

Adapting to Climate Change: A Guide for the Mining Industry

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This guide is part of a BSR industry series. For additional climate adaptation briefs, please visit www.bsr.org/adaptation.

Contents and Methodology

This brief covers:

Reporting on Risks and Opportunities: A synopsis based on reporting of climate risk in 2009 by 41 mining companies to the Carbon Disclosure Project (CDP).

Current Practices: An outline of actions related to climate change adaptation based on reporting from the CDP, interviews, and other publications.

Emerging Practices: Synthesis of company disclosures, literature, reviews, and input from climate change professionals through interviews.

This primer on climate change adaptation summarizes how companies in the mining industry are reporting on climate change risks and opportunities, and highlights current and emerging best practices and guidance for E&U companies on how to develop a proactive approach to climate change adaptation.

In this brief, mining refers to companies involved in the extraction of a broad range of metals and minerals, including precious metals, base metals, industrial minerals, coal, and uranium.

Introduction

Due to the wide geographic distribution of mining operations, climate change, including temperature and precipitation shifts as well as more frequent and severe extreme weather events, will have complex impacts on the sector. Climatic conditions will affect the stability and effectiveness of infrastructure and equipment, environmental protection and site closure practices, and the availability of transportation routes. Climate change may also impact the stability and cost of water and energy supplies.

Some examples: Warming temperatures will increase water scarcity in some locations, inhibiting water-dependent operations, complicating site rehabilitation and bringing companies into direct conflict with communities for water resources. In arctic and subarctic regions, however, warmer temperatures will open new mineral-rich areas for exploration and will reduce heating costs. The sector's high rate of energy consumption and international trade of products will increase mining's potential for greenhouse gas emission and energy regulation.

Mining companies often operate in some of the most politically and socially challenging parts of the world, where the industry remains an important driver of economic growth. Therefore, threats to the sector's profitability and viability, such as climate change, may have significant consequences for development in host countries. The extent to which mining avoids undermining host communities' resilience to climate change, and even fortifies that resilience, will directly impact the industry's reputation, social license to operate, and access to project financing.

The mining industry should take a proactive approach to climate adaptation for the following reasons:

- » The supply of critical inputs to mining processes, such as water and energy, is likely to face greater constraints.
- » Employee health and safety will be put at risk by increases in communicable diseases, exposure to heat-related illnesses and the likelihood of accidents related to rising temperatures.
- » Obtaining and maintaining a social license to operate will become more difficult in communities in which climate change exacerbates existing

Carbon Disclosure Project

Highlight: Of 41 company disclosures in 2009, 76 percent responded that climate change represents physical risk to the company, and 46 percent responded that physical impacts of climate change present opportunity.

Source: BSR Analysis

Of all of the 2009 public CDP respondents, South African companies are particularly active in discussing climate change risks and opportunities, because many have started to feel the consequences of climate-change-related legislation, as well as energy and water scarcity.

“Mining (and other) companies need to openly discuss, share information, and communicate about adaptation regularly. Companies should share costs and otherwise support climate modeling and other scientific and technical studies necessary to develop adaptation strategies when they are operating in the same region.”

Vivian MacKnight,
Sustainable Development
Analyst, Vale S.A.

Key:

Risks

Opportunities

vulnerabilities and increases direct competition between the company and the community for resources.

Increased physical and nonphysical risks will make project financing more difficult to secure.

This brief examines how climate change is affecting the mining industry and how companies are responding. While mining companies have primarily focused on climate change mitigation, they are starting to take significant steps to adapt to the consequences of climate change. Leading companies are developing sophisticated and integrated climate adaptation strategies that take a comprehensive approach to helping their organizations manage risk and seize opportunity. However, there is still considerable opportunity to embed management of climate change impacts across the industry, and to collaborate with stakeholders to do so in an efficient and effective manner.

Reporting on Risks and Opportunities

The following is an analysis of the 2009 mining company disclosures of climate change risks and opportunities to the Carbon Disclosure Project (CDP), one of the largest repositories of company reporting on climate change.¹ Our review of company responses revealed common themes in reported risks and opportunities, which are grouped and summarized in the six areas below, and accompanied by examples of companies that provided those responses. The companies that publicly reported on climate change risks and opportunities included a mix of major multinational and mid-tier mining companies, though it should be noted that some significant actors have yet to participate publicly.

