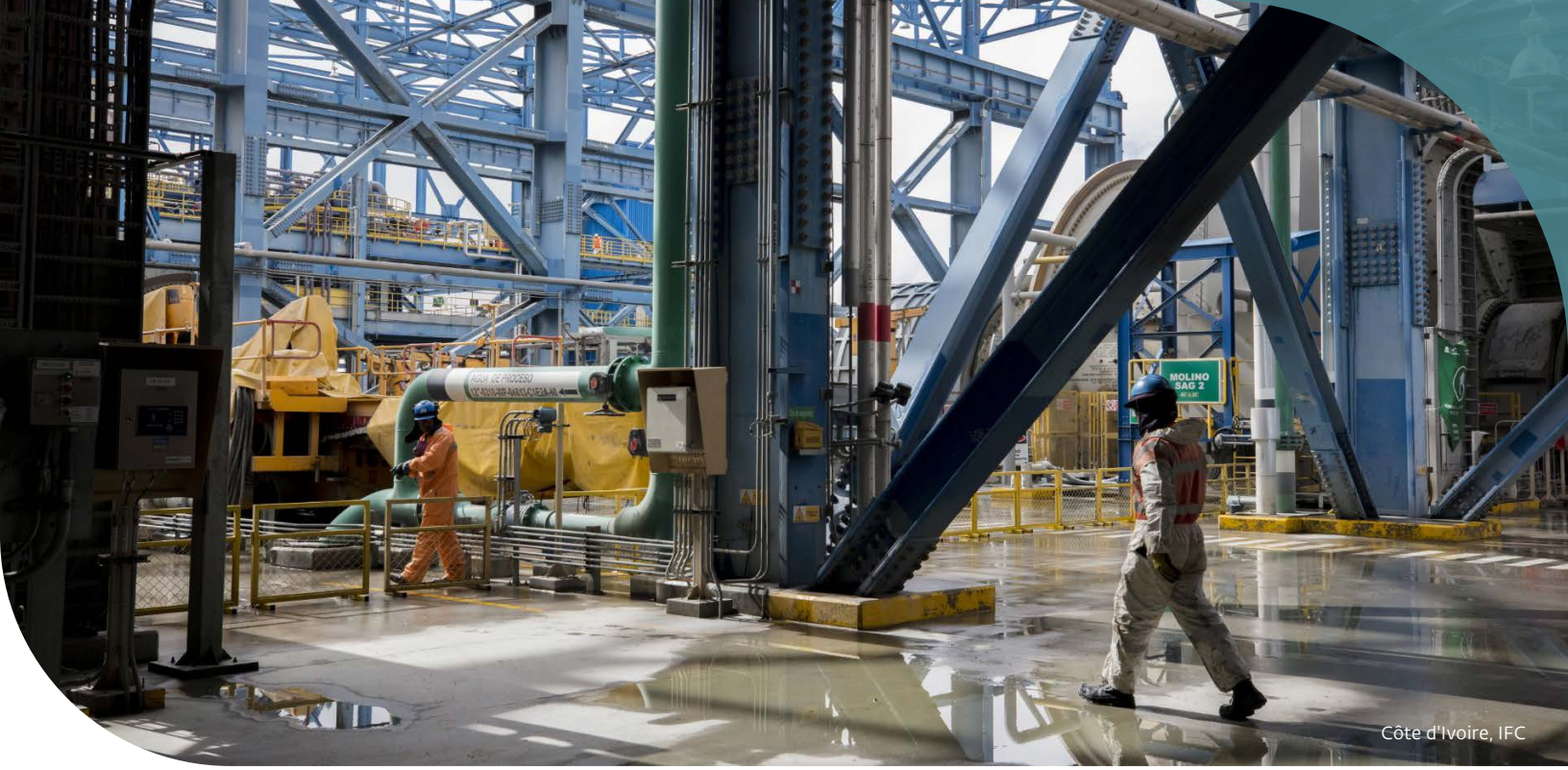
Table of Contents

List of Figures



Côte d'Ivoire, IFC

Executive Summary

Mining companies are at an inflection point—as the world transitions to a low-carbon economy, increasing global demand for critical minerals and metals requires that mining companies ramp up their operations while ensuring that this is done in a low-carbon and resilient manner. Climate projections related to flooding, sea level rise, drought, extreme weather events, and heat indicate that these physical climate risks will become more frequent and intense, increasing the challenges to mining operations, host communities, and value chains.

Without proper monitoring and a focus on responsible practices, mining also could undermine adaptation efforts in host communities and ecosystems. In some contexts, mining activities can be in direct conflict with other users' demands and needs for limited resources, such as water, land, and energy, and lead to heightened impacts that would leave the communities more vulnerable to climate change. Direct impacts that could arise include habitat loss; ecosystem fragmentation and degradation; water, air, soil, and noise pollution; and soil erosion and potential landslides. Indirect impacts include human migration, increased land clearance, and unintentional introduction of invasive species to an ecosystem. Mine waste—the largest amount of material that is mined—also contributes to ecosystem degradation and biodiversity loss when not properly managed. This could lead to more social inequality and access issues, which can hamper economic and social development priorities. Therefore, the mining sector needs to integrate climate considerations in their operations that are timely, context-specific, and consider the social, economic, and ecological context of host communities.

In addition, climate-related risks are increasingly being recognized as financially material. However, many companies underestimate and misdiagnose the scope of risk they face, leading to insufficient planning, preparation, and investment in solutions that can mitigate impacts. Failure to identify and address the full range of issues in ways that build longer-term resilience across the mining value chain can set up a costly cycle of short-term, reactionary responses and significant, recurring losses.

Guinea, IFC

This note offers guidance to mining companies on strengthening climate resilience both inside and outside the mine fence, guided by the best available scientific literature and tools. It features lessons and examples of real-world experiences from mining companies, as well as resources for further information. The note starts with a comprehensive overview of the type of climate risks mining companies face, underscoring the importance of engaging with local stakeholders to co-develop adaptation responses.

By providing a framework for a climate risk assessment to address the three dimensions of climate risk—hazard, exposure, and vulnerability—the note offers an approach that will help mining companies anticipate, avoid, and respond to the impacts of climate change.

It proposes a series of suggested adaptation actions that can be integrated into existing approaches to enterprise risk management. Taken together, these actions can form the building blocks of on-site climate resilience, as well as in frontline communities and ecosystems. The guidance note also offers a series of illustrative commitments that companies could undertake to address enterprise climate risk and build adaptive capacity across human, natural, physical, and financial assets.[2] In addition, it provides information on financial products and services that companies could use to fund adaptation investments, including classes of instruments that incentivize such investments through step-downs in loan terms.

Of note, the publication does not offer tailored adaptation plans for individual mining sites, companies, countries, or specific minerals and metals. The very nature of climate risk and adaptation means that each site and location will require a context-specific diagnosis of and response to climate risk to enhance adaptive capacity. Several resources are provided to help mining companies undertake tailored approaches to climate risk and adaptation across their own operations and value chains, including:

- Guidance on building an adaptation plan
- Adaptation commitments checklists
- Financing instruments for adaptation investments
- Terms of reference for a climate risk assessment

Mining companies can enhance their climate resilience, improve the well-being of communities, and protect the natural environment by following a pathway that involves:

- **Strengthening risk analysis** and foresight through a comprehensive climate risk assessment (CRA).
- **Investing in a diverse range of adaptation solutions** based on capital assets—human, natural, physical, and financial—and covering systems such as water, energy, land, workers, and communities, all of which are critical for the long-term viability of mining projects and sustainability of frontline communities.
- **Making and acting on public commitments to adaptation** that are:
  - Based on up-to-date climate science.
  - Built on the foundations of robust climate risk assessment.
  - Designed to cover on- and off-site response pathways.
  - Goal-oriented, to include both quantitative and qualitative goals.
  - Time-defined to cover short-, medium-, and long-term horizons.
  - Backed by tangible plans and immediate actions that are prioritized and sequenced, and rooted in transparency, accountability, and inclusion.
  - Expressed as absolute risk reduction and net-positive outcomes where possible, such as habitat restoration.
  - Articulated and embraced by company leadership and applied across the entire company.
  - Monitored, disclosed, and verified.

Peru, IFC

- **Mobilizing financial resources in support of adaptation.** This means moving beyond the traditional notion of corporate social responsibility projects to investments that respond to climate risks and reshape contracts that broaden ownership of natural resources.
- **Strengthening response cooperation through participatory planning.** Creating an effective enabling environment for climate adaptation involves working with communities, public authorities across multiple spheres of governance, and investors.
- **Integrating sustainability considerations into business strategy and core processes.** Mainstreaming sustainability requires avoiding siloed thinking and connecting climate risk mitigation and adaptation in core business planning and decision-making processes.
- **Understanding resilience as a journey.** Risk and resilience are both dynamic. Adaptation action plans must be agile and flexible to enable preemptive shifts in approach as changing socioecological conditions demand.

Report Highlights

- Mining companies tend to **underestimate their exposure and vulnerability** to climate risk.

- There is an estimated $366 billion annual gap in the financing needed to boost climate resilience through adaptation in developing countries, where many mining companies operate.[3] **Sustainable and blended finance,** among other innovative financial instruments, can play a key role in filling this gap.

- Planning, designing, and implementing effective adaptation strategies all **start with a comprehensive risk assessment.**

- **Participatory processes, stakeholder engagement, and inclusive solutions**—covering operations, value chain, and communities—are the through line to climate resilience.

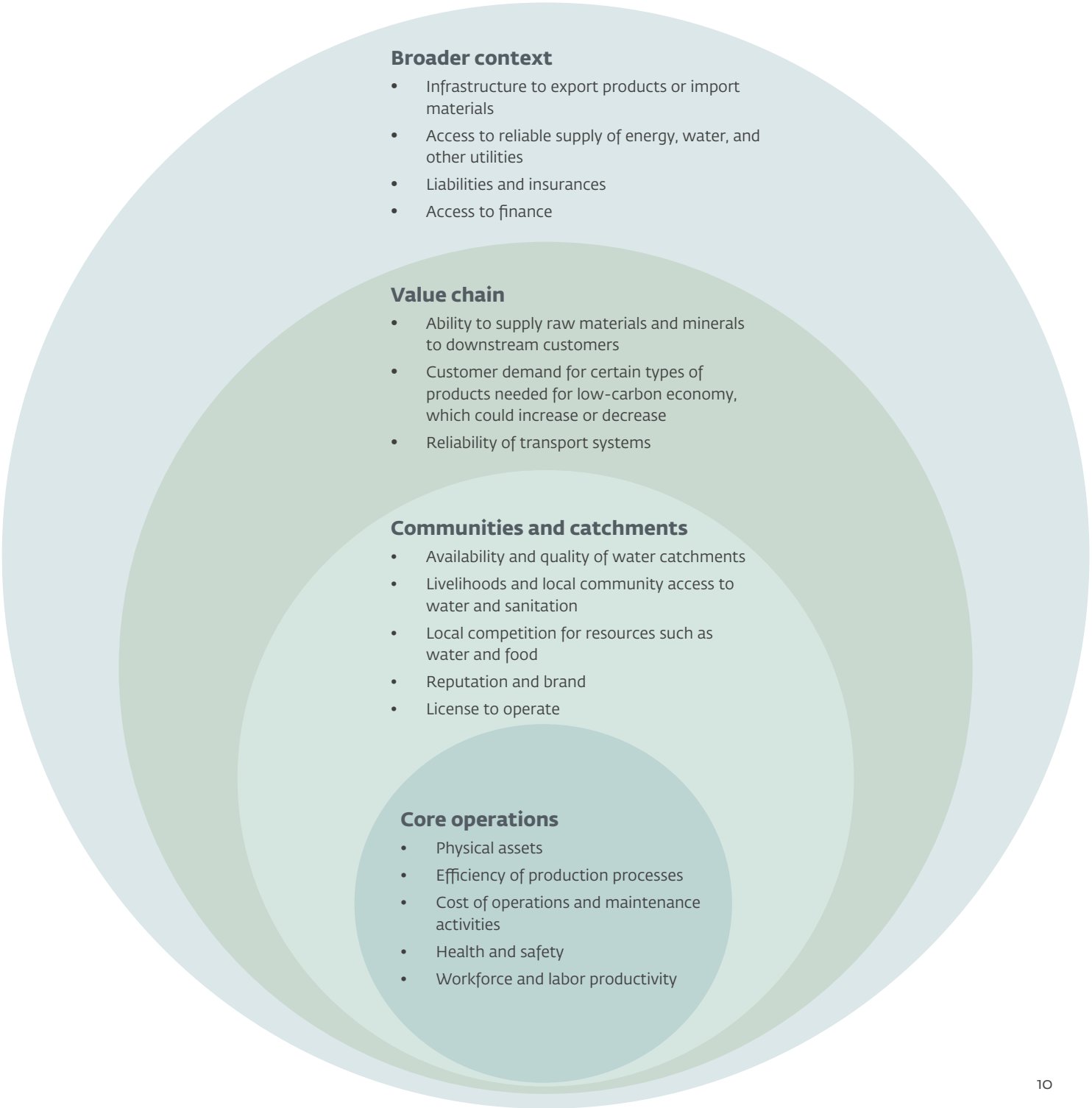
- **Committing to tangible and relevant adaptation goals**—and reporting on progress—contributes to long-term operational sustainability and drives positive impact, demonstrates accountability, and underpins social license to operate.

- Mining companies can access a **new class of financial instruments** that incentivize climate-adaptive investment.

EXHIBIT 1

Climate-resilient mining requires moving beyond "resilience of a project" to "resilience through the project"

Enhancing community resilience through tangible financial, infrastructure, health, education, employment, and environmental outcomes should be core to the project's vision.



