

Building Resilience to a Changing Climate: Investor Expectations of Companies on Physical Climate Risks and Opportunities

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IIGCC

The Institutional Investors
Group on Climate Change

About IIGCC

The Institutional Investors Group on Climate Change (IIGCC) is the European membership body for investor collaboration on climate change and the voice of investors taking action for a prosperous, low-carbon future. IIGCC has over 330 members, mainly pension funds and asset managers, across 22 countries, with over €39 trillion in assets under management.

Our mission is to support and enable the investment community in driving significant and real progress by 2030 towards a net zero and resilient future. This will be achieved through capital allocation decisions, stewardship and successful engagement with companies, policy makers and fellow investors.

For more information visit www.iigcc.org and [@iigccnews](https://twitter.com/iigccnews).



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1. Introduction

Investors, regulators, and policymakers are increasingly recognising that physical climate risks can have financial impacts for investment portfolios. If these present material risks, investors need to take them into account to meet their fiduciary duty. By taking action on physical climate risks and opportunities, investors can help build the climate resilience of both individual companies and their portfolio more broadly, as well as helping to channel investment towards adaptation solutions. In turn, this can help to build the climate resilience of wider society to a changing and more variable climate.

This set of investor expectations of investee companies builds on guidance produced by members of the Institutional Investors Group on Climate Change (IIGCC) that sets out how investors can integrate the risks and opportunities presented by the physical impacts of a climate change into their investment processes. *Understanding physical climate risks and opportunities – a guide for investors*¹ recommends that a first step investors should take to manage physical risk in portfolios is to conduct engagement with investee companies. This can improve the availability of physical climate-related data and information for investors and ensure that actions are taken by investees to address risks and build climate resilience.

Greater availability of information and improved data quality from investee companies is key to supporting investors and can enhance long-term shareholder value. Simultaneously, an improved understanding of physical climate risks and opportunities will help companies build resilience to the physical climate risks they may be exposed to so that, for example, they can continue to operate in a certain location and deliver expected returns. It will also help companies prepare for increasing climate/sustainability-related disclosure requirements and provide evidence to investors that companies are taking sufficient actions to build resilience to future climate impacts.

Investor engagement with investee companies is crucial. To support this, members of the IIGCC have produced a guide that establishes investor expectations of investee companies regarding the governance, assessment, management, and disclosure of physical climate risks and opportunities. It sets out why investors expect company boards to take responsibility for managing physical climate risks and opportunities, the steps that companies could take to assess physical climate risks, develop a strategy for building climate resilience, and identify opportunities to provide adaptation solutions. Key metrics investors would like companies to disclose in their public reports are also set out. In section 5, the guide concludes with guiding questions that investors can use to support the physical climate-related stewardship of investee companies.

In the context of this guide, the term **climate resilience** refers to the strategies, actions and partnerships through which a company absorbs and responds to climate-related hazard impacts on its operations and/or its value chain both now and in the future, and at the same time creates shared resilience benefits for the communities and natural ecosystems where it operates.

¹ [Understanding physical climate risks and opportunities – a guide for investors](#) (IIGCC, 2020).

The guide draws on and reinforces the recommendations of the Taskforce on Climate-Related Financial Disclosures (TCFD)² and EU Sustainable Finance regulations insofar as they relate to climate change adaptation³, against which companies are increasingly required to disclose climate-related information. Investors will also rely on corporate disclosures to meet their own reporting requirements under the EU's Sustainable Finance Disclosure Regulation (SFDR). Under SFDR, investors will be required to disclose how they are integrating sustainability considerations into investment and risk management processes, including in relation to the principal adverse impacts (PAIs) of investment decisions on sustainability factors⁴. By following this guidance, both companies and investors should also be better positioned to meet the growing body of climate-related financial disclosure requirements under development by a body of key standard setters under the International Financial Reporting Standards Foundation (IFRS) as well as others, both internationally and within different jurisdictions⁵.

The guide also points to and builds on leading work carried out by other institutions, such as that of the European Bank of Reconstruction and Development and the Global Centre of Excellence on Climate Adaptation (EBRD/GCECA) that provides detailed recommendations for metrics and best practices to disclose physical risks and opportunities⁶. IIGCC has added to these recommendations to include greater consideration of the resilience of local communities and natural ecosystems (see Appendix 1).

For many investors and companies, this may be the start of a journey towards adapting to a changing climate. As such, it is recognised that companies may not be able to meet the full set of expectations in this guide immediately. Therefore, the guide also sets out a set of minimum expectations that investors expect all companies to meet now given the urgency of the issue, with the expectation that companies progress and implement an increasing number of the expectations over time.

² Final Report: recommendations of the Task Force on Climate-related Financial Disclosures (TCFD, 2017); Proposed Guidance on Climate-related Metrics, Targets, and Transition Plans (TCFD, 2021)

³ Sustainable Finance (EU Commission).

⁴ The PAI disclosures are intended to show how investments have or may have a detrimental impact on the environment, with reference to a series of granular quantitative indicators. In total, there are 64 adverse impact indicators which investors can calculate (18 of which are mandatory), including total share of investments in investee companies with sites located in areas of high water stress.

⁵ The IFRS announced a working group to accelerate convergence in global climate-related and sustainability reporting standards. It will build on TCFD recommendations and include the participation of the Sustainability Accounting Standards Board (SASB), the Climate Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI) and CDP, as well as IOSCO as an observer. After issuing a prototype reporting standard in December 2020, the IFRS has indicated that it is targeting mid-2022 for climate-related risk disclosures, although it is not yet clear how physical climate risk and opportunity disclosures will feature.

⁶ Advancing TCFD Guidance on Physical Climate Risks and Opportunities (EBRD/ GCECA, 2020, p.10-11).



2. How can investors use this guide?

Corporate stewardship is an essential component of an investor's strategy to integrate physical climate risks and opportunities into investment decisions⁷ whilst supporting the climate resilience of companies and the wider economy. This guide can be used by investors as a standalone document to guide engagement by highlighting the key actions companies need to take and providing a basis for discussions with investee companies.

Investors can also use this guide as part of a wider investment strategy to align portfolios to the adaptation and resilience goals of the Paris Agreement, including Article 2(c) on aligning financial flows with low-carbon and *climate-resilient* development pathways. As part of the Paris Aligned Investment Initiative⁸, a global investor-led initiative to enable investors to align portfolios and activities to the goals of the Paris Agreement, forthcoming recommendations are expected to draw on this investor expectations guide to support investors to increase the alignment of listed equities within a portfolio to the adaptation and resilience goals of the Paris Agreement.

⁷ See [Understanding physical climate risks and opportunities – a guide for investors](#) for further guidance relating to integrating physical risk and opportunity information and data into investment processes (IIGCC, 2020).

⁸ <https://www.parisalignedinvestment.org/>



3. Physical climate risks and opportunities for companies

The latest findings from the IPCC's Sixth Assessment Report show that the average global temperature is expected to exceed 1.5°C by as early as 2040, and global warming of 2°C will be exceeded during the 21st Century unless significant reductions in emissions occur in the coming decades⁹. Reducing greenhouse gas emissions in line with the goals of the Paris Agreement is essential if we are to avoid the worst impacts of climate change.