Note that company names provided as examples do not constitute a comprehensive list of all companies that gave similar responses.

1. DISTURBANCE TO MINE INFRASTRUCTURE AND OPERATIONS

Natural disasters, changes to precipitation patterns, and rising sea levels may damage infrastructure, requiring additional measures to ensure its stability. Existing assets may no longer be able to meet original design parameters, and resource scarcity may constrain operations or increase costs.

| Impacts | Companies |
|---|--|
| More frequent and intense natural disasters may damage mine, transportation, and energy infrastructure and equipment, which in turn will disrupt construction and operations. Heavy rain and increased erosion may affect slope stability near opencast mines, and rising sea level may make coastal facilities harder to access. | Alumina, Anglo American, Barrick, China Steel, Kumba Iron Ore, Mitsubishi Materials Corp., Rio Tinto Group, Teck, Xstrata, Yamana Gold |
| Hotter and drier conditions may increase wildfires that threaten facilities. | Anglo Platinum, Cameco, Gold Fields |
| Flooding from increased rainfall in some areas can interrupt production, and may necessitate additional controls to enhance water treatment capacity. | AngloGold Ashanti, Exxaro, Harmony Gold Mining, Limerick Alumina Refining, Newmont Mining |
| Reduced amounts of water may be available for mining, processing, and refining activities. Costs will increase for pre-use and post-use water treatment. | Barrick, China Steel, Teck, Xstrata, Anglo Platinum |

¹ For more information on the Carbon Disclosure Project, see www.cdproject.net.

Spotlight on Arctic Operations:

For mine operations in the arctic, such as the diamond mines in Canada's Northwest Territories, the seasonal ice road network is critical for stockpiling materials necessary for operations. Warming temperatures and subsequent thaw of permafrost threaten the seasonal availability and safety of ice roads and the structural integrity of overland roads, bridges, pipelines, and airstrips.

In 2006, because of permafrost thaw, Diavik Diamond Mines had to fly in its fuel supplies rather than transport them over the ice roads, costing the company an extra US\$11.25 million.

| | |
|---|---|
| Rising temperatures will increase energy demand to cool underground mines and surface facilities. Greater demand and rising prices (driven by limited supply of natural gas, the imposition of carbon taxes, and expensive alternative energy sources) will add to costs. | Anglo Platinum, Mitsubishi Materials Corp., Northam Platinum, Outokumpu, Mining Simms |
| Temperature fluctuations that increase energy demand and strain the capacity of transmission and distribution facilities can disrupt supply to operations. Energy rationing may lead to permanent decreases in production, affecting profits and commodity prices. | Aquarius Platinum, Barrick, China Steel, Gold Fields, Harmony Gold Mining, Implats, Kinross |
| Warming ambient temperatures in the Arctic and other cold climates will make it easier to operate and reduce heating costs. | Agnico-Eagle Mines, Cameco, Kinross, Teck |

2. CHANGING ACCESS TO SUPPLY CHAINS AND DISTRIBUTION ROUTES

Increasing temperatures, greater precipitation, shifting storm patterns, and rising sea level will enable or inhibit transportation services that supply goods and services, carry personnel, and move ore to facilities for processing and to ports for export.

| Impacts | Companies |
|--|---|
| Natural disasters and heavy rainfall are likely to disrupt land transportation routes and degrade roads. Disruption in delivery of input materials such as steel, timber, cement, hydrochloric acid, and cyanide, or consumables such as diesel, tires, and reagents, will curtail production or limit its efficiency. | Exxaro, Gold Fields, Goldcorp, Kumba Iron Ore, Sesa Goa, Implats, Xstrata, Vale |
| Permafrost thaw on winter ice roads will interfere with consistent and timely supply of critical materials, potentially halting production at sites in the Arctic. The time available for haulage on ice roads will be shorter. | Kinross, Rio Tinto Group |
| Sea-level rise and frequent storms may affect port availability, interfering with timely transport to market. Demand for rail and road networks as alternative transportation mediums will rise, increasing costs. | Anglo American, Exxaro, Rio Tinto Group, Sterlite Gold, Vale |
| Rising temperatures will keep northern sea channels free of ice, allowing longer and more efficient shipping seasons for operations in arctic regions. | Teck |