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1

Introduction

Mining operations throughout the world are already being affected by the physical impacts of climate change. Flooding, drought, stronger storm intensity, greater variability of water supply, and the growing number of high-temperature days have caused health and safety impacts, production reductions or shutdowns, and increases in capital expenditure. These impacts have also contributed to a rise in vulnerable communities that are prone to social unrest.[4]

Some of the countries with the richest mineral and metal wealth are also the most climate-vulnerable and least equipped with adaptation strategies (figure 1.1). As a result, mining sites in these countries are increasingly susceptible to intense and frequent acute climate events and sustained chronic risk. The industry also faces increasing pressure from regulators, investors, stakeholders, and insurers to demonstrate how it is addressing climate change-related issues.

Combined, these challenges elevate the need for mining operations to include climate change-related risks and opportunities in their decision-making.

A climate-resilient approach can help companies address these issues. Resilience involves enhancing the capacity of economic, social, and ecological systems to anticipate and avoid contributing to, responding to, and transforming in the face of climate change.[5] It includes decarbonization—reducing or removing greenhouse gas emissions to avoid unmanageable climate change—, adaptation—reducing risks to moderate harm from unavoidable climate change—,and focus on the just transition—enabling all to benefit equally from the advantages of a net zero world.[6]

Mining companies are making efforts to decarbonize—enabled by available guidance such as IFC's "Net Zero Roadmap for Copper and Nickel Mining Value Chains," and uptake of financial instruments that enable investment in decarbonization.[7]

However, there is less investment in adaptation.[8] Although some mining companies are investing in aspects of adaptation to reduce their climate risks, these efforts are often fragmented, siloed, and limited.[9] The research for this guidance note found that a majority of companies do not have a comprehensive and ambitious approach to climate resilience—even though multiple studies have determined strong value in adaptation investment, yielding significant resilience dividends.[10]

One reason for this lack of attention to physical climate risk and adaptive investments is that companies are unsure about the projected exposure levels and/or vulnerabilities affecting them—or how to address them. In addition, the primary focus within companies is on decarbonization and managing climate transition risks.[11] This focus is reflected in climate-related performance metrics


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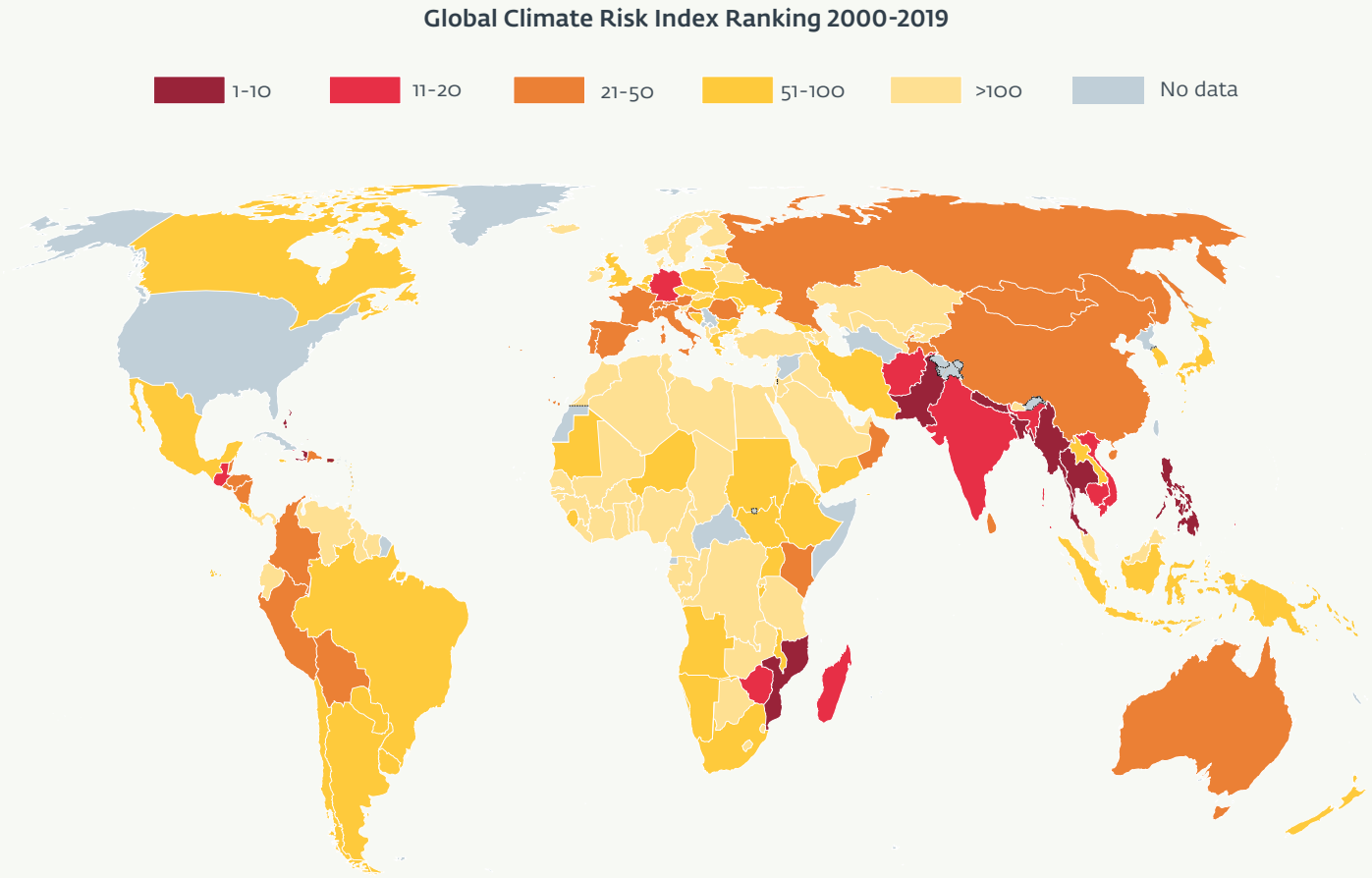
for C-suite mining executives, with the vast majority aimed at decarbonization targets. Another reason for the mining sector's limited prioritization of climate adaptation efforts is its focus on short-term financial goals and operational efficiencies rather than the potentially high, long-term costs associated with the physical impacts of climate change on its assets. This serves as a significant barrier for the mining sector to invest in long-term resilience strategies.[12]

FIGURE 1.1

Some of the countries with the richest mineral and metal wealth are also the most climate-vulnerable and least equipped with adaptation strategies



LATIN AMERICA & THE CARIBBEAN

- Bauxite
- Molybdenum
- Copper
- Neodymium
- Iron
- Nickel
- Lead
- Silver
- Lithium
- Zinc
- Manganese

SUB-SAHARAN AFRICA

- Bauxite
- Manganese
- Cobalt
- Molybdenum
- Copper
- Titanium
- Graphite
- Vanadiu

SOUTH ASIA

- Bauxite
- Copper
- Iron
- Neodymium

EUROPE & CENTRAL ASIA

- Bauxite
- Graphite
- Nickel
- Chromium
- Iron Silver
- Cobalt
- Lead
- Vanadium
- Copper
- Neodymium
- Zinc

EAST ASIA & PACIFIC

- Bauxite
- Manganese
- Cobalt
- Molybdenum
- Copper
- Neodymium
- Graphite
- Nickel
- Indium
- Silver
- Iron
- Vanadium
- Lead
- Zinc
- Lithium

Sources: Germanwatch. Global Climate Risk Index 2021; World Bank, Minerals for Climate Action

Methodology

The insights and recommendations in this note were generated using a mixed-methods research design. This enabled the team to harvest expertise from across the climate change and mining communities of practice and incorporate the views of industry professionals—including IFC's own experts—as well as community voices (table 1.1). Focus was on developing guidance to mining companies on how to understand, assess, and act on physical climate risks to strengthen their resilience to climate change across their value chains. It could also be of use to the development sector, community organizations, and nonprofits working in the mining arena to help improve their understanding of approaches to climate resilience and adaptation in the mining sector.

The principal source on climate science was the IPCC AR6. Other sources used to assess corporate performance on climate change were the disclosure reports published by mining companies; these annual reports represent the companies' own assessment of climate risk as well as the measures they are taking to respond. When disclosure reports were unavailable, the authors went directly to the mining company's own sustainability or annual reports. Finally, assessments from a variety of independent think tanks, academic institutions, and civil society organizations were used.

Semi-structured interviews were conducted with leading mining companies across the critical minerals and metals sector, and with specific climate adaptation experts. Focused group discussions and workshops further enriched the discussions and recommendations included in this report.

TABLE 1.1

Research methodology

LITERATURE REVIEW	INTERVIEWS	FOCUS GROUPS & WORKSHOPS
• **Climate science** – IPCC Sixth Assessment Report • **Climate risk assessment tools** • **Mining companies' climate performance** – CDP disclosure reports – Mining company sustainability reports – World Benchmark Alliance ESG assessments of more than 300 mining companies – Independent ESG assessments of companies – Best practices (TCFD, ISSB)	• **40 semi-structured interviews** – Critical minerals and metals company executives – Climate and mining experts	• **4 focus groups** – 150 participants total – ICMM, Mining Indaba, Climate-Smart Steering Committee • **2 community workshops in Indonesia and Chile** – Convened by the Stockholm Environment Institute

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2

Identifying Physical Climate Risks *for the* Mining Sector

The Task Force on Climate-Related Financial Disclosures (TCFD) has identified two distinct forms of climate risk. Transition risks are the policy, legal, technological, and broader market drivers designed to sunset the high-carbon economy of today and catalyze the development of the low-carbon and resilient economy of tomorrow. This note focuses on the second category of risk identified by TCFD: physical climate risk—the potential that human or ecological systems could face adverse consequences resulting from climate change.[13]

Three dimensions of physical climate risk affect the mining sector:

- The climate-related hazards
- The exposure to these hazards
- The underlying vulnerability to the hazards

The interplay among these dimensions—and their potential impacts—determines the degree of potential climate risk faced by mining companies.

Climate-related hazards

Hazards are natural or human-induced physical events, such as extreme temperatures, erratic rainfall patterns, and sea level rise, that could have adverse effects on physical assets, people, and the environment.[14] These hazards can cause impacts such as floods, droughts, and wildfires. Climate projections suggest that the world will likely experience increased intensity and frequency of such hazards and impacts, given the continued rise in cumulative CO_2 emissions and the effect on global warming. Every additional increment of warming amplifies these risks. The Intergovernmental Panel on Climate Change (IPCC) estimates that each 0.5°C of temperature rise will exacerbate 127 key risks, affecting biodiversity, water, food, human health and infrastructure.[15]

Exposure

The existence of a climate-related hazard does not automatically translate into a negative impact. A hurricane in the middle of an ocean, for example, may be more intense because of climate change, but it does little physical damage unless it makes landfall and passes through population centers situated on its course. What determines an elevated risk is the degree of exposure to the hazard for particular locations and geographies—looking at the potential impacts on people, livelihoods, environmental services and resources, infrastructure, and economic, social, and cultural assets that could be adversely affected.[16]

Exposure to climate hazards in one location can lead to cascading impacts extending well beyond the initial reach. For example, flooding can cause washed-out roads and unsafe water levels in tailing dams resulting in operational disruptions. It can also damage power stations, cause electricity blackouts, and negatively affect businesses, communities, and individual households. Losses from such disruptions could pile on and create broad-based economic and development challenges.

> **Every additional increment of atmospheric warming amplifies physical climate risks. The IPCC estimates that each 0.5°C of temperature rise will exacerbate 127 key risks, affecting biodiversity, water, food, human health, and infrastructure.**

From a health and safety perspective, high temperatures and more frequent heatwaves can increase heat stress among workers, reducing productivity, and elevating safety risks, bringing potential financial implications. Extreme weather events also can create hazardous conditions for workers, necessitating evacuations.

Vulnerability

Vulnerabilities are underlying weaknesses that exacerbate risk and increase the potential that those exposed—people, communities, businesses, supply chains, ecosystems,—will experience adverse effects in the event of a climate-related hazard.[17] Vulnerability includes a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt; it is the propensity or predisposition to be adversely affected by climate change,[18] Some countries with the richest mineral and metal wealth are also among the most climate-vulnerable and the most lacking in adaptation readiness (figure 1.1). Mining sites in these countries are increasingly susceptible to intense, frequent, and acute climate events and sustained chronic risk due to their exposure to physical hazards and limited adaptive capacities. This heightens their vulnerability to adverse impacts of climate change. For communities, these

vulnerabilities could result from intersecting, historical, and ongoing inequalities often linked to gender, ethnicity, low incomes, informal settlements, disability, and age.[19] In many emerging markets and developing countries, the absence of effective social protection public policies and lack of strong institutions also can contribute to vulnerability.

For the mining sector in particular, the heavy dependence on water represents a critical vulnerability (box 2.1). Surface and groundwater resources are under growing strain due to climate change and competing demands from other industrial sectors and local communities.[20] For example, 30 to 50 percent of copper, gold, iron, ore, and zinc production activities are concentrated in areas of high-water stress. In 2017, these sites accounted for approximately $150 billion in total annual revenues and were clustered in seven mining water-stressed hot spots: Central Asia, the Chilean coast, eastern Australia, the Middle East, southern Africa, western Australia, and western North America.[21]

Too much water can also be a problem, leading to overtopping of spillways and tailings and dam failure. Thus, mines must also manage water that comes in contact with operations through rain and runoff.