A global temperature rise of any magnitude will lead to physical climate impacts that will need to be identified, prepared for, and responded to. Significant increases in the frequency and severity of extreme climatic events and incremental hazards, beyond that already experienced in many parts of the world, are to be expected if the world does not deliver on the low carbon transition. Impacts from physical climate hazards such as hurricanes, floods, wildfires, extreme heat, drought, sea level rise, and water scarcity will be felt across the world, as figure 1 illustrates.¹⁰

Figure 1. Climate impacts from rising global temperatures

	In a +1.5°C world...	In a +2 °C world...	In a +3°C world...	In a +4°C world...
Acute risks	10% probability of ice-free Arctic summer at least once before hitting temperature limit.	80% probability of ice-free Arctic summer at least once before hitting temperature limit.	100% probability of ice-free Arctic summer at least once before hitting temperature limit.	
	41% increase in area burned by wildfires in an average Mediterranean summer.	62% increase in area burned by wildfires in an average Mediterranean summer.	97% increase in area burned by wildfires in an average Mediterranean summer.	
	86% increase in economic damages from river flooding in China.	120% increase in economic damages from river flooding in China.		443% increase in economic damages from river flooding in China.
	2.3°C increase in average temperature in Asia.	3°C increase in average temperature in Asia.		6°C increase in average temperature in Asia.
Chronic risks	Global average length of drought increases by 2 months .	Global average length of drought increases by 4 months .	Global average length of drought increases by 10 months .	
	Average rainfall in Asia increases by 4% .	Average rainfall in Asia increases by 6% .	Average rainfall in Asia increases by 10% .	
	20% decrease in rainfall in rainy season in South Africa, Western Cape.	20% decrease in rainfall in rainy season in South Africa, Western Cape.	20% decrease in rainfall in rainy season in South Africa, Western Cape.	
	6.4 million more cases of dengue fever in Latin America by 2050.	6.7 million more cases of dengue fever in Latin America by 2050.	7.5 million more cases of dengue fever in Latin America by 2050 (in a +3.7°C world).	
	0.3% increase in excess deaths due to heat in Australasia.	0.5% increase in excess deaths due to heat in Australasia.		1.8% increase in excess deaths due to heat in Australasia.
	8% plants lose over half of their climatic range.	16% plants lose over half of their climatic range.		16% plants lose over half of their climatic range (in a +4.5°C world)

Primary source: Carbon Brief¹¹. (Blanks cells indicate no comparable data available for the specified risk and temperature increase)

⁹ Climate Change 2021, The Physical Science Basis (IPCC AR6 WGI, 2021)

¹⁰ Impacts of 1.5°C Global Warming on Natural and Human Systems. In: Global Warming of 1.5°C (IPCC, 2018, Table 3.6)

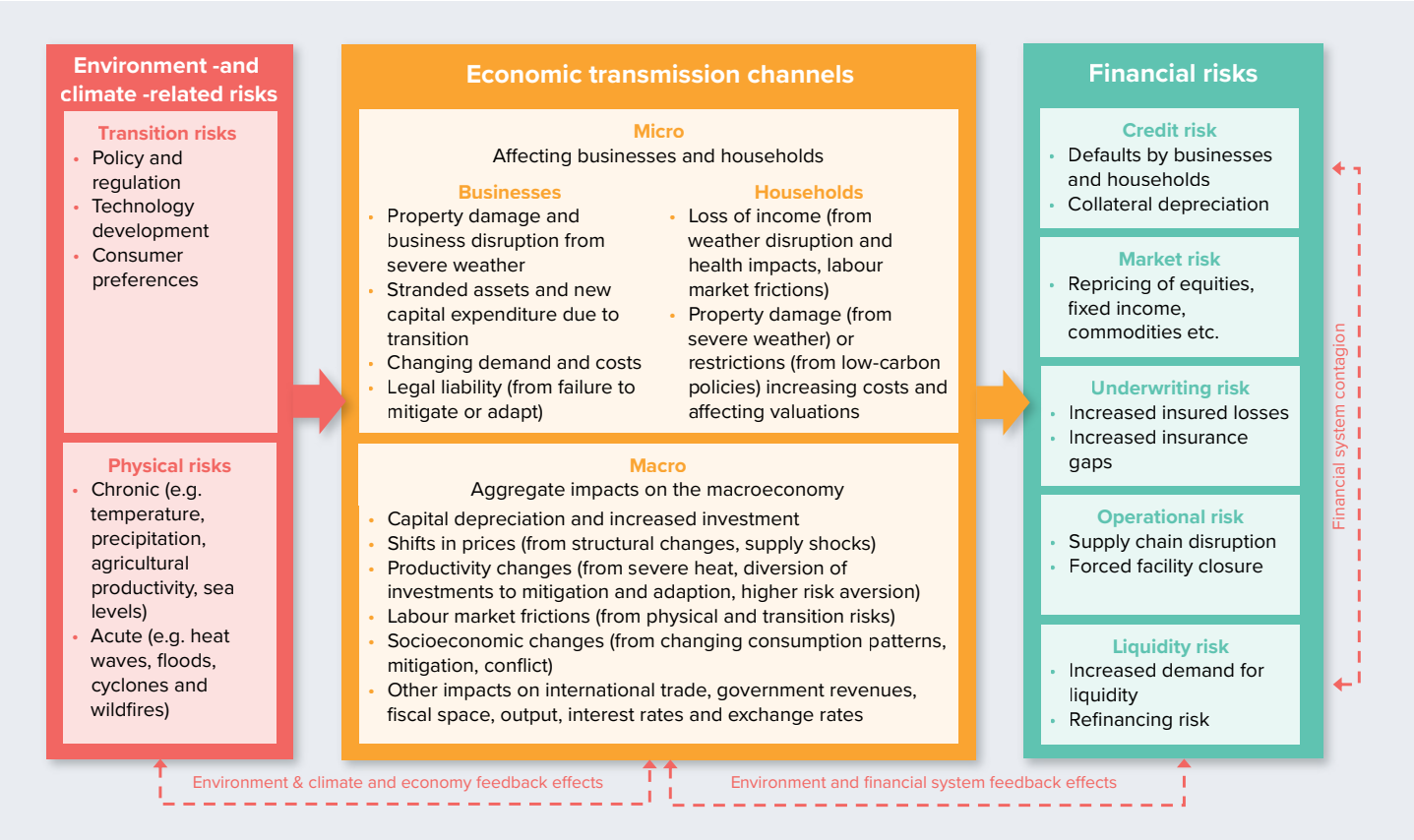
¹¹ The impacts of climate change at 1.5C, 2C, and beyond (Carbon Brief)

Physical Climate Risks

Physical climate hazards can impact corporate performance either directly or indirectly. For example, by directly disrupting operations, value chains, or markets. Or indirectly, by affecting the broader economic, human, or natural environment, such as through shifts in prices, labour market frictions, migration, ecosystem deterioration, or social license to operate. As demonstrated in figure 2, below, physical climate change can lead to a range of financial implications for companies.