3. CHALLENGES TO WORKER HEALTH AND SAFETY CONDITIONS

Natural disasters pose immediate health and safety risks, while warmer temperatures may affect worker recruitment, retention, safety, and productivity by increasing risks of accidents, creating or exacerbating food and water shortages, and causing greater prevalence of disease.

| Impacts | Companies |
|---|---|
| Rising temperatures increase the risk of heat-related illnesses and inhibit decision-making, increasing the likelihood of injuries, accidents, and fatalities and decreasing productivity. Underground cooling systems may be inadequate to handle changes in temperature and availability of water and energy. | Anglo Platinum, Exxaro, Gold Fields, Iluka Resources |
| Flooding may affect employee safety on-site and on roads. | Northam Platinum, Yamana Gold |
| Flooding, natural disasters, and drought will undermine food security, and rising temperatures will exacerbate water shortages, undermining worker health and productivity. | Aquarius Platinum, Gold Fields, Northam Platinum, Vale |
| Higher temperatures are likely to increase the incidence, prevalence, and geographic reach of tropical diseases such as malaria, yellow fever, cholera, and schistosomiasis, with consequences for workforce health. | AngloGold Ashanti, Cameco, Harmony Gold Mining, Implats |

4. CHALLENGES TO ENVIRONMENTAL MANAGEMENT AND MITIGATION

Changing temperature and rainfall patterns will affect assumptions about closure design and may increase financial liability and monitoring requirements. Companies may also be blamed for perceived impacts of subtle and cumulative climactic change.

| Impacts | Companies |
|--|---|
| Water scarcity and hotter temperatures will make it more difficult to reestablish vegetative cover, and will put stress on other environmental mitigation measures in some regions. | Lonmin, Newmont Mining |
| Risks of heavier rainfall include: tailings dam failure, discharge of contaminated water into surrounding areas, accompanying remediation costs, increases in environmental liability, impacts on community health and safety, and significant potential for reputational damage. | Gold Fields, Northam Platinum |
| Legacy mine sites rehabilitated under older climate regimes may require supplemental protection measures to ensure stability of waste rock and tailings covers. Environmental liability costs may increase, and monitoring responsibilities may be extended to ensure effectiveness of reclamation measures. | Anglo American, Lonmin, Barrick, Cameco, Kumba Iron Ore |
| Higher evaporation rates could reduce the need for water treatment and disposal by reducing volumes and therefore costs (e.g., for treatment of acid mine drainage). | Cameco |
| Elsewhere, increased CO ₂ and longer growing seasons will benefit revegetation efforts during reclamation and after closure. | Newmont Mining |

5. MORE PRESSURE POINTS WITH COMMUNITY RELATIONS

Mining companies often operate in areas with marginal physical environments, high poverty, and significant social, political, and economic challenges. Already vulnerable host communities stand to suffer from environmental stressors such as drought, flood, rising temperatures, and natural disasters. Resulting loss of livelihood and property, plus increased famine and disease, may worsen social conditions and contribute to civil unrest and political instability. Companies may face direct risks to operation over competition for resources such as water or energy and loss of legal license, or indirect risks such as loss of social license to operate and reputational damage from perceived human rights violations.