Excessive heat is another climate vulnerability for mining companies. Heat can affect the efficiency of mining and processing equipment, as well as transportation routes such as railways, if they are not appropriately designed for prolonged peak temperatures.[22] Increased stress on the electricity grid for cooling could lead to more competition for resources between frontline communities and mining companies, impacting mining companies' social license to operate. And studies suggest that mining companies could see a 20 percent loss in productivity during warmer months to avoid exposing workers to extreme heat conditions.[23]

BOX 2.1

Fast facts: Why water scarcity matters for mining

70% of mining operations from the six largest mining companies are located in water-stressed countries.[24]

Up to **50%** of copper, gold, iron ore, and zinc mines are in highly water-stressed areas.[25]

Mining companies could lose **$50B** in revenue and **27%** of production due to water risks by 2030.[26]

The sector faces other vulnerabilities as well, such as reliance on long-lived and capital-intensive fixed assets, deep and complex supply chains, extensive product transportation networks, and dependence on natural resources.

Exploring the intersections among exposure, vulnerability, and the hazard event is critical to accurately determining climate risk. Studies suggest that the scale of climate risk is more dependent on changes in vulnerability and exposure than on the frequency and intensity of hazards themselves, reinforcing the importance of understanding this interplay.[27]

Barbados, IFC

Climate impacts on mining operations

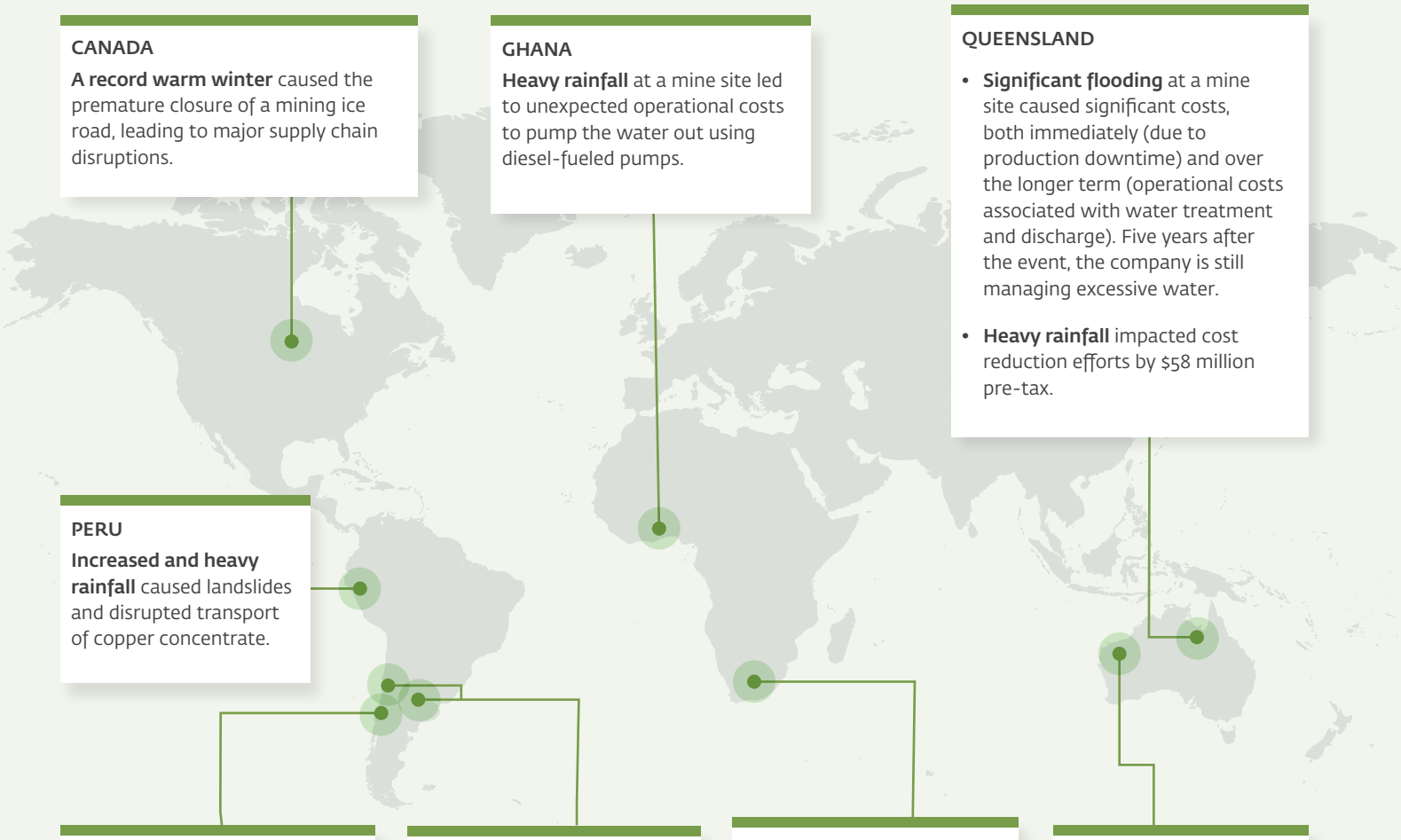
The mining value chain is already experiencing the negative impacts of climate change, often resulting in significant financial losses. Climate impacts on mining companies extend beyond the boundary of core operations (figure 2.1). For example, in a 2019 report, Newmont estimated between $65 million and $130 million in annual financial impacts from climate-related events that led to or resulted in:

- Damage to core operational assets
- Reduced production process efficiencies
- Increased maintenance needs and rising costs
- Electricity disruptions
- Impacts on workforce health and safety and reduced productivity
- Damage to transportation infrastructure, affecting the ability to export products or import materials
- Logistics disruptions affecting customer deliveries[28]

Table 2.1. offers details on how various climate hazards can impact mining companies and surrounding communities. It highlights how climate risks can impact the communities surrounding mining operations. The table also suggests each climate hazard's likely risk rating and frequency based on available scientific literature. Mining companies can adjust these based on the findings of their climate risk assessments (CRAs).

Figure 2.1.

Climate impacts on mining companies extend beyond direct operations



Source: ICMM

Anglo American focuses on water security

Water security is top of mind for Anglo American, given that many of its operations, including those in Chile, South Africa, and Zimbabwe, are dealing with water-related issues. In Chile, Anglo's operations continue to face severe drought conditions, experiencing record low levels of precipitation at the Los Bronces site in 2022, after prolonged water shortages stretching back to 2012.

In South Africa, the expansion and continued operation of the Mogalakwena Complex might be hindered by limited water access and ongoing drought conditions. The company has quantified the potential impact on the company's bottom line: an operational halt due to water supply concerns would represent a revenue loss of about $9.64 million per day.

Water shortages also could lead to increased operational costs from sourcing more expensive alternative water supplies. Meanwhile, larger than normal rainfall events have elevated other risks, such as water contamination and spillage into the wider environment.[29]

Climate impacts on communities

Communities adjacent to mining sites are often particularly vulnerable to climate change. This is due to their direct exposure to the natural environment, along with their often-remote locations, sparse populations, and non-resilient infrastructure.

The mining sector has a significant role to play in helping host communities strengthen their adaptive capacity to withstand the physical impacts of climate change. Knowledge and information gaps represent a significant challenge for communities , making it more difficult to develop of community-oriented approaches. Meaningful dialogue about the interconnected risks associated with the effects of climate change and mining expansion often requires technical expertise that local communities may not possess. Mining companies need to do a better job of accounting for these issues in engaging with communities and disclosing information about climate risks.[30]

Without proper monitoring and focus on responsible mining practices, mining can also be a risk multiplier in host communities (table 2.1). For example, mining and mineral processing operations can create competition for water during droughts or uncontaminated water availability during floods. Mining activities can increase ecosystem vulnerability and exposure, leading to heightened impacts, including for the communities that rely on ecosystem services. Among the direct impacts: habitat loss; ecosystem fragmentation and degradation; water, air, soil, and noise pollution; and soil erosion and potential landslides. Indirect impacts include human migration, increased land clearance, and unintentional introduction of invasive species to an ecosystem. Mine waste—the largest amount of material that is mined—also contributes to ecosystem degradation and biodiversity loss when not properly managed. This could lead to additional social inequalities and access issues, which would hamper economic and social development priorities within these communities.

The long-term consequences of the compounding impacts of mining and climate change are profound: an erosion of local communities' resilience to shocks and stresses, a loss of trust, and potentially larger and costly implications on companies' reputation.

Failure to account for communities' exposure, vulnerabilities, and impacts—including those brought on by mining activities—can amplify climate risks for mining operations, increase costs, and negatively affect social license to operate. Integrating community risks and adaptation needs into formal risk management frameworks and business strategies provides opportunities to yield co-benefits and avoid maladaptive responses.

Table 2.1

Illustrative climate impacts on mining companies and frontline communities

Climate Risks	Overall Risk Rating	Time Horizon/Frequency	Impacts on Mining Operations	Impacts on Communities
Extreme heat	High	Immediate (Current/recurring)	• Increased workforce health and safety risks and reduced productivity • Equipment inefficiency or failure: • Electrical/power outages • Cooling or water treatment processes • Reduced transmission capacity • Operational disruptions from rail buckling	• Injury or loss of life due to heat stress • Disease transmission from fly-in/fly-out workforce • Pressure on energy and water supplies • Conflict with other local users
Water stress/ drought	High	Near future (A few years from now)	• Insufficient supply for critical processes • Inability to adapt equipment and infrastructure to reduced supply or lower quality alternatives • Power outages/disruptions due to reduced hydropower generation capacity • Ineffective water treatment due to low water flow, resulting in increased costs and non-compliance with local/corporate regulations • Increased community expectations on shared water resources	• Reduced reliability of water and energy/power • Increases in water/power costs for households and local businesses • Damage to local water-reliant livelihoods • Heightened need for community water conservation • Hostility toward mining companies over sharing of water resources • Impacts on local or regional ecosystems: — Changes in habitat conditions — Shifts in biodiversity or ecosystem structure and function, such as dominant vegetation types
Floods	High	Immediate (Current/recurring)	• Tailings storage facility failure due to instability and erosion • Landslides • Underground/surface pit flooding • Equipment failure/damage from water exposure • Hazardous conditions for workers, requiring rapid evacuation	• Environmental risks: — Contaminated downstream flows — Unauthorized floodwater release • Damage to local water- and agriculture-reliant livelihoods • Drinking water contamination. • Increased energy costs for households and local businesses • More demand for emergency services • Damaged infrastructure which communities rely upon • Increased risk of malaria and other diseases from uncovered, stagnant water ponds — Reduced earning power due to illness
Wildfires	High	Immediate (Seasonal/recurring)	• Damage to mining infrastructure/equipment • Operational and supply chain disruption	• Safety and health risks for the workforce and communities from degraded air quality and low/reduced visibility
Tropical cyclones	Medium	Near future (Seasonal/recurring)	• Wind and flood damage to infrastructure and equipment • Telecommunications disruptions	• Safety risks for the workforce and communities • Damage to households, property, and agricultural land • Telecommunications disruptions
Sea level rise	Medium	Long term (Decadal change)	• Coastal infrastructure inundation and damage • Operational and supply chain disruption	• Increased flood risk for coastal operations and communities
Permafrost degradation	Medium	Long term (Decadal change)	• Destabilized terrain, affecting: — Secure tailings ponds — Mine access roads — Geotechnical structures • Structural and airstrip damage: — Operational delays — Additional and unplanned capital expenditure	• Similar impacts as for floods and storms, including: — Environmental risks — Damage to local water and agriculture-reliant livelihoods. — Water contamination leading to health issues — Damage to households, property, and productive assets — Telecommunications disruptions

Mongolia, IFC

3

Strengthening Climate Risk Assessment

Robust assessment of the climate risks facing operations, mining value chains, communities, and ecosystems will inform the development of effective adaptation solutions that reduce risks and help strengthen the climate resilience of the mining operations and local communities.

Few mining companies have taken a holistic and comprehensive approach to assessing climate-related risk. A typical risk assessment gap is a focus mainly on transition risk rather than physical risks, such as extreme weather-related events or longer-term shifts in climate patterns that can cause sea level rise or chronic heat waves.[31] Additional gaps include focusing on mining sites' limited exposure to climate hazard(s) and not on the underlying vulnerability; overlooking the number of company operations that could amplify climate risks for workers, communities, and nature; and failing to prioritize responses to the most material climate risks.

Business case for better climate risk management

There are financial reasons for mining companies to better understand their climate vulnerabilities to inform decisions that can effectively mitigate impact, manage risk, and contribute to resilience and greater prosperity. According to the Global Commission on Adaptation, early action on adaptation brings a triple dividend of avoided losses, economic benefits, and social and environmental benefits.[32] Similarly, the World Bank has found that every $1 invested in resilient infrastructure in low- and middle-income countries yields an average of $4 in net benefits.[33]

Conversely, the inability to demonstrate effective management of risks and vulnerabilities can come with financial consequences, potentially making it more difficult for mining companies to access capital. Leading investors—including the Global Investor Coalition on Climate Change, which represents $24 trillion in assets, and BlackRock, the largest asset manager in the world with $5.1 trillion under management—expect companies to have climate change strategies in place and provide assessments of how climate change would affect their business.[34] Insurers, too, are becoming increasingly reluctant to cover climate-related losses that should have been anticipated or addressed.[35] (See Section 6 for more on financing.)