This can include a reduction in annual revenue, increased expenditures, change in asset value, rise in default risk, and reduced access to capital and financing. The Network for Greening the Financial System (NGFS) provides an overview of the transmission mechanisms between environmental risks, including physical climate risks, and financial risks¹² (see figure 2 below).

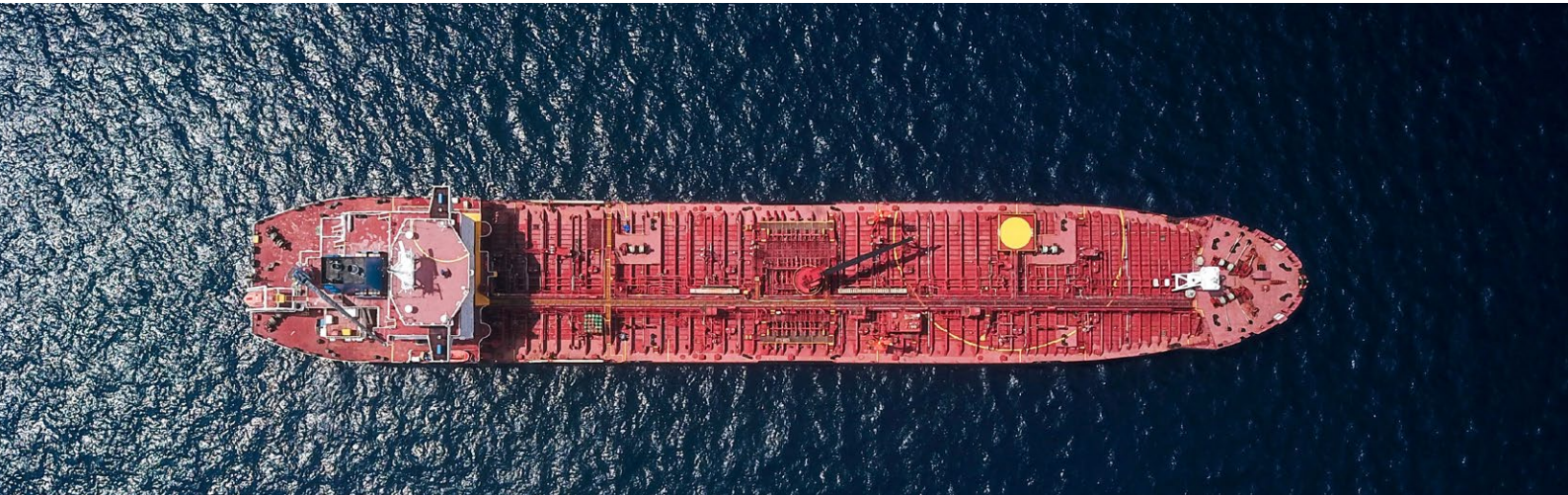
Figure 2. Transmission channels for environment- and climate-related risks to financial risks



Source: NGFS, 2020¹³

¹² Overview of Environmental Risk Analysis by Financial Institutions (NGFS, September 2020, p.6-)

¹³ As above.



Financial impacts will vary depending on a range of factors beyond the location of a company's facilities and the hazards it is exposed to. Other important factors include the natural resources and raw materials it uses and supply chain it relies on, the consumers it sells to, the exposure and adaptive capacity of employees, and the public policy a company operates within. The governance, risk management, and strategic planning measures a company has in place to anticipate and manage these risks and build climate resilience also play a crucial role in determining the financial impact of physical climate change on a company. Figures 3 and 4 demonstrate different financial impacts physical climate risks can have on companies.

Figure 3. Liquidity risk from rising temperatures

In spring 2020, mining company, Norilsk Nickel, was fined \$2.1 billion after a fuel spill polluted two Siberian rivers.

The company said that thawing permafrost weakened the foundation of its facilities and led to the spill, and that the fine would mean the company would struggle to meet its dividend policy¹⁴.

The spill led to around 21,000 tonnes of diesel leaking from the company's storage tanks into rivers and lakes in Russia's Arctic north.

The IPCC has identified thawing permafrost as a climate hazard across multiple regions, presenting risks to communities and infrastructure¹⁵.



Norilsk Nickel oil spill (photo: NS Energy)

Figure 4. Water scarcity, customer behaviour, and local government policies pose operational and reputational risk to companies

In 2017, PepsiCo and CocaCola faced a ban in two states in India, Kerala and Tamil Nadu, started by retailers' boycott of the products of the two multinational companies in protest of their depletion of groundwater. Data reveals that PepsiCo and other beverage companies face significant exposure to water stress in the United States and Mexico. Changing regulations, such as California's Sustainable Groundwater Management Act of 2017, and shifting availability of water supply as an input to beverages present a material risk to the industry¹⁶.

Physical Climate Opportunities

Physical climate risks also drive a range of opportunities. Effectively managing existing and future physical climate risks may create opportunities for a company to raise its performance and valuation. For example, improving business processes or retrofitting sites so that they are more resilient to an extreme weather event can benefit the business more broadly by reducing operating costs.

A changing climate also presents opportunities for companies to develop and offer adaptation technologies, products, and services such as climate analytics, low-energy cooling, and early warning systems. As companies, individuals, communities, and governments increasingly need to adapt, new products and services are required to forecast, prepare for, or respond to weather-related events and changing climate patterns. Figure 5 provides an example of a manufacturer providing adaptation solutions.

¹⁴ Norilsk Nickel fined record \$2.1bn over Siberia fuel spill (The Financial Times, June 2020)

¹⁵ Climate Change 2014: Impacts, Adaptation, and Vulnerability (IPCC AR5, 2014)

¹⁶ From Risk to Resilience – Engaging with Corporates to Build Adaptive Capacity (Four Twenty Seven, 2017)

These opportunities may be difficult for companies to identify. The European Commission has taken a step to support investment in adaptation through the development of the EU Taxonomy for Sustainable Activities. The taxonomy maps activities across multiple sectors that are deemed to contribute to climate change adaptation, alongside other environmental objectives¹⁷. New environmental and climate-related taxonomies are also emerging^{18, 19}. These taxonomies can support the identification of adaptation solutions across sectors and industries, thereby supporting investor engagement with companies and an increase in the flow of capital to these activities.

Figure 5. Manufacturing company provides adaptation solutions to water-related climate hazards

A US based company manufactures water drainage structures and supplies, such as plastic corrugated pipes. The company provides sub-surface storm water management drainage structures that support the capture, storage, and drainage of flood waters across a range of markets from property to agriculture. The company also provides products and services to support rainwater harvesting.



Culverts, creating channels for cross drainage (photo: ADS)

¹⁷ EU taxonomy for sustainable activities (European Commission)

¹⁸ The ASAP Adaptation Solutions Taxonomy provides an innovative taxonomy focussed classifying SMEs as an “Adaptation SME” based on the type(s) of technologies, products, and services it provides. The framework can be applied to companies regardless of size or geography.

¹⁹ For example, the UK Government has announced that it is developing a ‘Green Taxonomy’ which will provide a framework for identifying investments that can be defined as environmentally sustainable.



4. Investor Expectations of Companies

To facilitate engagement and stewardship relating to corporate action on physical climate risks and opportunities, members of IIGCC have set out expectations to help investors frame discussions with investee companies.