| Impacts | Companies |
|---|--|
| There may be increased requests for financial and employee support in response to natural disasters in host communities. Damage to livelihoods and property will elevate the need for basic services and restoration of economic activity. If these are also home communities for employee and contractor workforces, such incidences will directly affect worker health, attendance, and productivity. | Anglo Platinum, AngloGold Ashanti |
| Drought, extreme weather, and flooding may decrease food security, worsen poverty, induce migration, contribute to civil unrest, and increase conflict over natural resources. | Anglo American, Barrick, Gold Fields, Kumba Iron Ore |
| Flooding and rising temperature will increase the spread of tropical diseases that affect community health. | Anglo Platinum, Implats |
| Community water infrastructure and watershed restoration projects may be required to mitigate reputational risks and to meet needs of all users. | Exxaro |
| Sea-level rise may force migration of coastal peoples, whose movement to new areas may exacerbate social problems and conflicts in host communities. | Exxaro, Implats, Sterlite Gold |
| There may be opportunity for more meaningful engagement with local communities and other key stakeholders, particularly regarding collaboration on land, agriculture, and water management. | Anglo American, AngloGold Ashanti |

6. EXPLORATION AND FUTURE GROWTH

Climate change may significantly shape opportunities for growth in the mining industry. Availability of key inputs such as water and energy will physically and financially constrain the establishment of new operations or make existing operations uneconomical. Investors and insurers will take into consideration climate risks and company performance (both in terms of mitigation and adaptation). On the other hand, warmer temperatures will open the mineral-rich Arctic to exploration. Demand is likely to increase for materials used in existing and future low-carbon energy and industrial technologies, and new business opportunities in technological innovation and energy generation are emerging.

| Impacts | Companies |
|--|---|
| Future exploration may be restricted by expanded protections for biodiversity threatened by climate change and for forested areas that serve as carbon sinks. | Anglo Platinum |
| Inadequate energy supply will become a major constraint for expansion or development of new projects in some locations. | Aquarius Platinum |
| Different regulations to limit greenhouse gas emissions across jurisdictions may drive companies to move operations to less-regulated regions. | Limerick Alumina Refining, Teck |
| Investors, lenders, and insurers will pressure companies to minimize carbon liabilities and develop adaptation plans, as well as to incorporate climate change risk into due diligence. Management of climate impacts will affect share price and access to capital. | Anglo Gold Ashanti, Gold Fields, Harmony Gold Mining, Kinross, Northam Platinum |
| Climate-related damage may raise premiums or make insurers unwilling to provide insurance or re-insurance. | Exxaro, Rio Tinto Group |
| Warmer arctic and subarctic temperatures will open areas not previously accessible for exploration that are likely to contain a vast store of mineral wealth. | Newmont Mining |
| Demand for other commodities may increase due to new applications, particularly related to energy efficiency; and emerging technologies such as fuel cells, carbon reduction, diesel emission control, and water purification. | Alumina, Cameco, Exxaro, Freeport McMoRan Copper & Gold, Independence Group NL |
| Rising sea level may require construction of sea walls or other retaining structures, stimulating the cement industry. | Mitsubishi Materials Corp. |
| Patenting and marketing of highly energy-efficient mining and processing technologies will lead to new revenue streams. | Rio Tinto Group |

Current Practices

Mining companies are pursuing a range of adaptive practices to respond to current and potential disruptions tied to climate change. In some cases, these practices are intended to **protect the value** of existing or potential assets. In others, they are aimed at **creating value** through technological innovation, new market opportunities, and collaborative initiatives that address the changing needs of companies and communities affected by climate change. The following examples of practices and innovations are drawn primarily from the 2009 CDP responses, supplemented by company interviews.

VALUE PROTECTION

These practices provide examples of how companies are promoting resilience of physical assets and improving systems responses to effectively execute existing plans and expectations and maintain business continuity.

About Adaptive Practices

Based on identified risks and opportunities, companies report pursuing a range of adaptive responses, which are included in this section.

Adaptive practices are grouped by two types:

- **Value protection:** Ensuring resilience of physical assets and planning responses to maintain business as usual.

- **Value creation:** Devising solutions that contribute to the ability to pursue new revenue-generating opportunities and help suppliers, stakeholders, and customers adapt to a changing climate.