Challenges with current approaches to climate risk assessment

Many companies are already conducting climate risk assessments (CRAs), and they typically have a sound understanding of the transition risks that could impact operations. Current approaches to managing physical climate risks tend to focus on the vulnerability of a mining operation and developing adaptation responses to reduce immediate business and financial impacts. However, climate change creates a complex ecosystem of interconnected impacts between the natural and human environment that could lead to livelihood disruptions, food insecurity, climate-related migration, heightened risk of water pollution and waterborne diseases, and drought-induced competition for water resources.[36] These oversights contribute to underestimating and misdiagnosing climate risk, hindering effective adaptation and amplifying financial losses.[37]

Many CRA tools fail to consider the impact of multiple hazards at the same time—like heat and drought—or the interaction of climate and non-climate risks that can cause a ripple effect of damage and loss across a wider region. Instead, they tend to examine different hazards and exposure levels independent of other risks. Companies relying on these tools might have blind spots, making it more difficult to ensure that they have adequately addressed the full range of risks. And they could wind up taking actions that increase risk or result in maladaptation.[38]

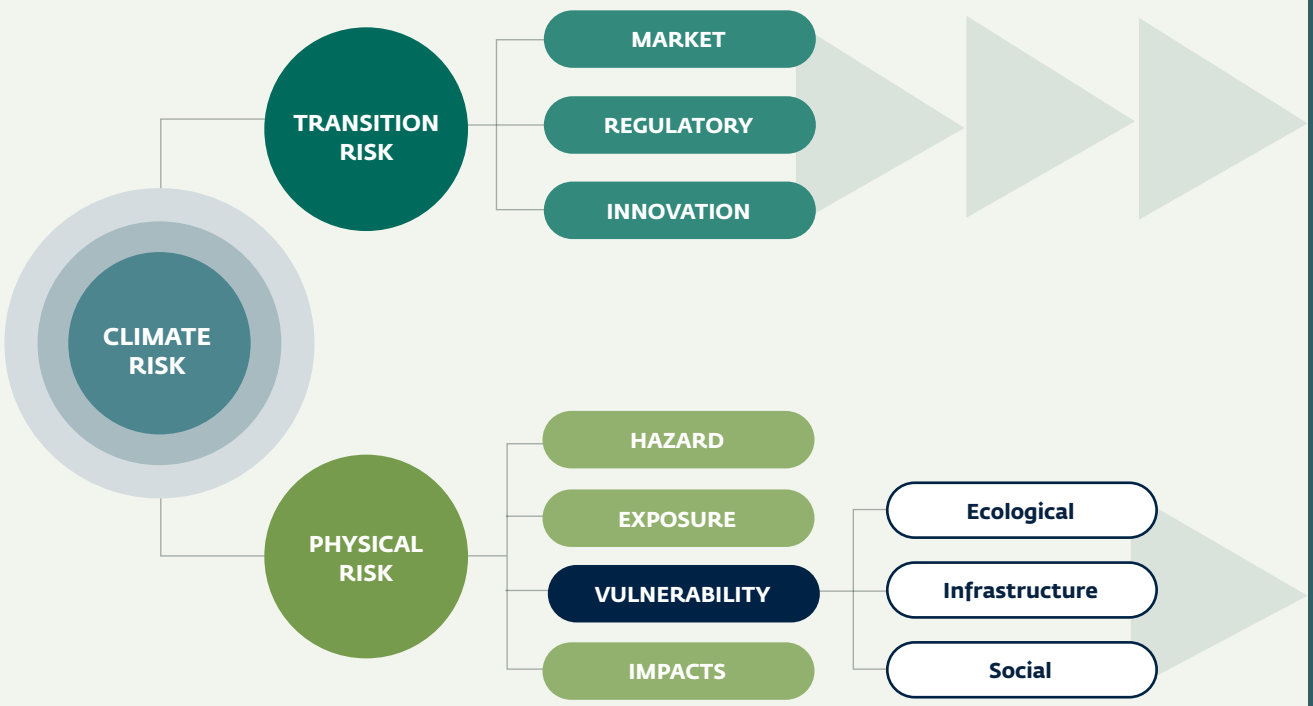
While these tools provide accurate projections about future climate trends, inherent uncertainties remain, particularly at finer geographical scales and longer time horizons. Effective climate risk assessment relies on integrating multidisciplinary insights, including reliable climate data, to provide actionable guidance for decision making. Still, these tools can offer reliable analysis for mining companies to identify material climate risks and plan for adaptation. However, few companies are developing corporate climate adaptation plans through consultation and co-creation with diverse groups and impacted communities. As such, the concerns and capacities of communities are rarely considered in planning. This can elevate exposure and vulnerability to hazards, increasing the potential that communities could wind up bearing the brunt of the impact.[39]

An improved methodology for climate risk assessments

A more comprehensive approach to climate risk assessments should account for the fact that climate risks are complex, cascading, and compounding in nature. These assessments should consider the ways in which mining might contribute to and interact with underlying vulnerabilities, capturing all the risks that might affect the company, its operations, workforce, communities, and supply chains.

Figure 3.1.

Vulnerability is a gap in company climate risk assessments



This means moving beyond a narrow approach to assessing risk through the lens of on-site climate hazards and using a systematic methodology that integrates the three dimensions of climate risk—hazard, exposure, and vulnerability–and considers the full range of off-site risks (figure 3.1).[40] It also involves understanding the potential impacts of climate change on the company's direct operations, the full upstream and downstream value chain, and frontline communities in the short-, medium- and long-term time frames under different scenarios. It requires building mine-specific climate datasets that consider site characteristics, such as size, location, geography, associated infrastructure, and project lifecycle. This enhanced approach calls for a company team of multidisciplinary experts with experience in climate science, engineering, social sciences, environmental science, finance, risk management, human resources, community, procurement, operations, planning, and critically, local context. (See table 3.1 for climate data sources and box 3.1 for a comprehensive CRA checklist.)

Effective climate risk assessment accounts for the fact that climate risks are complex, cascading, and compounding in nature.

RESOURCES & TOOLS

- TCFD framework

Table 3.1.

Sources for climate data

Source	Type	Resolution	Cost	Reliability
Coupled Model Intercomparison Project (CMIP)	Global Climate Models (GCM)	100-250 km	Free	Coarse spatial resolution
CORDEX	Downscaling (Regional Climate Models)	10-50 km	Free	Improved spatial resolution
ERA5	Reanalysis datasets	30 km	Free	Reliable for past climate conditions
World Bank Climate Change Knowledge Portal	Open source	Varies	Free	Using the latest climate data and scientific research available

This upgraded approach also means making use of participatory processes in identifying and analyzing the various exposures, vulnerabilities, and impacts that could occur depending on different scenarios. Such engagement should include community members—including Indigenous People, women, and youth—and local experts as well as workers, all of whom will bring different voices and perspectives, offering insights into how climate risk is affecting operations and the surrounding areas. Ultimately, these engaged community members will become agents of resilience within their own households and networks.

Communities are often at the forefront of managing the impacts of weather. They represent a valuable source of knowledge to inform the physical risk assessment process. Including community stakeholders ensures a comprehensive understanding of the risk universe and helps build social capital and trust between the company and the community. It can heighten understanding of underlying vulnerabilities, ensure coordination of onsite and offsite adaptation interventions, and draw in knowledge, while securing buy-in for action.

Investing in climate learning and expertise within the company's staff and leadership also will enhance the ability to develop robust CRAs. Doing so will increase the number of staff across the entirety of the company with sufficient climate literacy to understand and respond to physical climate risk. In recent years, many companies have distributed responsibility for leading decarbonization efforts throughout the C-suite. Ensuring that knowledge of climate risk and resilience is included in the profile of members of corporate boards—and as part of board training—can help improve the quality of climate-related oversight. Other actions companies can take to direct corporate decision making towards climate adaptation include integrating climate considerations in their emergency preparedness and response plans (EPRPs) and occupational health and safety (OHS) manuals. (For a terms of reference to undertake a comprehensive CRA, see Appendix A.)

CHECKLIST

Comprehensive climate risk assessment

- ☑ **Involve cross-functional staff teams: operations, environmental and social, human resources, risk and legal, engineering**
- ☑ **Involve diverse community representatives, including women, youth, and Indigenous Peoples throughout assessment process**
- ☑ **Set baseline conditions by collecting historical climate data and climate projections using best-available science:**
  - Cover the full set of acute and chronic climate hazards
  - Break down on- and off-site hazards
    - Analyze climate variability and hazards across all geographies
    - Inventory climate hazards using past, present and future projections
  - Incorporate mine site characteristics
    - Size
    - Location
    - Geography
    - Infrastructure and lifecycle
- ☑ **Collect data and knowledge on vulnerability and root causes:**
  - Include socioeconomic factors, infrastructure, ecosystems, and other relevant parameters
  - Engage with local experts to conduct stakeholder interviews
- ☑ **Assess company assets, systems, workforces, communities, and stakeholders for exposure to climate hazards**
  - Identify critical geographies and aspects of the business in the path of hazards
  - Review literature and exposure datasets for current and future projected changes in population, infrastructure, and land use
- ☑ **Analyze physical, ecological, and social vulnerability of the company, the broader supply chain, and frontline communities:**
  - Review literature and vulnerability-related datasets to inform analysis
  - Prioritize engagement with frontline communities to identify vulnerabilities
  - Interview local and subject-matter experts; value chain stakeholders to validate and add to the analysis
  - Consider additional indicators to diagnose underlying drivers of vulnerability such as:
    - Literacy levels
    - Unemployment rates
    - Infrastructure quality
    - Poverty rates
    - Class and social structures, including gender norms
- ☑ **Develop risk scenarios based on:**
  - Combined hazard, exposure, and vulnerability information
  - Compounding and cascading risks
- ☑ **Estimate anticipated impacts and costs**
- ☑ **Assess the likelihood and severity of different impacts**
- ☑ **Integrate the results of the climate risk assessment across all core business strategies:**
  - Identify and quantify impacts on:
    - Infrastructure
    - Operations
    - Workforce
    - Communities
    - Ecosystems and biodiversity
- ☑ **Assess the financial impacts of climate risk on:**
  - Revenues
  - Expenditures
  - Assets and liabilities
  - Financial capital
- ☑ **Publish the results of the CRA**
- ☑ **Develop a risk management action plan**
  - Engage in participatory processes to develop resilience strategies based on boosting adaptive capacity
  - Prioritize adaptation solutions to address risks and opportunities across:
    - Water
    - Energy
    - Infrastructure
    - Land
    - Workers
    - Communities
- ☑ **Set timeframes for implementation of solutions**
- ☑ **Quantify the benefits of resilience**
- ☑ **Monitor progress and reassess climate risks on a regular basis**
- ☑ **Communicate the findings to internal and external stakeholders**

> **As with all risk assessment and management processes, implementation and outcomes are not static. Climate risk assessment and management are continuous processes. As vulnerabilities evolve, risks should be re-assessed every 2-5 years, along with re-evaluation of adaptation pathways. The shifts in the cycle will depend on the changes that will occur to mining infrastructure and operations; population demographics, social structure and local economy; and biodiversity and natural environment. Other factors that could influence changing vulnerabilities and the need to adjust approaches include advances in climate science, data analytics and datasets, and updated projections of future climate conditions.[41]**

MINING COMPANY EXPERIENCE

Assessing climate risks

Newmont anticipates heightened climate risks

Newmont has first-hand experience with the impacts of more intense and more frequent rainfall events. At company sites in Australia, Suriname, and Texas, severe rainfall flooded access roads, contributed to pit-wall slides that halted mining activities for months, caused damage to nearby communities, and prevented the delivery of critical supplies. And at a company site in Peru, employees took time off from work to assist in community clean-up after an extreme El Niño event dramatically increased rainfall, affecting production output.

- The company estimates annual financial impacts from such events ranging between $65 million and $130 million, depending on the year. As a result, Newmont has heightened its focus on monitoring and location-specific scenario planning. Among the anticipated risks they are planning for:
- Reduced power supply reliability and greater disruption to inbound supply chain and outbound product distribution due to extreme events.
- Increased rainfall that could flood mine pits, on-site warehouses, and storage areas.
- Stronger storm intensity that could delay the transport of workers and critical goods/supplies.
- Extreme heat leading to more large-scale wildfires.
- Droughts and decreased precipitation that affect hydroelectric power supply and add to water insecurity, impacting production, water quality, and operating costs.[42]

Rio Tinto zeros in on sites with elevated climate risk

Rio Tinto has identified several sites that are highly exposed and vulnerable to climate risk. Based on what they call "severe but plausible" scenarios, planners estimate costs running as high as $2.2 billion. Assumptions include a single catastrophic event, major operational failure, and shipment disruptions of up to four weeks.

Such planning is not unrealistic, given the company's past experience: In 2006, its Pilbara operations weathered six cyclones, which flooded mines and disrupted operations for several weeks. In 2009, flooding shut down part of Rio Tinto's railway network while bridges and culverts were repaired. And in 2013, Tropical Cyclone Christine caused operational disruption and a loss of essential services to residential towns. Other sites in Queensland, Australia also face exposure to climate-related problems, including Gladstone, which is vulnerable to storm surge and sea-level rise, and Weipa and Amrun, which must deal with rising temperatures, impacting worker health and safety.[43]

Peru, IFC

Freeport-McMoRan takes a geography-specific approach to climate risks

Freeport-McMoRan has a global footprint, with operations in multiple regions with varied climates. Using different climate scenario analyses across time frames, the company anticipates:

- **Arizona, USA:** A 20 percent increase in significant rainfall frequency and a 5 percent increase in intensity, with a 20 percent projected increase in the total precipitation during each event. These same facilities are also expected to experience overall declines in annual rainfall and extended periods without rain, as the character of rainfall changes to short, intense bursts of extreme rainfall followed by longer dry spells in between, in contrast to steady, dependable rainfall throughout the rainy season. Arizona operations will see large future increases in heat-wave days, ranging between 25 and 69 days by 2050, causing losses in labor productivity.[44]
- **Chile and Peru**: Many more heat-wave days, extended periods without rain, and increased water stress.
- **Indonesia:** Significant risk of extreme events linked to sea-level rise at the critical Amamapare port. This could lead to severe disruption in the delivery of essential materials and exports of commodities to markets. It also exposes the coastal power plant that supplies the port to risk of damage and shutdown, thus increasing the likelihood of power outages to their operations.
- **Global:** The company estimates a decline in total annual rainfall ranging between 5 percent and 11 percent by 2050 across all operations.[45]


Mongolia, IFC

4

Building Resilience *and* Adaptation Pathways

How mining companies are taking action

Adaptation involves adjusting to and managing unavoidable climate change and its impacts, to moderate harm and take advantage of opportunities.[46] It includes changes in infrastructure, institutions, behaviors, practices, skill sets, systems, and knowledge to cope with anticipated climate change impacts. To date, the mining industry has often taken a fragmented approach to adaptation. Typically, focus is on community investments and nature-based solutions around a particular site rather than on comprehensive, strategic, and corporate-wide investment across human, natural, financial, and physical capital assets. Genuine and transformative adaptive capacity requires strengthening human rights, addressing inequalities, empowering women, and improving access to services for communities that have historically borne a disproportionate share of climate impacts and costs.