The expectations complement and reinforce existing frameworks, such as TCFD and the EU sustainable finance regulation insofar as they relate to climate change adaptation.



4.1 Establish a climate governance framework

Investors expect companies to consider the financial implications of both climate transition risks and physical climate risks. Many boards are already assessing a company's exposure to climate transition risks. However, investors also expect the board to understand the potential financial impacts of physical climate risks on the company.

Companies should establish a strong climate governance framework to achieve this. This should be underpinned by a clear responsibility for managing physical climate risks and opportunities at board level and a commitment to greater disclosure.

Investors expect directors and fiduciaries to approach governance of climate change (both the transition and climate resilience) in the same way as they would any other material matter. A director may be in breach of their duty of care and diligence if they fail to adequately consider and govern foreseeable and financially material climate risks²⁰.

Therefore, the board should ensure it has the expertise and the right sources of information to make sound decisions relating to physical climate risks and opportunities. Where this does not already exist, the board should take steps to improve its understanding and awareness of physical climate risk and consider taking advice from external experts.

Long-term strategic decisions should be informed by the most up to date physical climate data and information. A strong governance framework ensures physical climate risk and opportunity considerations are appropriately integrated into committee meetings and corporate performance tracking and incorporated into the roles of relevant executive management²¹.

A strong governance framework should provide the necessary senior level buy-in and accountability to set metrics and targets to measure, monitor, and report on physical climate risks and opportunities in the short, medium, and long term. Linking performance and remuneration, including executive remuneration, to performance against targets will provide additional assurance to investors that a company is serious about managing these risks and building climate resilience.

²⁰ Directors' Liability and Climate Risk: Comparative Paper (Commonwealth Climate and Law Initiative, 2019)

²¹ Companies should draw on corporate governance principles such as those set out by the International Corporate Governance Network (The Global Governance Principles) and the World Economic Forum's eight climate governance principles.

Investors expect directors and auditors to deliver Paris-aligned accounts. Companies that face material risks from climate change, either transition or physical risk, must by law, in most jurisdictions, report these in their narrative disclosures to shareholders²². Over time, a company's financial statement should reflect the implications of material physical climate risks on assets, liabilities²³, profits and losses, alongside the risks relating to transitioning to net zero by 2050²⁴.

Investors expect companies to deliver timely and high-quality corporate disclosures, covering all material physical climate risks and opportunities. In addition to Paris-aligned accounts, investors expect TCFD disclosures and reporting in line with the Corporate Sustainability Reporting Directive (CSRD)²⁵.

Minimum expectations

Investors expect companies to:

- **Make a commitment at board level to consider physical climate risks and opportunities, in addition to transition risk, in line with the expectations set out in this document.**
- **Demonstrate board responsibility and accountability for physical climate risks and opportunities, and report on directors' expertise and experience.**
- **Commit to enhanced disclosure of material physical climate risks and opportunities, including in financial statements.**

4.2 Undertake physical climate risk and opportunity assessment

Investors expect companies to determine the types of physical climate risks that the company may be exposed to in the future and an estimate of financial impact from material risks.

Investors expect companies to assess direct and indirect impacts on the business over the short-, medium- and long-term. TCFD recommends that companies 'define timeframes according to the life of their assets, the profile of the climate-related risk they face, and the sectors and geographies in which they operate'²⁶. Companies should determine the most appropriate type of risk assessment based on the time horizon under assessment. A probabilistic approach, such as the use of catastrophe models widely utilised in the insurance sector, may be applicable over the shorter term, for example 1-5 years. To assess longer-term and indirect impacts on the business, however, investors expect companies to use scenario analysis. Scenario analysis allows companies to explore different possible futures whilst accounting for uncertainty in climate policy and for the cascading impacts of climate change. The outputs of scenario analysis should inform business strategy and be integrated into strategic decisions related to managing material physical risk and implementing adaptation measures²⁷.

Companies should select at least two relevant climate scenarios. This should include a 'worst-case' scenario whereby average global temperatures rise by 4°C by 2100 and a more optimistic scenario, such as those based on current climate policies. IPCC releases emissions driven scenarios with a range of temperature outcomes, such as the four Representative Concentration Pathways (RCP) featured in the IPCC's Fifth Assessment Report (2013) and the upcoming Shared Socioeconomic Pathways²⁸ expected as part for the IPCC's Sixth Assessment Report (2021-22). Region-specific and hazard-specific models are also available that can provide greater granularity of climate data.

²² For instance, the SEC requires material risks and impacts to be disclosed. See [Commission-level interpretative statement](#) (2010)

²³ See [Liability risk and adaptation finance](#) (MinterEllison; UNEP FI, 2021) for an exploration of the relationship between physical climate risks and liability risks, and the potential impact of such legal action on adaptation finance.

²⁴ See [Investor Expectations for Paris-aligned Accounts](#) for further detail of how company directors and auditors are expected to incorporate climate-related risk in financial statements (IIGCC, November 2020).

²⁵ The CSRD is part of a comprehensive package of measures promoting the EU Commission's objective of directing capital flows towards more sustainable activities. The CSRD will revise and extend the reporting requirements introduced by the Non-Financial Reporting Directive (NFRD).

²⁶ [Proposed Guidance on Climate-related Metrics, Targets, and Transition Plans](#) (TCFD, 2021, p.42)

²⁷ See [Scenario Analysis for Physical Climate Risk: Foundations](#) (Four Twenty Seven, 2019) for guidance on integrating physical climate risk into scenario analysis for corporates and financial institutions.

²⁸ [CMIP6: the next generation of climate models explained](#) (Carbon Brief, 2019)

Figure 6. Indirect impact of sea level rise on a global megacity

It is important that companies assess indirect impacts of physical climate change in addition to direct impacts.

Societal impacts such as migration and mass relocation due to a changing climate could have implications for corporate performance. Indonesia, for example, is planning to move its capital city from Jakarta to the island of Borneo, 10,000km away, due to the vulnerability of the city to sea level rise and subsidence. Much of the coastal megacity is experiencing sea level rise of 10cm per year or more. This is significantly higher than the observed global average of 2.8-3.6mm per year. According to the IPCC, Bangkok, New Orleans, West Netherlands, and Shanghai are amongst the cities also highly vulnerable to subsidence²⁹.



Residents in Muara Baru, one of the fastest sinking areas in Jakarta, live below sea level.

Investors expect companies to ensure that they have adequate in-house expertise to develop and integrate scenario analysis into business decision making processes on an ongoing basis. This can include regular collaboration with research institutes, providing training to staff, and bringing in external experts

To support risk assessment, investors expect companies to maintain a physical asset register and disclose the locations of these assets. Companies should also maintain an inventory of current and future climate-related risks in relation to those assets, with particular attention on major value chain assets. An inventory should include the type of asset (e.g. office, factory), and can focus on the business' most material assets, where materiality can be defined in relation to both a company's operations and its value chain³⁰. For example, operationally, a company's material physical assets can include the factories or facilities responsible for a significant proportion of production. In relation to the value chain, materiality can be defined in relation to the geographic concentration of any climate sensitive commodities a company's supply chain is dependent on, for example.