- 1 Establishing comprehensive management systems to address climate adaptation:** A few leading companies have taken significant measures to adapt internal management structures in ways that facilitate proactive, adaptive, and integrated management of climate change impacts.
 - » **Vale** has established corporate guidelines for climate change that include commitments related to adaptation, such as changes in facilities management, integration of climate considerations into the company strategic plan, and working with legislators to develop policy changes that support adaptation. The cross-functional New Economy and Climate Change team, with representatives from climate change, energy, operations, operational risks, strategic planning, and other internal departments/groups, meets regularly to address climate change risks and opportunities across the company.
 - » **Gold Fields'** formal climate strategy includes adaptation, mitigation, response/management and reporting elements. Each site must identify climate-related risks and opportunities and develop responses that are implemented and monitored using existing management systems.
- 2 Regional and site-level scientific modeling to identify and quantify physical risks and opportunities at the local level:** Translation of global climate models into likely localized impacts is critical to adaptation planning in an industry whose facilities are spread worldwide.
 - » **Anglo American** conducted a group impact assessment project from 2008 to 2009 with Imperial College London to model likely changes in temperature and rainfall that could pose a hazard to its operations. Individual predictions for each site helped the company create a risk inventory for current and future operations, and develop site-level adaptation strategies to enhance the climate resilience of these operations and their surrounding regions.
 - » **Exxaro** used downscaled general circulation models to assess climate change impacts for both operations and communities where employees are located. The study examined both natural climate hazards and inherent vulnerability of existing infrastructure, population, and socioeconomic activities.
 - » **Vale** commissioned the National Institute for Space Research of Brazil to assess vulnerability under different climate change scenarios in northern and southern Brazil and their effects on factors such as water availability and biodiversity.
 - » **Newmont Mining's** environmental and social responsibility group worked to identify and assess other risks that do not have immediate financial risk but harm business in other ways.
- 3 Modification of risk-identification processes to include climate risks and opportunities:** Leading companies are modifying their risk-identification and mitigation exercises to incorporate the effects of climate change.
 - » **HudBay Minerals** identifies climate change risks as part of its implementation of environmental management systems and standards such as ISO 14001 at its operating subsidiaries.
 - » **Norsk Hydro** incorporates climate change risks into its standard social and environmental risk assessment processes.
- 4 Integrating climate-related risks and mitigation measures into business decisions throughout the project lifecycle:** Companies are examining broad impacts of climate issues throughout project lifecycles, particularly up-

front in project design and decision-making, and as an ongoing element of risk management.

- » **Anglo American** plans to integrate a “climate test” into its capital-expenditure approval processes.
- » **Exxaro** is integrating technical reviews of energy efficiency, greenhouse gas emissions, and water requirements into all projects under development. The company has also established an onshore captive insurance company to accumulate adequate reserves through approved alternative risk-transfer technology to provide for future uninsurable risks.
- » **Gold Fields** is requiring all new projects to draw 20 percent of their energy needs from renewable sources.

5 Ensuring robust engineering design and construction standards for facilities: Companies are making sure that their assets and infrastructure can withstand increased frequency and magnitudes of extreme weather events and flooding in expansions or new sites.

- » **Kumba Iron Ore** is gathering data on the probability, magnitude, and frequency of extreme weather events at its sites to understand their cumulative impact on structures.
- » **Alumina** has built its bauxite operations in Brazil to withstand increased frequency and magnitude of extreme weather.
- » **Kinross** has built redundant water storage facilities to contain process solutions and capture rainwater for use.
- » **Norsk Hydro** is raising its facilities in Qatar by two meters to withstand flooding.

6 Reviewing emergency procedures and developing contingency plans: Companies are considering their planning for natural disasters, floods, fires, and pandemics in light of the expected increase in frequency and magnitude under various climate scenarios.

- » **Teck** buys insurance for weather conditions that would impact operations.
- » **Cameco** has engaged with Saskatchewan Fire Services to conduct an independent audit of its mitigation controls and response measures for forest fires. The company has also implemented a pandemic preparedness procedure as part of its emergency planning.
- » **Gold Fields** participates in local fire protection agency activities for emergency response to all fires.
- » **Harmony Gold Mining** has introduced a malaria-awareness campaign to promote early diagnosis.
- » **Vale** has a department that monitors weather that could affect railways and ports, communicating this information across the company. It is installing a radar-supported weather monitoring system at its ports to detect and forecast storm in time to shut down and secure equipment.