While the mining industry as a whole lags on this more comprehensive approach, some mining companies have advanced efforts to address adaptive capacity in a more holistic way. Examples of such efforts are highlighted throughout this section.

Using the climate risk assessment to define adaptation priorities

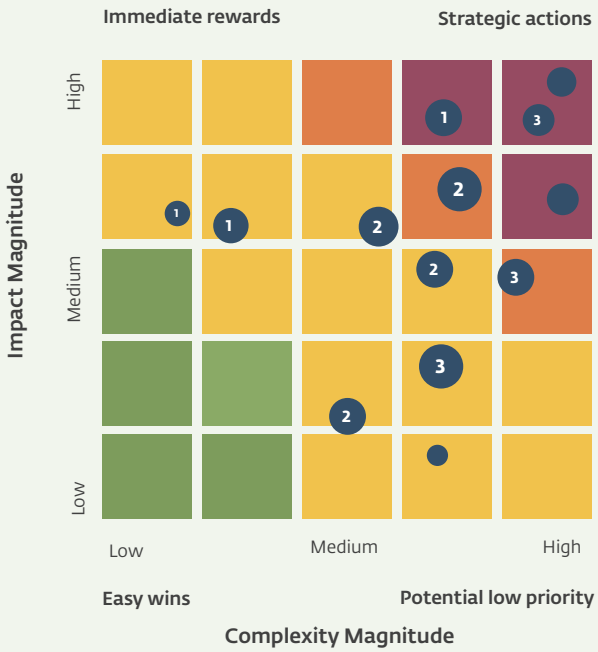
The lines between where comprehensive climate risk assessment ends and effective adaptation planning begins can blur, underscoring the continuous nature of the process, given the dynamic nature of global climate conditions. Conducting routine CRAs, as well as monitoring, measuring, reviewing, and updating solutions will ensure that the company's adaptation approach can adjust as conditions change—enabling sustained climate resilience. Therefore, adaptation action plans must be agile, incorporating new and improved insights from the best available science and analytics to preemptively shift approaches as changing socioecological conditions demand.

Participatory processes play a key role across all adaptive solutions planning, design, and implementation efforts, ensuring input from all climate-affected parties throughout the mining value chain. So, too, does benchmarking—learning lessons from peers across the industry or in other sectors to avoid duplicating investments that may inadvertently reduce adaptive capacity and increase climate risk exposure, as well as to accelerate successful adaptation solutions.

Another step that could guide adaptation planning is to use a heat map to categorize risk for each vulnerability and the complexity of implementing risk management controls, which can help prioritize adaptation strategies. A two-dimensional heat map would highlight critical areas where immediate, high-impact actions can be taken with relatively low complexity. Figure 4.1 shows a visual representation of a heat map that could be used to prioritize adaptation actions.

Figure 4. 1

Heat map of climate risk vulnerabilities and impacts



This heat map organizes adaptation actions by impact (vertical axis) and complexity (horizontal axis). High-impact, low-complexity actions are quick wins, while high-impact, high-complexity actions need strategic focus.

Boosting adaptive capacity in four areas

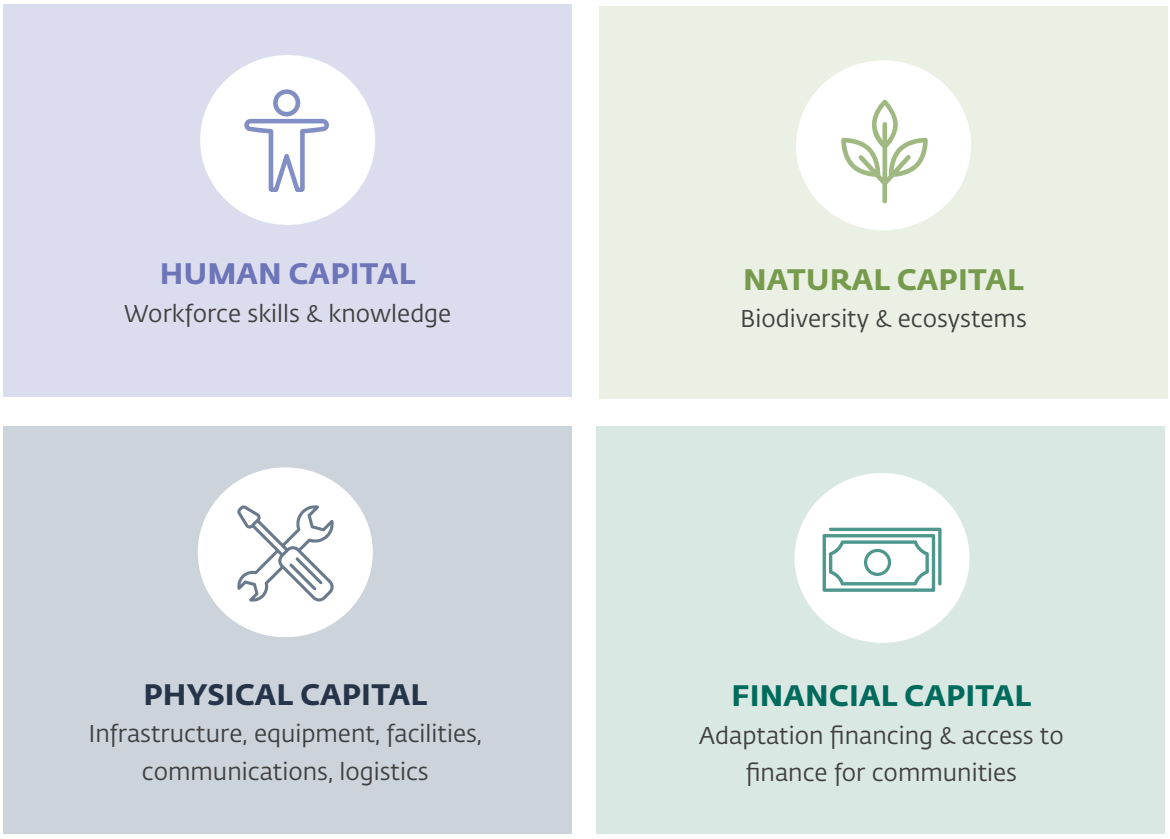
Global good practices suggest a framework for resilience strategies and solutions based on investing in several key areas to enhance adaptive capacity across human, natural, physical, and financial capital assets (figure 4.2).

Investing in these interdependent capacities can address underlying causes of vulnerability, such as poverty, inequality, and environmental degradation and increase the adaptive capacities of key stakeholders. Doing so also can mitigate climate impacts on water, infrastructure, biodiversity, ecosystems, and worker well-being, among others—all critical to the long-term viability of the mining site and the development and sustainability of frontline communities.[47]

Mining companies that have invested in enhancing adaptive capacity have unlocked opportunities to reduce costs, preserve or enhance revenues, avoid operational disruptions, improve stakeholder relationships, and ensure compliance with evolving regulatory policies.

Figure 4. 2

Four capital assets for climate-resilient mines and mining communities



Guinea, IFC

HUMAN CAPITAL

Investing in people

These investments are designed to improve climate adaptation, energy transition, and resilience-related skills and knowledge, particularly within the company itself, but also within frontline communities and the workforce. Examples include leadership, workforce, and household climate change education, upskilling, and evacuation preparedness training.

Pilbara Minerals builds Indigenous workers' digital skills in Australia

To decarbonize the company's operational footprint and improve productivity and mine safety, Australia-based Pilbara Minerals upgraded its vehicle fleets to autonomous haulage systems. But this transition also led to a drastic reduction in the number of truck drivers needed and an increase in the number of digitally literate workers needed. The new requirements also meant excluding under-skilled Indigenous workers. In a region of Australia lacking in alternative economic opportunities, this created challenges for local community members. To address the skills gaps, the company is collaborating with regional authorities on reskilling and retraining programs, focused on areas such as mechatronics, robotics, and data analytics. Launched in June 2019, these collaborations resulted in the first nationally recognized course in automation, giving students advanced skillsets that are transferable across multiple industries.[48]


Mongolia, IFC

In Mongolia, miners and communities agree on shared water stewardship

Mongolia's South Gobi is an arid region endowed with significant copper, gold, coal, and other natural resources. An uptick in mining activity and widespread use of irrigated agriculture alongside traditional herding livelihoods has exacerbated water shortages brought on by climate change and degraded water infrastructure. This has affected all concerned, including exploration and mining companies, local residents, and herders. Against this backdrop, IFC brought together 12 exploration and mining companies operating in the Gobi region to improve their water management and community engagement practices. Working together with local communities, activists, and government representatives, the group developed a code of practice on shared and responsible water management. Additional efforts included training for community, government, and mining company stakeholders to improve understanding of mining and groundwater systems, participatory water monitoring programs to increase transparency on mining impacts on water resources, and strengthened communications, among others—all of which has led to improved relationships and enhanced water stewardship.[49]

Newmont invests in capacity building for disaster preparedness

Newmont contributed funds to the American Red Cross Global Disaster Preparedness Center, which supports learning, knowledge sharing, innovation, and networking among disaster preparedness practitioners worldwide. The funding will enable the development of an early warning system for communities in Latin America and the Caribbean. It also supports Limitless, a global initiative that identifies and supports youth-led innovations to enhance community climate-change resilience.[50]

NATURAL CAPITAL

Investing in biodiversity, habitats, and ecosystems

Natural assets include the full range of services provided by biodiversity and ecosystems, including land and water. Mining companies have multiple avenues to invest in nature, such as wetlands preservation, reforestation, conservation, revegetation, and support for regenerative agriculture.[51]

Australia, Adobe Stock

BHP invests in mangroves for coastal defense and blue carbon credits

In 2022, BHP launched a new grant program to support blue carbon projects in Australia. Blue carbon refers to the carbon trapped and stored in vegetated, coastal ecosystems—primarily mangroves, tidal marshes, and seagrasses. The project aims to restore more than 200 hectares of degraded coastal wetlands near Victoria to protect endangered shorebirds, enhance carbon capture within the coastal wetlands, and improve the health of Wadawurrung Country's residents. Investing in the protection and restoration of coastal wetlands is a highly effective natural climate solution for removing carbon dioxide from the atmosphere and locking it away in the soil. Coastal wetlands can trap carbon and reduce a company's carbon footprint, while providing a range of services that also will help mining companies adapt to the impacts of climate change. For example, mangrove forests increase resilience to sea-level rise and extreme weather events by stabilizing the coastline and reducing the strength and height of waves. In addition, they can provide food and livelihoods to coastal communities, enhance wildlife biodiversity, and provide recreational opportunities.[52]

PHYSICAL CAPITAL

Investing in buildings, equipment, and infrastructure

Mining companies' physical assets span infrastructure, equipment, facilities, logistics, communications, utilities, and even agricultural land. Investments in adaptive capacity upgrades to protect physical assets include improved coastal defenses, green infrastructure, and early warning systems.

BHP integrates adaptation measures into the design of its facility expansion plans

Disruptions caused by extreme weather events, such as cyclones overtopping port infrastructure, led BHP to integrate resilient design measures into its facility in Queensland, Australia. By constructing higher marine infrastructure, including a replacement trestle and a new loading facility, BHP ensured that the increasing storm intensity and storm surge levels didn't affect their operations. Disruptions from cyclones, such as production shutdowns at Western Australia Iron Ore (WAIO), have led to adaptive management practices that allow WAIO to respond to the risk of heightened cyclone intensity in the Pilbara region. Water scarcity and quality impacts have also led to desalination investments in Chile.[53]

Rio Tinto uses climate data to build resilient infrastructure

Climate data is a key consideration when designing important features like drains, spillways, and slopes for tailings storage facilities so that they can withstand climate impacts. Rio Tinto has developed a climate change resilience assessment methodology (CCRA) to understand how climate change might impact tailings storage facilities. The CCRA involves:

- Assessing key features such as drains and slopes.
- Comparing the design to what the future might hold based on climate change projections.
- Identifying the risks and their consequences.
- If a key feature is deemed vulnerable, creating a plan to further assess and mitigate the risks.[54]

FINANCIAL CAPITAL

Investing in communities' access to adaptation funding

Studies suggest that the greatest gains in well-being come from prioritizing access to finance to reduce climate risk for low-income and marginalized communities, including people living in informal settlements.[55] Efforts here focus on increasing financial flows for adaptation and expanding financial services to frontline communities. Examples include forecast-based financing, crop insurance, access to financial services, and payment for ecosystem services.

Mining companies support investment in upgraded municipal water systems, gain cost savings as a result

Rustenburg, a municipality in the northern part of South Africa, has long faced water supply challenges. Mining activity has grown in the region, representing a dominant economic force and job creator—accounting for 50 percent of all formal jobs. The expansion in mining activity has also attracted new residents, leading to increased demand for water. But outdated and insufficient water infrastructure struggled to meet this rising demand. In 2000, a wastewater treatment facility reached its capacity limit and overflowed, polluting a nearby river. But burdened with a poor credit score, the municipality could not raise the funds for improvements to water infrastructure.