As part of the assessment, companies should also consider the economic opportunities presented by a changing climate. Effectively managing existing and future physical climate risks may create opportunities to increase corporate performance, by upgrading equipment, for example. Companies may also find that physical climate impacts present opportunities to develop and offer new products and services or move into new markets, as demonstrated in figure 8. There are a number of sectors that are well positioned to provide adaptation solutions, such as infrastructure, water, healthcare, and telecommunications.

Investors expect companies to review their risk and opportunity assessment and scenario analysis annually to account for any factors that might affect a company's exposure and vulnerability to climate change, such as those arising from operational decisions, changes to supply chains, or investment decisions.

Every five years, companies should review the scientific basis of climate scenario analysis. Regular reviews will ensure changes to climate science, public policy, and market conditions are accounted for, and the company's strategy for managing physical climate risk and building climate resilience is underpinned by the most recent data and information.

²⁹ Jakarta's sea level rise prompts a move – at a price (Acclimatise, 2019)

³⁰ This investor expectation reflects a recent call for physical risk location data by Wellington Management and Woodwell Climate Research Centre, as part of the Physical Risks of Climate Change (P-ROCC) Framework, with an example reporting format provided on page 3. 'Call for physical risk location data': 'Physical Risks of Climate Change (P-ROCC) Framework'

Figure 7. Power provider uses climate models to inform actions for building grid resilience

A major power provider in California distributes electricity to 15 million people. Increasingly high temperatures and extreme weather events such as wildfires, droughts and storms, are affecting California residents. 10 of the 20 most destructive California wildfires have occurred since 2015.

The company created a Wildfire Mitigation Plan in response to climate change. In 2019 it replaced more than 300 circuit miles of overhead power lines with insulated wires, far exceeding the company's goal of 96 miles. Fast-acting fuses have been installed at over 10,000 locations to reduce electrical currents during the instance of a downed wire, and the company has conducted enhanced inspections on 100% of overhead distribution and transmission infrastructure in areas identified as high fire risk.

The power provider is focussing on long-term mitigation of physical climate risk using climate models and scenario analysis which extend out to 2070. The company's actions are informed by 10 climate models, with some models region-specific to California, and endorsed by the California Public Utilities Commission and Air Resources Board.

Minimum expectations

Investors expect companies to:

- **Maintain a physical asset register and disclose the location of these assets.**
- **Disclose the hazards assessed and time-frames used for risk assessment. Disclose how and why other hazards were omitted from the analysis.**
- **Disclose the two or more climate scenarios used to assess indirect and longer-term impacts and any external expertise used.**
- **Disclose the outputs of scenario analysis, including exposure to direct climate impacts due to the location of facilities, the types of future risks the company is exposed to, and estimated financial impacts from material risks and any opportunities identified.**
- **Disclose how the company is integrating these outputs into strategic business decisions relating to risk and opportunity management.**

4.3 Develop and implement a strategy for building climate resilience

Following risk assessment, a strategy should aim to build company resilience to both chronic and acute physical climate hazards, over the short, medium, and long term. It should provide transparency as to how materiality has been defined when setting out the material physical climate risks the company is exposed to. A strong strategy will set out a company's risk appetite, critical thresholds to differentiate between a "tolerable" and "intolerable" level of risk, and the actions a company will take when those critical thresholds are passed.

Investors expect companies to develop a strategy that sets out how the company plans to effectively manage, monitor, and report on physical climate risk and build climate resilience. A strategy should aim to increase the climate resilience of the company to the physical climate risks it faces now and/or in the future and create shared resilience benefits for the communities and natural ecosystems where it operates.

Figure 8. Examples of adaptation solutions³¹

- Weather and climate analytics
- Hydrological forecasting modelling
- Remote sensing-based tools for physical climate risk exposure assessment
- Water-efficient irrigate systems
- Water metering to reduce consumption and detect leakages
- Water storage and harvesting
- High precision laser land levelling to reduce runoff
- Geosynthetic products to control flood and protect against erosion



³¹ Examples taken from [The ASAP Adaptation Solutions Taxonomy](#) (an initiative led by The Lightsmith Group, in partnership with the Inter-American Development Bank, the Global Environment Facility, and Conservation International).

Investors expect companies to use the outputs of a risk assessment to anticipate and manage material climate-related risks with the aim to maintain business continuity and rebound following climate-related shocks. There are a number of information, policy, financial, and legal strategies a company can employ to do this. This includes maintaining larger capital reserves, negotiating shorter financial contracts or shorter lease terms on physical property, or expanding insurance cover to direct and indirect impacts. A climate resilience strategy should set out the actions a company takes and the cost of these actions, including insurance coverage, opex, and capex. Through a strategy, the company should demonstrate its financial resilience to physical climate risk.

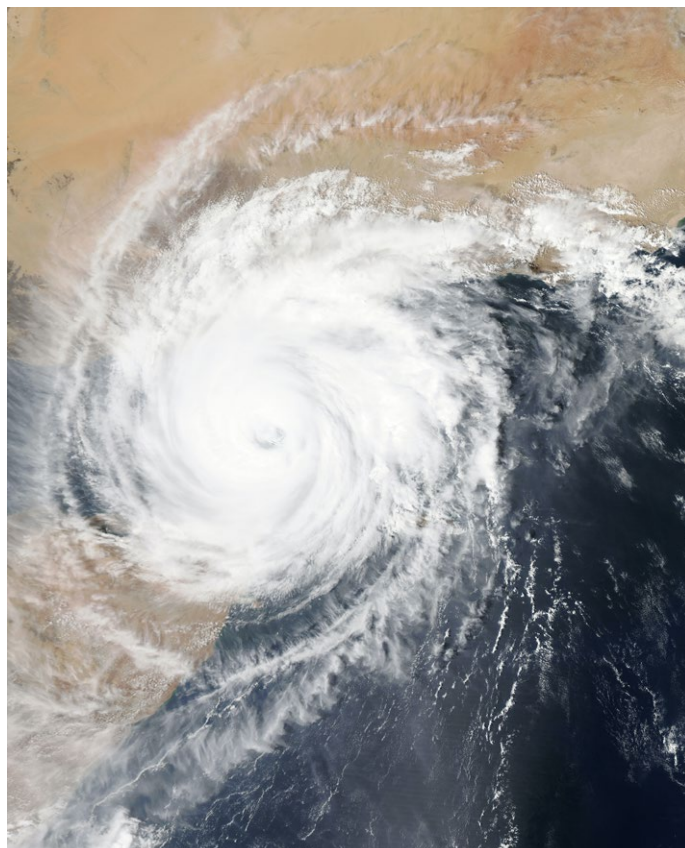
Companies can conduct legal due diligence to understand how physical climate risks give rise to commercial risks or potential liabilities in material contracts or financial transactions and act accordingly to address these. Companies should also work in partnership with local stakeholders to manage risk in the supply chain. For example, a company with operations located in an area prone to drought could engage with water utilities to ensure continuity of supply in a context of changing rainfall patterns³². In turn, the company can also commit to sustainable water consumption to increase the resilience of the local community during periods of water scarcity.