7 Designing comprehensive water management measures: Companies are identifying and developing access to new water sources to ensure sustained adequate supply, increasing the efficiency of water use through conservation practices, developing processing technologies that reduce consumption, and looking for advanced opportunities for reuse and recycling.

- » **Norsk Hydro** has built a desalinization plant for its new facilities in Qatar.

Tapping the International Carbon Markets

A number of mining companies have seized the opportunity to earn certified carbon credits through the Carbon Development Mechanisms for trade on the international market. This mechanism has created opportunities for the industry to develop new technologies and products that support emissions reduction and create new revenue streams.

To date, many CDM projects in the mining industry have focused on coal methane capture, where methane gas from coal operations is captured and destroyed through flaring, or use for energy generation and motive power.

Project examples:

- » Both Appin and Tower Power plants use 2.5 million tons per year of coal-mine waste methane from Endeavor Coal in Australia. This has generated multiple streams of revenue for BHP Billiton, including federal renewable energy certificates and carbon credits for state and international trading.
- » Gold Fields' Beatrix mine-capture project in South Africa generates carbon credits and provides methane for power generation.
- » Lihir Gold's geothermal power plant meets 75 percent of the mine's energy needs. It is the first project in Papua New Guinea to be registered for carbon-credit trading, and generated US\$4.5 million in 2008 through the sale of Carbon Emission Reductions on global markets.

- » **Anglo American** is investing in a dam pipeline project funded by multiple mining companies, electric utilities, and petrochemical companies to provide water for its operations in South Africa.
- » **Newcrest Mining** has prioritized reduction of evaporation losses as a key water management strategy.
- » **Exxaro** is exploring options such as dry beneficiation processes, water recovery from slimes dams, and collection and use of storm water.
- » **Iluka Resources** utilizes recycled municipal water at its facilities in South Australia.

VALUE CREATION

These practices offer examples of how companies are creating solutions that contribute to the ability to pursue new revenue-generating opportunities and to collaborate with other stakeholders to meet both corporate and community needs in the context of climate change.

- 1 Expansion of commodity portfolios:** Companies that have traditionally specialized in extraction of specific metals or minerals are diversifying their production for greater flexibility in responding to rapid change in the market.
 - » **Gold Fields** is investigating the feasibility of mining other minerals to become less reliant on a single commodity and its associated climate change risks.
- 2 Technical innovation and collaboration to provide integrated solutions for thriving under a harsher climate:** Companies are developing ranges of solutions to help stakeholders and communities address changing climactic conditions.
 - » **Gold Fields** is testing hard ice and three-chamber pump systems, which may offer new solutions for effective cooling in underground facilities.
 - » **Anglo American** is participating in a water reclamation joint venture with BHP Billiton in Mpumalanga, South Africa, that provides potable water in sufficient quantity to meet the needs of both its mines and local municipalities. The company is exploring similar joint investments with other major mining houses and the national utility, Eskom.
- 3 Investment in renewable energy technologies and alternative fuels:** Companies are investing in better ways to manage energy supply, cost, and financial risks due to regulation. They are also taking advantage of new revenue streams from carbon credits.
 - » **Barrick** purchases renewable energy and has built natural gas, geothermal, solar, and wind facilities at its operations in the Americas. The company is also using biodiesel at its underground operations in North America and is exploring options for similar fuels in Africa.
 - » **Rio Tinto Group** is investing in the development of carbon capture and storage technologies.
 - » **Exxaro** has decided to move into energy as a business and formed a new business growth division exploring wind, solar, and coal bed methane projects in Africa. The company hopes to generate carbon credits from these ventures under the Clean Development Mechanisms.
 - » **Sesa Goa** has developed a clean process for making coke that is generating revenues through carbon credits and licensing of the technology.