In 2003, a novel consortium came together, including the municipality, the local water utility, a bank, and a consulting firm, creating as a special purpose vehicle called Rustenburg Water Services Trust to partner with the private sector on water projects. The trust signed a 25-year concession contract to finance, upgrade, and operate water infrastructure, enabling the creation of a bulk water and sewage system. Two mining companies, Anglo American Platinum and Impala Platinum, agreed to purchase the non-potable treated wastewater produced, which has helped them reduce reliance on imported water.[56]

Barbados, IFC

5

Committing *to* Adaptation

With climate risks identified, resilience strategies defined, and adaptive capacity investments prioritized, the next step involves making tangible commitments to action. Publicly committing to adaptation—including setting concrete targets—demonstrates the seriousness with which the company takes climate resilience and ultimately helps ensure social license, as well as financing. As previously noted, investors and insurers are interested in ways in which mining companies are addressing their climate risks—including attending to the broader social and environmental context outside the perimeter of mining operations while making financial decisions.

To date, over 10,000 companies, headquartered in 128 countries, have made climate commitments. In addition, IFC has committed to aligning all of its investments with the Paris Agreement's goals, covering mitigation and adaptation priorities.[57] And nearly 4,000 companies and financial institutions, including 121 mining companies, have signed on to the Science-Based Targets initiative (SBTi), in which companies set greenhouse-gas emissions reduction targets consistent with reaching net zero emissions by 2050.[58]

However, few companies have set similar targets related to adaptation strategies, freshwater conservation, or biodiversity conservation and restoration.[59] And within the critical minerals and minerals sector, there is little integration or standardization of adaptation-related commitments.

Building on the decarbonization commitment model

The growing use of decarbonization commitments offers an instructive model for developing adaptation commitments. A look at the structure of such commitments reveals that they typically include robust design architecture, ambitious targets, solutions that allow companies to reduce emissions over time, and transparency on emissions reduction calculations methodology and disclosure. This helps ensure integrity and impact. Using these same structural elements, underpinned by a comprehensive CRA, the resilience strategy, and a prioritized list of investments in on- and off-site adaptive capacity, companies can develop robust adaptation commitments.

The SBTi offers a good case study on how corporate-level climate commitments could be incentivized and adopted across sectors. Primarily focused on the push for decarbonization, SBTi has contributed significantly to raising corporate climate ambition, particularly in the mitigation area. With their SBTi commitments, companies have improved their understanding of climate change, created greenhouse-gas inventories to baseline their emissions, set targets, and identified solutions to meet the targets. They also have developed collaborative initiatives that enable emissions reduction in partnership with peers across the industry, along the supply chains, and in other sectors. Similar efforts should be encouraged for corporate-level reporting on adaptation commitments.

Illustrative adaptation commitments to build climate resilience in the mining sector

Climate adaptation is context-, time-, and sector-specific. Solutions and commitments to boost adaptation in mining must account for such factors. They should:

- Have a basis in science and be built on a robust, site-focused CRA.
- Include tangible plans based on adaptation pathways identified by the IPCC or other credible sources.
- Span the four capital assets—human, physical, natural, and financial.
- Feature immediate action rather than promises to act later.
- Address risks identified across scales—such as impacts on households, communities, and company operations.
- Include plans to strengthen stakeholder capacity and enable organizations and processes that can work across these scales.

What follows are suggestions for five types of adaptation commitments—"no-regret" actions that maximize positive aspects of adaptation strategies, minimize negative aspects, and can yield adaptation benefits.[60]

Figure 5.1

Adaptation commitments to build climate resilience in mining

Implementing adaptation commitments can help companies:

- Minimize or avoid asset damage
- Improve workforce health and safety
- Strengthen alignment with communities
- Enhance government relations
- Gain co-benefits
- Maintain a stable operating environment

ADAPTATION COMMITMENTS

1. Water stewardship
2. Strengthened human rights
3. Disaster preparedness and early warning systems
4. Conservation restoration, and nature-positive future
5. Climate governance and skills development


Mongolia, IFC

ADAPTATION COMMITMENT

1 Water stewardship

Rationale

Water stewardship is the use of water in ways that are socially equitable, environmentally sustainable, and economically beneficial.[61] Given the number of mining operations in water-stressed catchments, mining companies need to consider how climate change coupled with usage patterns will increase water stress, both for their own operations and for frontline communities. Effective stewardship requires collaboration and concerted action from all parties, including government, civil society, business and local communities through inclusive stakeholder engagement.

Commitments to water management for adaptation should be backed by quantifiable, verifiable, and attributable targets. For example, mining companies can commit to assessing current pressure on water quantity, depending on changing climatic conditions. And they set targets to reduce such pressure. Another commitment might involve reducing impacts on fresh water from mining operations and discharges, thereby improving water quality across value chains. Doing so could also be a way to relieve demand pressures on availability, while enabling socioenvironmental co-benefits. Several mining companies have already taken action to apply sectoral guidance for setting context-based water use targets.[62]

CHECKLIST

Water stewardship

Apply strong and transparent corporate water governance principles:

- Publicly disclose the company's approach to water stewardship for adaptation.
- Allocate clear responsibilities and accountabilities for water governance and management:
  - Board/steering committees
  - Corporate management
  - Site level
- Integrate water considerations in business planning:
  - Company strategy
  - Asset lifecycle
  - Investment planning
- Publicly report company water performance, material risks, opportunities, and management response using consistent industry metrics and recognized approaches.

Effectively manage water in operations:

- Maintain data on water balance.
- Understand how water balance relates to the cumulative impact of other users in light of extreme climate conditions.
- Set context-relevant water targets or objectives for sites with material water-related risks.
- Proactively manage water quantity and quality to reduce potential socioenvironmental impacts and realize resilience and adaptation opportunities.
- Ensure all employees have access to:
  - Clean drinking water
  - Gender-appropriate water sanitation and hygiene (WASH) facilities

Collaborate to achieve responsible and sustainable water use:

- Identify, evaluate, and respond to catchment-level water-related climate risks and opportunities.
- Identify and engage proactively and inclusively with stakeholders:
  - Those influencing water use and discharge.
  - Those affected by a site's water use and discharge.
- Support water stewardship initiatives that promote:
  - Better water use
  - Effective catchment
- Actively engage on external water governance issues:
  - Partner with governments, local authorities and other stakeholders.
  - Support predictable, consistent, and effective regulations to underpin integrated water resource management.

RESOURCES & TOOLS

- IFC Voluntary Code of Practice on Water Management
- ICMM Water Stewardship Maturity Framework
- WRI's Aqueduct Tool


Guinea, Stephanie Sines, IFC

ADAPTATION COMMITMENT

2 Strengthened human rights

Rationale

Intersecting social, cultural, economic, legal, and political inequalities exacerbate socioecological vulnerability and lead to disproportionate impacts on workers and marginalized communities, including Indigenous populations and women. This amplifies climate risk and results in weaker adaptive capacities.

Human rights issues are particularly relevant for mining companies at a time when many of the same countries with abundant natural resources are affected by violent conflict and/or high degrees of institutional and social fragility.[63]

Although human rights considerations are the government's responsibility, a company does have control over several important issues, such as labor rights, health/pollution prevention, involuntary resettlement, cultural heritage preservation, and community engagement. Identifying and involving vulnerable and marginalized groups as partners in the development of on- and off-site resilience strategies can ensure that they benefit equally from the investments in adaptation. In addition, enabling access to information, decision making, and grievance mechanisms is particularly important to communities.

CHECKLIST

Strengthened human rights

- **Integrate human rights considerations in physical climate risk assessment:**[64]
  - Locate high-risk areas for at-risk groups.
  - Clarify the scope of company responsibility.
  - Identify remedies for actions that undermine the realization of human rights.
- **Provide fair pay and working hours:**
  - Set wages that equal or exceed legal requirements or represent a competitive wage within the job market (whichever is higher).
  - Assign regular and overtime working hours within legally required limits.
- **Respect the health and safety of workers:**
  - Call on suppliers to do the same.
  - Address growing heat-related risks for workers.
- **Respect the rights, interests, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples in project design, development and operation:**
  - Anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, communities, and the environment.
  - Deliver sustainable benefits.
- **Obtain free, prior, and informed consent (FPIC) of Indigenous Peoples:**[65]
  - Identify locations where significant adverse impacts could occur.
  - Factor in impacts of relocation and disturbance of cultural heritage lands and territories.
  - Capture the outcomes of engagement and consent processes in agreements.
- **Integrate a gender focus in all aspects of adaptation planning and implementation.**
- **Ensure access to an effective grievance mechanism:**
  - Enable early warnings about and swift remediation of project-related issues.

RESOURCES & TOOLS

- ICMM Mining Principle on Human Rights
- IFC Performance Standards
- UN Guiding Principles on Business and Human Rights

Indonesia, Adobe Stock

ADAPTATION COMMITMENT

3 Disaster preparedness and early warning systems

Rationale

Establishing and improving early warning systems for extreme weather events, such as hurricanes, floods, and wildfires enables the flow of accurate and up-to-date information. This can help the company and communities prepare and respond effectively, thereby reducing recovery time and disruption after the events. Such preparation and response can minimize damage and lower recovery costs.

CHECKLIST

Disaster preparedness and early warning systems

- **Support efforts to improve hazard forecasting and early warning notification systems:**
  - Partner with government hydrometeorological agencies and other stakeholders.
- **Invest in equipment and facilities to improve forecasting and extreme weather monitoring:**
  - Weather stations
  - River gauges
  - Weather technologies
  - Other observational infrastructure
- **Share information on extreme weather events with local authorities and communities:**
  - Forecasts
  - Exposure/hazard maps
  - Impact data
- **Develop robust contingency, disaster preparedness, and response plans:**
  - Partner with government disaster management agencies and civil society organizations.
  - Account for changing risks due to climate change.
  - Include company operations and frontline communities.
- **Convene regular drills, tabletop exercises, and simulations with relevant stakeholders:**
  - Test the effectiveness of disaster preparedness and response plans.
  - Identify gaps.
  - Improve coordination.
- **Set up reliable emergency communication channels:**
  - Include backup communication methods to ensure the flow of information between responders, authorities and the public.
  - Conduct frequent tests to ensure functionality.

RESOURCES & TOOLS

- Common Alerting Protocol
- Global Facility for Disaster Reduction and Recovery
- Public Awareness and Public Education for Disaster Risk Reduction (PAPE)
- World Bank Climate and Disaster Risk Screening
- Climate Centre

ADAPTATION COMMITMENT

4 Conservation, restoration, and nature-positive future

Rationale

Ecosystems that provide essential services to humans are experiencing warming that alters their structure, composition, and functioning.[66] This degradation affects company operations and surrounding communities, increasing climate exposure and vulnerability. Reversing such losses and creating the conditions needed to achieve transformation will be critical to ensuring climate resilience and long-term operational sustainability.

Commitments here should apply to activities across all four realms of nature—land, freshwater, oceans, and atmosphere—and across the company's entire sphere of influence, including direct operations, value chains, and broader market connections.

Kenya, Adobe Stock

CHECKLIST

Conservation, restoration, and nature-positive future

- ☑ Protect and conserve pristine areas of the natural environment, with no mining or exploration in World Heritage Sites or legally designated protected areas.
- ☑ Mitigate biodiversity loss at operations, with at least no net loss of biodiversity at all mine sites by closure, against a 2020 baseline.
- ☑ Set targets to reduce nature-related impacts.
- ☑ Collaborate across value chains with initiatives and partnerships that halt and reverse nature loss throughout supply and distribution chains.
- ☑ Restore and enhance landscapes around operations through partnerships with Indigenous Peoples, land-connected peoples, and local communities.
- ☑ Catalyze wider change to the fundamental systems that contribute to nature loss and foster opportunities for nature's recovery.
- ☑ Report and disclose the results of nature-related impact and dependency assessments, along with performance outcomes.[67]

RESOURCES & TOOLS

- ICMM Position Statement on Nature
- IFC Biodiversity Reference Guide
- World Bank Forest-Smart Mining: Guidance to Applying Nature-Based Solutions in the Mining Sector
- Science-Based Targets Network
- Task Force on Nature-Related Financial Disclosure
- Pollination Nature Positive Strategy


Mongolia, IFC

ADAPTATION COMMITMENT

5 Climate governance and skills development

Rationale

Managing risk and enhancing climate adaptation requires investment in human capital, including company leadership and workforce, as well as suppliers and community members. Current and future disruptions from climate change, automation, and the changing footprint of mining will all require new knowledge and information. Without investment in human capital, there is a risk of further elevating the exposure and vulnerability of community members who might lack the technical skills to qualify for increasingly technical jobs.

CHECKLIST

Climate governance and skills development

- **Conduct skills gaps assessments:**
  - Identify skills and jobs that are at risk from:
    - Increased mining activity
    - Use of new technologies such as automation and digitization
- **Develop worker resilience plans:**
  - Address ways to retain, upskill, and redeploy employees and contract workers.
  - Include upskilling needed to drive inclusive economic participation and diversification beyond mining.
- **Prepare workers and local communities for post-mine closure life to strengthen their autonomy and resilience:**
  - Collaborate with local governments.
  - Support initiatives that strengthen:
    - Health awareness
    - Technical skills
    - Vocational training and entrepreneurial skills development
    - Science, technology, engineering and mathematics (STEM) education
- **Identify existing inequalities at an asset level.**
- **Adapt operational procedures and procurement policies to reduce inequalities:**
  - Develop standards and initiatives to boost recruitment, hiring, and investment in vulnerable and affected groups.
  - Prioritize local procurement.
  - Improve gender balance of workforce.
  - Support skills development for women-owned suppliers and entrepreneurs.
- **Enable access to green, formal, and decent jobs in the transition away from high-carbon assets:**[68]
  - Workers
  - Communities
  - Across the supply chain


Guineaa, IFC

6

Financing Adaptation

Instruments and innovative mechanisms

This section details the current landscape for adaptation finance, offers insight into the role mining companies can play in boosting resilience by investing in adaptation, and provides an overview of the types of financing mechanisms available—as well as their potential for unleashing needed funding flows towards adaptation.