As part of a company's strategy, companies should also set out an approach to identifying new opportunities to provide adaptation solutions. Investors expect a changing climate to fuel market shifts, generating a need for new technologies, services, and products to forecast, mitigate, or respond to the direct and indirect impacts extreme weather events and changing climate patterns. Opportunities exist across a broad range of sectors, such as water management, satellite and telecoms services for weather and climate monitoring, healthcare, and environmental consultancy³³.

Minimum expectations

Investors expect companies to:

- **Disclose how the company defines materiality, including critical thresholds.**
- **Disclose the actions to be taken to manage material risks from physical climate impacts.**
- **Disclose how the company will finance this approach.**
- **Disclose the opportunities that have been identified to invest in and/or provide adaptation solutions.**



³² Chapter Zero provides an overview of actions Non-Executive Directors can take to effectively manage physical risk in Questions to assist non-executive director oversight of physical climate risk management (July, 2020).

³³ Embracing change by adapting to a new climate (Impax Asset Management, May 2020).

4.4 Identify and report against metrics to demonstrate progress over time

Many companies are now familiar with metrics that quantify a company's contribution to greenhouse gas emissions and the climate transition risk a company is exposed to. However, metrics for quantifying, measuring, and communicating physical climate risks and opportunities are less well developed and far from industry standardisation, although beginning to emerge.

Quantifying the impacts of physical climate change is critical to determining materiality of physical climate risks and essential for developing a forward-looking view of how future risks may affect corporate performance. Investors expect companies to start building a set of relevant metrics to quantify and measure physical climate risks and opportunities³⁴.

Physical climate risk metrics

We would like to see companies use forward-looking risk exposure and impact metrics. **As a minimum, companies should quantify and report the proportion of assets or business activities materially exposed to physical risks, based on key categories of commonly expected risks.** For example, the proportion of buildings in wildfire areas, or the proportion of electrical substations at risk from sea level rise by 2050³⁵.

In addition, companies should also consider using forward-looking impact metrics to assess the potential future financial impacts of physical risks on a business. Emerging metrics such as climate value-at-risk and climate adjusted probability of default (PD) are developing in sophistication and becoming more widely utilised. Climate VaR provides a probability-weighted estimate of future financial losses and is expressed as a numeric value or range in a selected currency³⁶. Climate-adjusted PD provides an analysis of the impact of climate risk on credit risk.

Companies can build an understanding of past and recent climate impacts based on corporate financial data. This will provide a baseline against which to assess the implications of future changes in climate.

All companies should understand and disclose:

a) financial impacts of recent weather events, for example, facilities and business lines affected, cost of business interruption, inventory write-downs, cost of repairs or upgrades.

Companies with moderate to high sensitivity to variability in climate, such as companies in the manufacturing, agriculture and food, energy and utility, tourism, and retail sectors, should also disclose:

b) the material impacts of weather variability on corporate value chains. Weather variability can affect labour, equipment, energy consumption, and markets, amongst others.

As noted above, developing a forward-looking view of future physical climate risk is essential³⁷. Therefore, investors expect companies to disclose:

c) future impacts of climate change. Companies can use outputs from scenario analysis and risk assessment (see 4.2) alongside data collected on the financial impacts of past and recent weather events. Companies can disclose future impacts using projections based on the same metrics as past impacts, for example, future impact of heat on sales. Alternatively, companies can use aggregated metrics that reflect the net risk for the business, accounting for risk management measures such as insurance, or planned retrofitting of facilities. This includes the metrics outlined above: proportion of assets or business activities materially exposed to physical risks, climate VaR, climate-adjusted PD. Disclosures of future impacts from acute and chronic hazards should cover, at a minimum, all material facilities, or critical facilities, as well as vital suppliers.

Examples of forward-looking physical climate risk exposure and impact metrics:

- The proportion of sites and business lines exposed to relevant climate impacts.
- The projected changes in production, revenues, operational expenditure (opex) or capital expenditure (capex) due to climate change.
- Value-at-risk from probabilistic estimates, for example, a 1:100 or 1:200 extreme weather event disruption to operations or production, key suppliers, customers, or markets.
- Annual average losses from projected climate impacts.

Source: EBRD/GCECA

³⁴ The investor expectations in relation to metrics for physical climate risk disclosure draws primarily on the leading guidance from EBRD/GCECA and recommends that companies familiarise themselves with the recommendations set out in this report. The metrics outlined here also follow the direction of travel of the TCFD, and investors recommend that companies consider the latest recommended metrics and targets outlined by the Task Force.

³⁵ This recommendation is in line with guidance from TCFD, SASB, and the European Commission.

³⁶ *Forward-Looking Financial Sector Metrics: Consultation* (Task Force on Climate-related Financial Disclosures, 2020).

³⁷ Investors acknowledge that the uncertainty surrounding the type and timing of climate impacts, business consequences, and effectiveness of risk management efforts, makes an assessment of future risks more complex.

Opportunity metrics

Companies should disclose capex and opex associated with adaptation activities. In addition to the qualitative disclosures detailing risk management and adaptation planning outlined in section 4.3, investors expect companies to provide insight into the extent to which they are investing in adaptation to build corporate climate resilience by measuring and disclosing expenditure (capex and opex) associated with adaptation activities, such as building retrofits or upgrading equipment.

Companies should quantify and disclose revenue data associated with adaptation activities. This guide asks companies to develop an approach to identifying opportunities to offer adaptation solutions as markets and customer needs shift (see section 4.3). Measuring and quantifying revenues associated with the provision of adaptation products or services will show investors that companies are adequately identifying and responding to these opportunities. It will also provide a basis on which to estimate the positive contribution of companies and investors to increasing climate resilience.

To identify which activities are considered as providing adaptation solutions, companies can use existing and emerging taxonomies, such as the EU Taxonomy for Sustainable Activities³⁸ and the ASAP Adaptation Solutions Taxonomy³⁹, which aim to define the types of economic activities, technologies, products, and services that contribute to climate change adaptation.

Impact metrics

Corporate action on physical climate risks and opportunities should aim to create shared resilience benefits for the communities and natural ecosystems where they operate.

Investors expect companies to monitor and disclose the positive impact the company's actions have on the climate resilience of local communities and natural ecosystems. Companies can start with qualitative, more descriptive, disclosures. As understanding, technical capacity, and data availability improves, companies should develop and disclose quantitative metrics as relevant to business. Examples of quantitative impacts metrics include the number of agricultural workers that have been made more resilient to projected increases in extreme heat, or the number of people no longer exposed to flooding.

Certain groups, communities, and ecosystems are more vulnerable to climate impacts than others. Economically, politically, or socially marginalised people, rural and urban poor, and groups with limited adaptive capacity are particularly vulnerable⁴⁰. **Where possible, companies should identify vulnerable people, communities, and ecosystems, and disclose the impact the company's actions has had on the climate resilience of these specific groups.**

Investors would like companies to set targets covering physical climate risks, opportunities, and climate resilience impacts. Whilst it is challenging for investors to recommend specific targets that are applicable to companies across different sectors and that are exposed to different climate risks, targets should demonstrate ambition to increase corporate resilience and support resilience of the most vulnerable groups to a changing climate. Targets will allow companies to track progress over time and show investors that a company is serious about measuring, monitoring, and disclosing physical climate risk and opportunity, and building climate resilience.