- » **Gold Fields** became the world's first mining company to sell Certified Emissions Reductions from its methane gas field at the Beatrix mine in South Africa.
 - » **Vale** and **Gold Fields** have invested in biodiesel and other agricultural production that could be used as an alternative energy resource.
- 4 Waste recycling programs:** Companies are exploring ways to profit from emissions and other waste while addressing supply shortfalls.
- » **Gold Fields** built a tire-retread facility at its Tarkwa, Ghana, mine to address shortages in supply and problematic disposal options. The extended life of the tires decreases energy and material use by avoiding purchase of new tires. The company is exploring other options to reuse waste for stability of supply and energy use.

Recommendations

This paper discusses a range of responses to climate change that are readily observable to those in the mining industry, and many of them will be familiar to those who are managing climate change or business risk more generally. Mining companies need to adapt their corporate strategies, design and engineering practices, and supply and distribution systems to these physical changes. While there are clear signs that some companies in the industry are moving quickly to address climate-related risks and opportunities, there is still considerable need to improve awareness and take action, particularly at the senior management level.

A recent report by the David Suzuki Foundation on climate adaptation in the Canadian mining industry noted a gap between the experience of climate change impacts on the ground and awareness among executives: "It is noteworthy that senior management were less likely to perceive climate hazards as negatively affecting operations compared to those performing other roles."² This perception gap is supported by the findings of a KPMG survey of senior executives in the industry in August 2010. The survey found that about 60 percent of respondents had implemented structural changes to address climate change, while 57 percent had not redefined roles and responsibilities to include climate change in job descriptions and management systems. The major reason for hesitation? Half had yet to quantify the potential costs of climate change for their businesses.

Furthermore, most climate adaptation initiatives in the mining industry have focused on physical risks of climate change. Less developed is a detailed understanding of the site-level social risks and opportunities. Nor have mining companies yet seized the opportunity presented by climate change to collaborate with communities, development agencies, NGOs, and governments on adaptation—and in doing so enhance their social licenses to operate.

For these reasons, BSR recommends that mining companies establish climate change adaptation strategies that contain the following key components:

- 1. Work with host communities to develop concrete climate adaptation plans.** Mining can share scientific information for site planning to inform community preparation, advise on emergency planning practices, and advocate for climate-resilient economic growth with local authorities and development agencies.

² Yupari, Anida, "Climate Change and Policy Law Implications for the Mining Industry." CEPMLP Research Network: Working Papers, 2010.

2. **Integrate climate-compatible development into initiatives for sustainable local benefit from project operations.** Explore development projects that make little or no use of scarce natural resources; strengthen community peace and security programs; build capacity for sound structural engineering; and develop government planning and emergency response capabilities.
3. **Explore how investments in ecosystem services can improve local resilience.** For example, investment in integrated watershed management programs, enhancement of local water supplies, and protection of existing sources can help secure the availability of sufficient clean water to meet company and community needs, even in light of increasing scarcity and competition. Through participatory and integrated resource management practices, companies can engage host communities as partners in resource management, monitoring, and enhancement.
4. **Work with stakeholders to understand their emerging concerns.** New issues are emerging as climate change allows new ecosystems, such as the Arctic, to be opened for mineral exploration. Stakeholder expectations regarding corporate climate change mitigation, adaptation, biodiversity, and indigenous peoples are likely to find new focus in arctic exploration. Proactive engagement can establish responsible exploration and operational practices in this sensitive environment.
5. **Initiate cross-industry collaboration on regional adaptation strategies.** Explore opportunities to collaborate within geographic regions to share information and costs for climate modeling, other supporting scientific/technical activities, best practices, and implementation of large-scale adaptation strategies. For example, Vale is involved in the “Company for the Climate” initiative in Brazil, in which private companies meet monthly to discuss climate information and learn from each others’ efforts to develop mitigation and adaptation strategies. Opportunities may exist for complimentary work across industries such as food and agriculture, mining, energy, and transportation.

Corporate adaptation strategies will vary significantly, given the diversity of geographies and commodities produced by the industry. No matter where they are located, however, mining companies can become catalysts for adaptation, not only within their own operations, but in their host communities and among regional businesses. Investment in the resilience of such partners is likely to be as important as ensuring the physical stability and resilience of the corporate value chain.

For more tools on managing climate change adaptation, visit: www.bsr.org/adaptation.