The adaptation finance gap

The gap between the financial resources required for climate adaptation and the actual funds available is widening, posing a significant challenge to efforts to combat climate change. Countries are struggling to secure the estimated $212 billion needed annually for climate adaptation by 2030. By 2050, this annual financial need is projected to increase to $239 billion.[69]

In fact, despite the encouraging growth in global climate finance, which reached $1.3 trillion annually in 2021–2022, adaptation finance lags behind, representing just 5 percent of the total, amounting to $63 billion per year. This modest increase from previous years is insufficient to meet the growing resilience and adaptation demand.[70]

The cost to fully fund adaptation solutions in developing countries—where many exploration and mining sites are located—is estimated at between $215 billion and $387 billion annually.[71]

However, the current adaptation finance flow is estimated to be only $21.3 billion. If these trends continue, the result would be an annual adaptation finance gap for developing countries of between $194 billion and $366 billion annually—representing financing needs up to 18 times greater than international public finance flows.[72] And adding further strain to already indebted countries: the heavy reliance on debt, which makes up 80 percent of adaptation finance.[73]

The mining sector should take these figures seriously.. For example, mineral resource-rich Africa received just 20 percent of global adaptation finance in 2021–2022, or about $13 billion. This falls well short of the continent's estimated annual need of $53 billion for adaptation between 2020 and 2035: at the current rate of adaptation funding flows, Africa is projected to receive only $195 billion in total by 2035.[74]

Box 6.1

Adaptation finance: Sources and funders

Funds for adaptation come from several sources.

- **Domestic/public:** Including public finance and public procurement.
- **International/public**: Including financing flows to governments from multilateral and bilateral institutions.
- **Domestic and international/private**: Including companies' own investments to upgrade adaptive capacity, technology, services, and products; and adaptation finance provided to companies by financial institutions.

The annual adaptation finance gap for developing countries—where many mining operations are located—ranges between $194 billion and $366 billion each year—representing financing needs up to 18 times greater than international public finance flows.

Adaptation finance considerations for mining companies

The significant gaps in public financing for adaptation amplify the importance of private sector investments in climate resilience to address direct operational climate risks and the climate risks faced by local communities. By extension, these risks threaten entire economies, particularly in developing countries that are heavily reliant on revenues from the mining sector.

Despite the critical need, private sector investment—including by mining companies—remains extremely low, accounting for less than 3 percent of global adaptation finance flows.[75] Among the reasons for the relatively low levels of investment in adaptation and resilience-building are lack of certainty on climate-related risk and vulnerability data to inform capital investment planning, and low perceived or actual returns on investment.

The mining sector can take steps to change this dynamic by investing in sustainable practices such as efficient water management, reforestation projects, and land restoration efforts, all of which support climate resilience. In addition to increasing financial flows for adaptation, companies can also explore ways to expand financial services to frontline communities so they too can invest in resilience. Such efforts can help to change the narrative around questionable returns, by demonstrating significant long-term benefits (See Section 3 for more on financial benefits).[76]

The mining sector can contribute to climate change adaptation and resilience-building by:

- Providing goods and services that facilitate adaptation, including technology innovation and expertise to help identify climate risks and vulnerabilities, and services such as early warning systems.
- Adapting their own operations and assets to become climate-resilient, ensuring business continuity and profitability.
- Investing in adaptation commitments and actions within and beyond operational boundaries.

To support these investments, mining companies can leverage a range of financial instruments, which offer tremendous potential for increasing the flow of adaptation funding. Each comes with different features and characteristics. The variety of options allows for innovation in structuring the design of interventions to align with the needs of involved stakeholders. Diversifying the range of financial tools to include guarantees, local currency swaps, and results-based financing can yield sustainable and effective solutions for funding adaptation initiatives, giving mining companies additional avenues to close the finance gaps and foster climate-resilient practices.

Matching the optimal financing mechanisms with specific interventions can be a complex process. Box 6.2 offers suggestions on the types of issues for companies to consider as they evaluate their financing options.

Despite the encouraging growth in global climate finance, which reached $1.3 trillion annually in 2021–2022, adaptation finance lags behind, representing just 5 percent of the total needs, amounting to $63 billion per year.

Box 6.2.

Financial planning for adaptation investments

To inform financing options, mining companies need to answer several important questions, including:

- What are the hazards / exposure / vulnerabilities to be addressed though an investment?
- How much capital is required?
- How much time is available to structure financing?
- What is the implementation time frame of the intervention?
- What are the quantifiable outcomes expected and over what time frame?
- What potential partners and investors are interested in these outcomes, such as local financial institutions and multilateral donors?
- Are the measures for these outcomes well-accepted by the market or standards organizations?
- Is there a market for the purchase of outputs that are created, such as carbon credits, forestry products, and water treatment byproducts?
- Is it reasonable to expect some financial return on investment?
- Has the climate adaptation intervention model been proven in the market or in similar contexts?
- Which entity will receive funds, such as the mining company itself or a local social enterprise?

Mongolia, IFC

Financial instruments for investing in climate adaptation

Mining companies are likely to be familiar with traditional forms of financing, such as bank loans and capital markets financing. In recent years, new asset classes have emerged that offer additional potential to support companies' climate adaptation investments. This section provides a brief overview of promising mechanisms that are most frequently used by the mining sector to achieve climate commitments—albeit with a focus on emissions reduction targets. There are opportunities to expand the scope of these instruments to include financing for climate-proofing mining assets and to assist local communities in mitigating physical climate impacts to build resilience.

Grants and donor capital

These financing mechanisms aggregate philanthropic capital, potentially from a range of donors, enabling projects that would otherwise not be possible. Foundations, corporations' social responsibility programs, and individual donors share a distinct ability to deploy nimble, responsive, flexible, risk-tolerant, and patient capital in ways that support high-value interventions directly and help de-risk investment from other sources. Historically, mining companies were most likely to invest in climate adaptation through their philanthropic foundations, by issuing grants and conducting technical assistance. Financing mechanisms in this category include:

- **Private trust funds:** Funded by a mining company or consortium of miners to finance legacy issues, regulatory mandates or other priorities.
- **Philanthropic/donor trusts:** Funded by foundations or international development.
- **Technical assistance facilities:** Funded by companies and donors to boost adaptation capacity building. For example, in 2019, the Canadian government provided $325,000 for the Mining Association of Canada, to support the development of best mining sector practices and guidance on climate change risks and adaptation measures.[77]

Results-based financing mechanisms

Rather than financing outputs, these mechanisms deploy donor capital only when pre-determined outcomes are achieved and verified. Initial capital is financed by private capital that is then repaid to investors, presuming outcomes. Such instruments are an effective way to create new climate adaptation markets or initiatives that do not have a track record because they can clearly demonstrate and showcase the impact achieved through these interventions. Examples include:

- **Environmental impact bonds:** Similar to traditional bonds with fixed interest rates and terms, but they offer investors project performance payments/incentives linked to desired environmental outcomes.
- **Performance-based transfers:** Fiscal transfers from a higher level of government conditioned on achieving performance in predetermined areas. The transfers serve as incentives for local governments to improve their institutional performance and service delivery outcomes relating to community resilience in their jurisdictions.
- **Conditional cash transfers:** Cash payments to program beneficiaries, typically poor households that meet certain criteria, such as adopting a climate adaptation behavior.

Performance-based transfers and conditional cash transfers are incentives used by governments to achieve predetermined outcomes. Mining companies can leverage these opportunities by working with national and local governments to implement such mechanisms in conjunction with a company's community climate adaptation strategy. This will create a concerted stakeholder approach, resulting in more efficient and cost-effective delivery, improved implementation, and better outcomes.

Sustainable finance/use-of-proceeds instruments

Sustainable finance refers to any financial instrument with a dedicated use of proceeds focused on eligible categories, including climate adaptation, climate mitigation, social benefits, nature benefits, and ocean conservation. These instruments are usually in the form of bonds and must be aligned with guidelines and principles from organizations such as the International Capital Market Association (ICMA), Loan Market Association (LMA), and IFC (See Resources and Tools). Sustainable finance represents an important avenue for large, credit-worthy companies that want to invest in resilience. Bonds for adaptation are typically timebound, tied to funding a specific, sustainability-focused initiative, and come with a second-party opinion confirming the alignment of the sustainability frameworks with the relevant ICMA or LMA principles. Approximately 16 percent of deals in the green bond market included financing for adaptation and resilience, mostly in water-related sectors.[78] Loans used to finance climate resilience-focused efforts can enable measurable improvements in adaptive capacity. Governments and companies alike are making use of such instruments.[79]

Examples include:

- **Resilience bonds**: These typically involve a special purpose vehicle (SPV) set up by the private sector, an investor, insurance companies, and/or investment banks, in which the sponsor (government entity or companies) is responsible for making a coupon payment. The proceeds from capital raised by the bond issuance can finance investments in climate resilience projects. The coupon payments are paid by the sponsor—the government entity or company—to the investors, thus offering a lower debt-capacity burden.
- **Sustainability/green/blue/social bonds and loans:** Financial terms are similar to traditional bonds and loans, but proceeds are used for specific investments, for example, low-carbon and climate-resilient transport, water, power, and building projects, or for socially beneficially projects, such as investments in employment, health, housing, utilities, and education.

RESOURCES & TOOLS

- International Capital Markets Association:
  - Green Bond Principles
  - Social Bond Principles
  - Sustainability-Linked Bond Principles
- IFC: Blue Finance Guidelines
- Loan Syndications and Trading Association:
  - Green Loan Principles
  - Sustainability-Linked Loan Principles

Antofagasta's green loan finances new water desalination plant; reduces reliance on fresh water in Chile

As part of its plans to expand its Los Pelambres copper mine in Chile, Antofagasta is using the proceeds of a $875 million loan to finance the construction of a water desalination plant and pipeline, which will enable the mine to use seawater for its operational needs. S&P Global has labeled about $530 million of the total as green financing—the amount projected to fund the desalination operation. It's an important project in a water-stressed region that has serious hydrological restrictions during droughts, allowing more predictable output for mining operations and reducing competition for limited water resources with local communities. To ensure that the seawater desalination operation will not have adverse impacts on marine life, the mine is installing a marine ecosystem monitoring system.[80]

Sustainability-linked finance

Sustainability-linked finance (SLF), including sustainability-linked loans and bonds, also offers significant promise for scaling up finance for adaptation and resilience. Unlike other types of sustainable finance, such as green and social bonds, these instruments link finance to broader company plans rather than a specific project, and to measurable, quantifiable indicators of progress. They incentivize the pursuit of ambitious and robust sustainability targets by tying pricing—usually through interest rates—to the externally verified achievement of both qualitative key performance indicators and quantitative sustainability performance targets across a range of sustainability issues. Uptake is growing: as of June 2023, global SLF issuances surpassed $1.6 trillion. Typically, companies have focused on climate metrics in setting their targets. Of these climate metrics, most aim for emissions reduction, rather than for adaptation targets.[81]

Increasingly, however, companies are understanding a broader range of uses for SLF, including for social goals such as achieving better gender balance in the workforce and community development.[82] For example, Anglo American's $100 million sustainability-linked loan from IFC is supporting the company's efforts to improve education for children and build the capacity of local small businesses in rural communities close to its mining operations in South Africa.[83]

With this broader understanding comes significant opportunity for use of these instruments to meet companies' adaptation commitments. To date, there has been limited uptake of key performance indicators (KPIs) related to climate resilience; however, efforts to advance climate resilience are underway. For example, the Climate Bonds Initiative, under the auspices of the United Nations Office for Disaster Risk Resilience, has developed a climate resilience classification framework with the primary objective of promoting and facilitating investment in climate resilience through capital markets.[84] ICMA is also developing a registry that will include new KPIs focusing on water, land use and biodiversity, and value chains, which can support adaptation efforts.[85]

Anglo American leads on social KPIs and targets

IFC's $100 million sustainability-linked loan (SLL) to Anglo American is helping advance the company's global sustainability strategy. A first for the mining sector globally, the SLL focuses exclusively on social development key performance indicators (KPIs) and targets, with an emphasis on delivering benefits for communities in the vicinity of the company's mining and processing operations in South Africa.

The loan is aligned with Anglo American's global sustainability goals, as articulated in its Sustainable Mining Plan. The goals include ensuring that schools in host communities perform within the top 30 percent of state schools nationally and supporting three offsite jobs for every on-site job by 2025. The loan's sustainability performance targets are connected to these goals, with a focus on South Africa. The SLL comes with clear incentives for achieving the KPIs and targets. Each KPI features a minimum, base, and stretch target. If the company meets the stretch targets, the interest rate will not change. Anglo American has committed to contributing additional funds to agreed social causes if it falls short of fully achieving the stretch targets under the terms of this loan. The targets include:

- **Education target:** This target aims for host community schools supported by Anglo American's South Africa Education Program to rank in the top 30 percent of public schools by 2025, as determined by the results of national exams. To achieve the target, the program focuses on whole-school development and delivering training for educators and school management teams, including upgrades of school infrastructure and equipment.
- **Livelihood target:** This target connects with the company's longstanding enterprise and supplier development program in South Africa, called Zimele. Through Zimele, the company delivers mentorship, capacity building, skills development, and access to finance to small businesses in the mining value chain and in other sectors, with a focus on women and young people. The target explicitly defines the contribution that will be required from Zimele towards the corporate target of 3 off-site jobs for every onsite job by 2025.[86]

Insurance and risk transfer

Insurance minimizes the impact of climate losses through financial risk transfer mechanisms-- underwriting climate risk—and can assess, manage, and communicate risk exposure. It can help vulnerable households protect their livelihood and assets against disasters and climate shocks. Insurance supports recovery from climate disasters and can also encourage climate adaptation, such as by providing incentives for fortifying homes or reducing risk in communities through better building and land-use strategies, thus mitigating future impacts. Mechanisms within this category include:

- **Standard insurance:** Also known as indemnity coverage, standard insurance reimburses the insured party for the amount of damage sustained by any event. The cost of repairs is estimated/measured when an event occurs.
- **Parametric insurance:** Event-based payment of a set amount of money, calculated on a pre-agreed, objective measure of the disaster itself, called the trigger.
- **Insurance-linked securities:** An alternative asset class in which investors' returns are primarily linked to the occurrence of natural catastrophes.
- **Nature-based insurance:** Involves ascribing insurable value to a communally owned asset, such as mangroves, and using parametric insurance to increase its resilience.