Minimum expectations

Investors expect companies to report on and show progress against the following metrics:

Risk metrics

- **Companies must disclose against metrics related to each, a) impacts from recent extreme weather events, b) impacts of weather variability, c) future risks of climate change.**
- **As a minimum forward-looking metric, companies should quantify and report the proportion of assets or business activities materially exposed to physical risks, based on key categories of commonly accepted risks.**

Opportunity metrics

- **Expenditure (capex and opex) associated with adaptation and building corporate climate resilience.**
- **Revenues from the provision of adaptation solutions, as defined by the EU Taxonomy criteria for 'substantial contribution' to adaptation where possible.**

Impact metrics (quantitative or qualitative)

- **A quantitative or qualitative assessment of the climate resilience benefits for people in the workforce, local communities, or natural ecosystems.**

³⁸ EU taxonomy for sustainable activities (European Commission)

³⁹ The ASAP Adaptation Solutions Taxonomy provides an innovative taxonomy focussed classifying SMEs as an "Adaptation SME" based on the type(s) of technologies, products, and services it provides. The framework can be applied to companies regardless of size or geography.

⁴⁰ For further information about vulnerable groups, see Considerations regarding vulnerable groups, communities and ecosystems in the context of the national adaptation plans (Least Developed Countries Expert Group).

5. Questions investors can ask when engaging companies on physical climate risks and opportunities

This guide sets out the key expectations investors have of companies relating to physical climate risk and opportunity. However, investors also acknowledge that engagement and stewardship is crucial to ensure that investee companies recognise the importance of the issue and put the best possible approaches in place to manage physical climate risk and build climate resilience.

This section provides examples of the questions investors can ask investees to gain a better understanding of their physical climate risk management capabilities and support them to adapt and build resilience to climate shocks and stressors^{41, 42}.

Element	Primary question	Detailed question
Governance/ management	Can you describe how you manage the physical impacts of climate change?	<ul style="list-style-type: none"> Who is responsible for identifying, assessing, and managing the physical risks associated with a changing climate? Does your Board oversee the management of physical climate risks? If so, how? How often, and in which circumstances, does your Board discuss the management of physical climate risks? Have you engaged with key stakeholders to understand their views on climate change-related risks? What have the outcomes of these discussions been?
Risk analysis process	Can you describe your process for assessing the risks and opportunities associated with the physical impacts of climate change?	<ul style="list-style-type: none"> How do you identify climate change-related risks and opportunities? What datasets do you use to understand these risks? Do you use climate change-related scenarios to inform your business scenarios (strategy or risk assessment processes)? If yes, what climate scenarios do you use, and over which timeframe? What is the scope of your risk assessment? For example, does it consider: <ul style="list-style-type: none"> Direct impacts on assets over their lifespan? Wider value chain and knock-on effects? Impacts on tangible and intangible assets/ value? Impacts on competitors, market sectors and economies? Impacts on local communities and the natural environment? Impacts on future market conditions? Opportunities for new products, services or markets? Opportunities to invest in adaptation? What are the key climate change-related risks and opportunities you have identified? How do you define / assess the significance of these risks and opportunities in the context of other risks/ opportunities? Are there areas where further data/ information is required? Do the results of your risk assessment indicate that physical climate risk will have significant financial or other (e.g. brand, market access, regulatory) implications for you?

⁴¹ Adapted from Sullivan et al. 2009 with input from Environment Agency Pension Fund. Available in [Understanding Physical Climate Risks and Opportunities](#) (IIGCC, 2020, p.64).

⁴² Additional guidance is available from Chapter Zero, in Questions to assist non-executive director oversight of physical climate risk management (Chapter Zero, 2020), which also includes best practice responses to questions that can be asked.

Element	Primary question	Detailed question
Risk management and engagement	<p>Can you describe the major actions you are taking to respond to the physical impacts of climate change and improve asset resilience?</p> <p>Are you engaged in any discussions with your suppliers and customers on the impacts of climate change on their businesses?</p>	<ul style="list-style-type: none"> • How and when are you taking actions to manage the climate change-related risks you have identified? • What indicators or measures are you using to monitor the investment implications of the physical impacts of climate change? • Do you include the management of physical risks on your risk register? • Have you established a structured process to monitor and review climate physical risks over time? • Will you be taking any steps in the next 12 months to review your business strategies and your major projects in the light of the risks and opportunities posed by the physical impacts of climate change?
Reporting	<p>Can you describe the information you provide to your investors, to your clients/ beneficiaries and to other stakeholders?</p>	<ul style="list-style-type: none"> • What information do you report on the implications of the physical impacts of climate change? Do you report on (a) the investment implications of these impacts, (b) the actions you have taken to mitigate these impacts, (c) the effectiveness of the actions you have taken? • How often do you report this information? • If you do not currently report, do you have plans to start reporting?



6. Taking forward investor engagement with companies on physical climate risks and opportunities

Alongside the publication of this guide in September 2021, 59 investors representing \$10 trillion in assets under management or advice, sent an open letter to 50 publicly listed companies to request that they adopt the investor expectations set out in this guide.

IIGCC leveraged data from a physical climate risk analytics firm⁴³, Four Twenty Seven, part of Moody's ESG Solutions, to identify companies highly exposed to a range of physical climate risks relative to other companies in the same sectors and regions. The climate hazards within scope of the assessment included flooding, heat stress, hurricanes and typhoons, sea level rise, water stress, and wildfires.

The sectors within scope of this analysis were those in the energy and mining, transportation, utilities, and three manufacturing sub-sectors – food processing, technology, and pharmaceuticals. These sectors were prioritised by IIGCC due to the exposure of these sectors to physical climate risks relative to other sectors and the critical role these sectors need to play in building societal resilience to a changing and more variable climate by increasing their own climate resilience and investing in adaptation solutions.

IIGCC categorised companies into three regions for the analysis – Europe, North America, and Rest of World – based on the location of the headquarters of the companies. The regional categorisation reflects the greater exposure of IIGCC members to European and North American headquartered companies whilst recognising many members are global investors and certain regions of the world are more exposed to physical climate impacts than others and therefore, it is crucial that investors engage with companies across all regions.

A key aim of IIGCC is to form a consistent message and voice to facilitate company and investor dialogue. An open letter to companies represents a first step towards increased investor engagement with companies and overtime, we will aim to strengthen IIGCC's support of investor engagement and stewardship with companies in relation to physical climate risks and opportunities. As global temperatures rise and an increasing number of investors commit to aligning portfolios with the Paris Agreement, both investors and corporates will need to increase action if we are to meet the adaptation and resilience goals of the Paris Agreement.

About Four Twenty Seven

Four Twenty Seven (427mt.com), an affiliate of Moody's, is a leading publisher and provider of data, market intelligence and analysis related to physical climate and environmental risks. We tackle physical risk head on with analytics that identify the exposure of any location in the world to climate change hazards such as floods, heat stress, hurricanes & typhoons, sea level rise, water stress and wildfires, which pose an immediate threat to investment and loan portfolios.