Blended finance

Blended finance can help unlock pools of investment capital by reducing investors' risks. Blended finance addresses market barriers that prevent faster, more widespread, or longer-term sustainable adoption of less proven technologies and business models in least-developed, low-income, and lower middle-income developing countries. Financing mechanisms within this category include:

- **Mix of concessional debt and equity:** Useful when access to commercial debt is not possible. Concessional finance, also called patient capital, offers lower or no financial return expectations and/or longer time horizons. This type of financing is available through development finance institutions such as IFC.
- **De-risking mechanisms:** These include guarantees—instruments that promise to repay all or some of the investment amount in case of default—and first-loss capital—in which the lending party agrees to bear first losses in an investment to de-risk and catalyze more capital.
- **Blended impact investment funds:** Structured vehicles that use catalytic capital from public or philanthropic/donor sources to increase private sector investment.
- **Public-private partnerships:** Collaborations between the government and private sector to finance, build, and operate development projects—infrastructure projects in particular.

Guinea, IFC

Climate adaptation intermediation platforms

Intermediation platforms offer another option because they can blend a variety of financing mechanisms from multiple co-funders to strengthen climate adaptation.

For example, through a community project development facility, a mining company can provide seed funding to address community needs. These facilities are structured as independent, locally led, self-sustaining entities. A formal agreement establishing the entity connects community members and the company, with a focus on issues such as re-skilling, improving non-mining livelihoods, greening local supply chains, and sustainability. The facility also can leverage funding from other stakeholders, including financial institutions and government donors, to scale the work. Once there are financially viable community-based projects, this can attract commercial, ESG-oriented, impact investors to support complementary efforts to boost resilience and adapt to climate change. Because the facility is structured as an independent entity, it can fund beyond specific adaptation projects, with proceeds from return-seeking projects being at least partially reinvested.

Table 6.1.

Financial instruments for investing in climate adaptation

Financial instrument	Description	Reasons for use
Grants and donor capital	Non-repayable funds provided by governments, philanthropic foundations, or international organizations to support specific projects or initiatives.	Enables financing early-stage research, pilot projects, and community adaptation efforts without financial burden.
Results-based financing mechanisms	Funding disbursed based on the achievement of specific, pre-defined results or outcomes, often linked to sustainability or resilience goals.	Incentivizes achievement of measurable adaptation outcomes, such as reducing water use or enhancing ecosystem resilience by tying funding to results.
Sustainable finance/ Use of proceeds instruments	Debt instruments such as green or resilience bonds, with proceeds earmarked for environmentally sustainable projects.	Provides capital for investments in adaptation infrastructure, such as water recycling systems or resilient roads.
Sustainable finance/ Sustainability-linked instruments	Loans or bonds with terms linked to borrower's performance on sustainability targets.	Incentivizes improvements to sustainability metrics, such as enhancing climate resilience.
Insurance and risk transfer	Financial products such as climate-related insurance that transfer risk to mitigate financial losses from climate hazards and impacts.	Helps manage risks from extreme weather events or other climate-related impacts, reducing potential financial losses.
Blended finance	Combination of public and private capital to de-risk investments in high-impact projects, often in challenging environments.	Leverages public funds to attract private investment in adaptation projects, such as improving infrastructure to withstand increased flooding risks.
Intermediation Platforms	Platforms that connect investors with projects, facilitating access to capital for sustainability-focused initiatives.	Provides mining companies with access to a broader pool of investors interested in financing adaptation projects, increasing capital availability.

Mongolia, IFC

7

Conclusion

This report has offered guidance to enable carefully considered, well-designed, and strategically aligned climate adaptation approaches that present opportunities for the mining and metals sector to reduce costs, preserve or enhance revenues, avoid operational disruptions, improve stakeholder relationships, and ensure compliance with evolving regulatory standards.[87]

The guidance comes at a critical juncture. It is clear that as the pace of climate change picks up, continued delays in taking adaptation action will make it more difficult—and more expensive—to respond to the impacts of global warming.

THROUGH PURSUING CLIMATE ADAPTATION, MINING COMPANIES CAN:

Strengthen climate resilience in their operations by following adaptation pathways detailed in this report, including:

- Developing a comprehensive understanding of the climate risks they face, along with the risks faced by local communities and natural ecosystems.
- Identifying solutions to mitigate these risks that include boosting capacity in several areas: workforce; communities; nature; buildings, equipment, and infrastructure; access to finance; and the enabling environment.
- Engaging with communities as full partners in the adaptation process, with an emphasis on diverse voices and inclusion of women, youth, and Indigenous Peoples.
- Making concrete commitments to specific adaptation goals, including setting quantitative and qualitative targets.
- Mobilizing a wider range of financing to catalyze increased investments in climate adaptation.
- Monitoring and reporting on progress towards making operations climate resilient and enabling wider community benefits through supporting local resilience actions.
- Conducting routine reviews and follow up climate risk assessments; adjusting responses and solutions as conditions change.

Share knowledge and experience with industry peers and those in other sectors, to learn more about what works, what does not, and the kinds of interventions that yield positive outcomes for the company, communities, and nature.

Collaborate with industry stakeholders, climate scientists, financial institutions, and others to establish—and sign on to—adaptation compacts similar to the decarbonization commitments of the SBTi, to raise awareness, increase ambition, and advance climate resilience on a broader scale.

Comply with disclosure requirements, such as those provided by TCFD and TNFD, and ensure that mining operations are aligned with highest level of corporate social responsibility and industry good practices.

The mining sector plays a significant role in catalyzing socioeconomic growth and development opportunities in many developed and emerging economies that host operations. The sector can further enhance this critical role and optimize its economic leadership by demonstrating increased awareness of climate hazards, exposure, and vulnerabilities, and their complex interconnections—and by using this understanding to strengthen local climate resilience. Through systematic and inclusive adaptation planning, wider consultation, and collaboration across the mining value chain, mining companies have an opportunity to make even greater climate contributions, yielding an inclusive and more climate-resilient future.

Guinea, IFC

Appendix A

Terms of reference for a climate risk assessment

Introduction

Background information on company and purpose of the assignment.

Background

Physical climate risk is determined by the existence of physical hazards, exposure to those hazards, and underlying vulnerability. Climate hazards refer to the possible future occurrence of acute or chronic events including inter alia extreme weather; alterations to ecosystems and their services; an increase in the incidence of flooding and drought with consequences for water availability and access; and sea-level rise. Exposure refers to an area in which hazard events may occur, differing according to geography and economic sector. Exposure is determined by the presence of people; livelihoods; environmental services and resources; infrastructure; and/or economic, social, or cultural assets in the path of a hazard. Vulnerability refers to underlying weaknesses that exacerbate risk, namely the propensity of exposed elements, whether people, ecosystems, biodiversity, economic sectors, complex supply chains or individual companies, to suffer adverse effects when climate-related hazards occur.

The dynamic interaction between hazards, exposure, and vulnerability are already impacting the mining of critical minerals and metals, the companies who mine them, and the communities that reside near mining projects. The mining sector can understand and respond to these risks in a way that strengthens enterprise risk management and enhances community resilience, or it can exacerbate these risks by contributing to pressures on natural resources, biodiversity and local communities.

Objective

The objectives of this assignment are to provide the company with a detailed identification and assessment of physical climate change risks; measures to address climate risks and opportunities to increase climate resilience; support the improvement of enterprise risk management; and improve climate literacy and learning for the client's leadership and staff. Results should include:

- Clearer understanding of how climate change will impact the client using science-based scenarios and looking at both observed and projected impacts. This should lead to deepened understanding of the impact of climate change on the client's operational, financial and sustainability performance.
- Detailed breakdown of hazards, exposure and underlying vulnerability as they relate to business assets, operations, financial performance, the workforce, ecosystems, and local communities.
- Enhanced understanding of socio-ecological vulnerability (i.e., nexus with gender, human rights, informality, access issues, etc.) and its implications for physical climate risk. Qualitative assessment of climate change risks and related vulnerabilities of the client project considering its geographic, regulatory, technical and socioenvironmental conditions based on a review of the project's characteristics and context, and available climate data. For example, short-term or long-term effects of climate change on the safety or workers, energy and resource efficiency, local communities, supply chains, environmental pollution, local ecosystems and biodiversity.
- Identify the client project's performance characteristics (safety, water access, land use, etc.) that could potentially be affected by climate change risks and vulnerabilities.
- Identification of likelihood and implications of compound and cascading risk under different impact scenarios.
- Guidance on if and when limits to adaptation may be breached with one or more of the climate risks identified in the assessment.
- Quantification of costs and opportunities by assessing costs of physical climate risk to the client's project, and where possible, detailing the resilience dividend of preemptive investments in adaptive capacity.
- Prioritization of at risk assets, ecosystem services, and populations inside client's core operations (onsite) and within local communities (offsite) along with clearer understanding of the timing/onset of risks and how this influences client actions in the short, medium and longer-term.
- Recommendations on climate resilience interventions that the client could implement to enhance its performance through dedicated functional measures and ensure that operations do not result in incremental impacts or vulnerabilities to communities in predicted climate change scenarios.
- Build capacity of the client's leadership team and staff through workshops and relevant knowledge materials to facilitate decision making on resilient operations, enhance employee engagement in identifying climate risks, provide guidance for the development and implementation of climate resilience management plans and strategies.

Scope

Insert project specific information including site(s), geography, and timescales that are relevant to the company.

Methodology

A mixed-method approach is expected to cover comprehensive literature review; semi-structured interviews with relevant client counterparts, issue experts, and local stakeholders; 2 (two) workshops – one to offer a training on climate risk management; and one at the end of the project to deliver findings and results.

The methodology should treat the three dimensions of climate risk – hazard, exposure, and vulnerability – in a comprehensive and integrated manner.

For climate hazards, the provider should analyze climate variability and hazards in client geographies, with inventory of climate hazards indicating past, present and future changes at client-relevant time horizons. The analysis should include extremes in addition to mean conditions, and a quantification of changing return-periods of selected hazards.

For exposure, the provider should assess client assets, systems, workforce and stakeholders in the path of climate hazards. This should include engaging the client in co-creation to identify critical geographies; analyzing aspects of the business exposed to climate risks; and reviewing literature and exposure datasets (availability will vary based on hazard and geography) for current and future projected changes in population, infrastructure, and land use.

For vulnerability, the provider should analyze physical, ecological and social vulnerability of client company, supply chain and frontline communities. This should utilize literature and vulnerability-related datasets to inform analysis of vulnerability areas; and involve interviews with local experts, subject-matter experts, and stakeholders to review, validate, and add to the analysis.

The methodology should combine the risk arising from the three dimensions to create a comprehensive narrative of present and future climate risks that is calibrated based on likelihood and level of impact.

Deliverables and timeline

Activities should reflect the balance of mixed methods research outlined above. The final deliverables should contain:

- A project inception report and data information needs
- Site visit mission report presenting details on information/ data source being utilized and chronicling the interviews, focus groups, and other meetings/activities.
- A technical report detailing the approach, methodology, findings and recommendations.
- Presentation slides directed at senior leadership within the client company and focused on findings and recommendations.
- Two workshops—one offering a tailored training on climate risk management for the client's senior leadership and one at the end of the project to deliver findings and recommendations.

Guinea, IFC

Qualifications and competencies

Interested providers are expected to demonstrate the following qualifications and competencies:

- Extensive expertise working in partnership with institutions on the design and implementation of climate risk and adaptation projects.
- Multi-disciplinary team with experience working across the science, policy and practice (finance and enterprise risk) of climate risk management.
- Extensive experience working with the private sector.
- Demonstrable understanding of the three dimensions of climate risk—hazard, exposure and vulnerability. Detailed understanding of socioecological vulnerability as it relates to both client and frontline communities is vital.
- Skills specific to the sector and geographical footprint of the client.

Endnotes

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CLIMATE SMART MINING INITIATIVE

The Building Climate Resilient Mining Value Chains guidance note was prepared by IFC as part of the World Bank Group's Climate Smart Mining (CSM) Initiative. The CSM Initiative was launched in 2019 as a public-private partnership led by the World Bank and the IFC with the aim of achieving sustainable mineral supply chains, practical solutions for decarbonization and resilience, and improving environmental, social and governance (ESG) standards for mining. CSM's work addresses four aspects of sustainability in mining: decarbonization, resilience, circular economy, and market opportunities.

IFC SUSTAINABLE INFRASTRUCTURE ADVISORY

The Sustainable Infrastructure (SI) Advisory team supports companies' climate and social inclusion efforts that in turn can strengthen their business, environmental, social, and governance capabilities. Through strategic partnerships, we support companies with diagnostics, analysis, and advice on strategy and implementation. For more information, please see www.commdev.org.

PALLADIUM

Palladium works with mining companies globally to improve their social performance, predominantly through identifying opportunities to finance and transform frontline community business ecosystems in a climate smart fashion.

ICMM

ICMM is an international organization dedicated to improving the social and environmental performance of the mining and metals industry.