Four Twenty Seven provides on-demand analytics and subscription data products to access this unique offering. Our physical climate risk application allows users to explore the climate risk drivers for a single asset or a portfolio of assets, scoring thousands of locations in minutes. We also offer forward-looking climate risk scores for equities, based on an ever-growing database that now includes over one million corporate sites and covers over 2,000 publicly-traded companies globally. Additional datasets include climate risk scores for sovereigns and U.S. municipalities.



⁴³ Investors may use physical risk analytics provided by other data and service providers in the market to inform their assessment of portfolio level or asset level physical risk exposure.

7. Appendix 1. EBRD/GCECA Framework for Disclosure

IIGCC members welcome the work undertaken by the EBRD/GCECA relating to metrics for reporting physical climate risks and opportunities. We have added to this framework to recognise the importance of ensuring social justice in adaptation, drawing parallels with the concept of a just transition in the goal to decarbonise our economies. We also recognise that sustainably managing, conserving, and restoring ecosystems

can play a significant role in enhancing climate resilience, adaptive capacity, and reducing social and environmental vulnerabilities in the face of physical climate risk, and contribute to transformative adaptation⁴⁴. Therefore, additional metrics cover climate impacts, risk management, and climate resilience strategy disclosures relating to local communities⁴⁵ and ecosystems.

⁴⁴ Ecosystem-Based Disaster Risk Reduction: Implementing Nature-Based Solutions for Resilience (United Nations Office for Disaster Risk Reduction, 2020)

⁴⁵ As discussed in the forthcoming Investor Expectations for corporate resilience to physical climate impacts and social justice (Murray Birt, DWS)

	Supply chain	Operations (including employees)	Markets	Community (social)	Ecosystems
Recommendations for the disclosure of physical climate risks					
1. Hazard and materiality	<ul style="list-style-type: none"> Assess exposure to heat stress, extreme rainfall, drought, cyclones, rising sea levels, wildfire and other industry-relevant and/or locally specific climate hazards across the corporate value chain. 				
2. Timeframe	<ul style="list-style-type: none"> Assess exposure to first-order (direct) impacts in the short to medium term (2-5 and 5-20 years) using a probabilistic approach; use scenario analysis for long-term risk (more than 20 years) and possible exposure to second-order (indirect) impacts 				
3. Level	<ul style="list-style-type: none"> Location (country or city) of key supplier facilities and a measure of their importance 	<ul style="list-style-type: none"> Location (country or city) of critical business facilities (such as production or support systems) and key distribution or logistics sites, as well as a measure of their importance 	<ul style="list-style-type: none"> Breakdown of sales by country and by segment 	<ul style="list-style-type: none"> Location of (i) local communities, (ii) vulnerable groups, such as indigenous communities and women 	<ul style="list-style-type: none"> Location and description of local ecosystems
4. Impacts from recent extreme weather events	<ul style="list-style-type: none"> Decreased production capacity due to supply-chain interruption 	<ul style="list-style-type: none"> Reduced revenues, including situations where a significant number of staff members are unable to get to work Increase in operational expenditure (opex), such as repair costs, insurance premiums Increase in capital expenditure (capex) such as impairment of fixed assets, inventory write-downs 	<ul style="list-style-type: none"> Reduced revenues from lower sales due to the consequences of extreme weather events 	<ul style="list-style-type: none"> Impacts to (i) local communities, (ii) vulnerable groups, such as indigenous communities and women 	<ul style="list-style-type: none"> Impacts on local ecosystems
5. Impacts of weather variability	<ul style="list-style-type: none"> Increase in supply-chain costs due to changes in the availability of commodities 	<ul style="list-style-type: none"> Increase in opex (energy costs, negative impacts on the workforce) Increase in capex due to weather or natural resources 	<ul style="list-style-type: none"> Reduced revenues from lower sales due to variability in the weather 	<ul style="list-style-type: none"> Impact on local communities due to variability in the weather 	<ul style="list-style-type: none"> Impact on local ecosystems due to variability in the weather

	Supply chain	Operations (including employees)	Markets	Community (social)	Ecosystems
6. Future risks of climate change	<ul style="list-style-type: none"> Suppliers or commodities likely to be affected by climate change Value-at-risk (VaR) from 1:100 or 1:200 and annual average loss projections from disruption to key supplier(s) 	<ul style="list-style-type: none"> Number of sites and business lines exposed to relevant impacts of climate change Projected change in production, revenues, opex or capex due to climate change VaR from 1:100 or 1:200 impact on operations or production Annual average losses from projected impacts of climate change 	<ul style="list-style-type: none"> Markets or sales likely to be affected by climate change VaR from 1:100 or 1:200 loss projections from impact on key customer(s) or markets 	<ul style="list-style-type: none"> Forecasted impact of climate change to local communities, and vulnerable groups 	<ul style="list-style-type: none"> Forecasted impacts to local ecosystems
7. Physical climate risk management and climate resilience strategy	<ul style="list-style-type: none"> Supply-chain risk management strategy Engagement with suppliers to help identify, assess and manage climate-related physical risks Engagement of suppliers with local and national governments to identify, assess and manage these risks e.g. # of supplier meetings held, improvements in supplier risk management (qualitative) 	<ul style="list-style-type: none"> Insurance and risk management instruments and total cost of risk (net risk exposure after risk management) Planned improvements, retrofits, relocations, or other changes to facilities that may reduce their vulnerability to climate impacts e.g. \$\$\$ spend Engagement with local or national governments and local stakeholders on local climate resilience 	<ul style="list-style-type: none"> Logistics, distribution and sales risk management strategy Engagement with distributors and key customers to help identify, assess and manage climate risks 	<ul style="list-style-type: none"> Engagement with local governments and stakeholders, specifically vulnerable groups, on climate resilience Metrics include number of meetings held; number of women at meetings, changes to planning (qualitative) 	<ul style="list-style-type: none"> Natural capital solutions, informed by ecosystem adaptation approaches and review of indigenous peoples practices Metrics include, % of ecosystems regenerated; % of biodiversity increase; number of natural capital-related jobs created (with gender split)

Recommendations for the disclosure of physical climate opportunities

8. Opportunities	<ul style="list-style-type: none"> Identify opportunities inherent in managing existing and emerging physical climate risks Identify opportunities based on adapting to market shifts driven by a changing climate Identifying opportunities to invest in adaptation and resilience e.g. through nature-based solutions
9. Timeframe	<ul style="list-style-type: none"> Assess and disclose opportunities using an adequate timeframe, according to the industry and the type of opportunity: snapshot of current context (shortest timeframe) business planning timeframe asset lifespan (longest timeframe)
10. Level	<ul style="list-style-type: none"> Disclose physical climate opportunities at the segment level Disclose climate resilience benefits at the facility level for critical facilities
11. Metrics for climate resilience benefits	<ul style="list-style-type: none"> Disclose benefits of climate resilience investments using the same metrics that are used for the disclosure or physical climate risks In addition, whenever possible, assess and disclose public co-benefits from climate resilience investments (in other words, the wider economic benefits of managing physical climate risks)
12. Metrics for business opportunities	<ul style="list-style-type: none"> Disclose qualitative information on the lifecycle of a new commercial opportunity, including: the development stage of an endeavour the business area and connection to company's core business the size of the potential market the approximate timeframe for commercial viability

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