CLIMATE CHANGE PHYSICAL RISK TOOLKIT

Investor Leadership Network

INVESTOR
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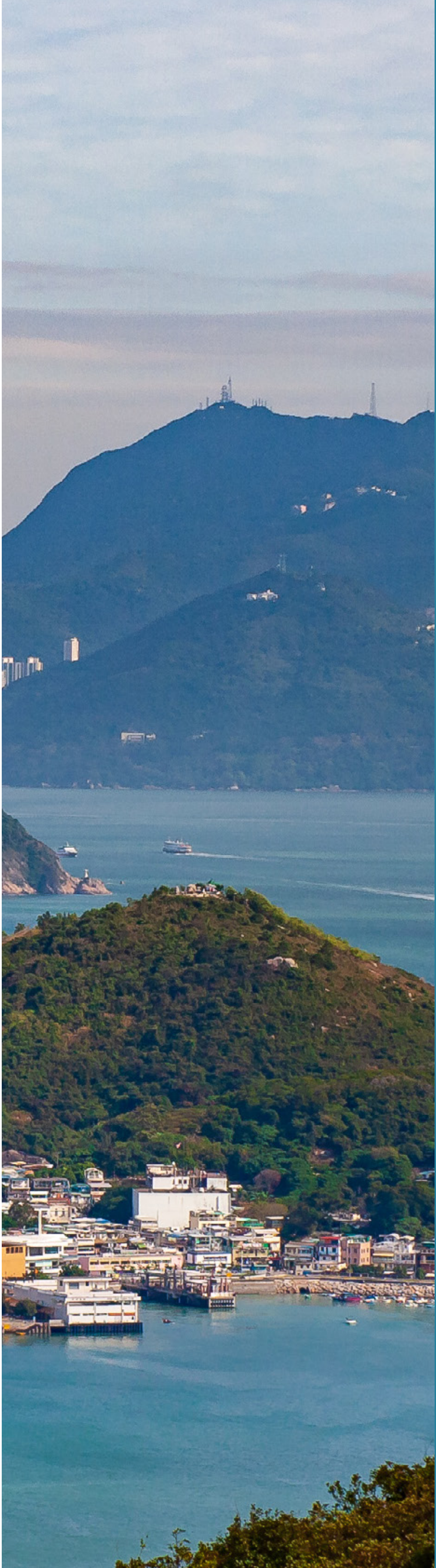
NETWORK



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OVERVIEW

The **Investor Leadership Network (ILN)** has established its Climate Change Advisory Group to facilitate collaboration among global investors, build on existing guidance and best practices, and expand the adoption of uniform and comparable climate-related disclosures based on the Task Force on Climate-related Financial Disclosures (TCFD) recommendations.

This **ILN Climate Change Physical Risk Toolkit** is designed to provide practical guidance for investors to better understand the potential physical impacts of climate change on their investments and the corresponding financial implications. The toolkit comprises four resources:

- The **Scientific and Macroeconomic Context** for understanding physical climate change risks;
- A step-by-step **Scoping Methodology** to identify potentially material physical climate risks and opportunities at the individual investment level, supported by an illustrative case study;
- A **Disclosure Guide** with criteria for assessing physical risk disclosures and metrics, supported by examples of better corporate practices; and
- A **Resource Guide** of credible third party sources to assist investment professionals in researching and analyzing physical climate risks and opportunities in specific detail.

While evidence of a changing climate continues to grow, the potential effects of its associated physical risks on a company's operations and future prospects remain difficult to incorporate into traditional investment analysis. The TCFD in its 2021 Status Report noted that it has found limited descriptions of the potential financial impacts of climate change in corporate reporting, despite this being critical decision-useful information that investors seek to understand.[1]

Investors are therefore encouraged to use this guidance to identify and analyze the unique physical risks that climate change poses to current and target investments, based on the geographies, sectors and value chains associated with each investment.

Chapter 1

A PRIMER ON PHYSICAL CLIMATE RISKS

This chapter provides a summary of the science behind climate change, and the corresponding risks to the global economy.

1.1 BACKGROUND

Climate is the prevailing pattern of variables such as temperature and precipitation that persist over periods of time ranging from decades to thousands of years or more. These variables are impacted by broader Earth systems, including conditions in the atmosphere, oceans and polar regions.

While the climate has shifted over the Earth's history for a variety of reasons (e.g., solar and orbital cycles, volcanic periods), **climate change** as currently defined refers to those changes in climate that are attributable — directly or indirectly — to human activity and are incremental to natural climate variability.[2]

In 1988, the United Nations established the Intergovernmental Panel on Climate Change (IPCC) to provide objective information on the natural, political and economic impacts of and responses to climate change.

The IPCC is broadly seen as one of the world's most authoritative scientific sources on these topics, and in August 2021 published the Physical Science Basis of its Sixth Assessment Report.

Emissions of greenhouse gases (GHGs) from the combustion of fossil fuels are the primary source of climate change and, according to the IPCC, have **unequivocally** caused the warming of the oceans, land and atmosphere since human industrial activity began.[3] The scientific term for these human-induced climate changes is anthropogenic. GHGs such as carbon dioxide in the atmosphere have quickly risen to their highest levels in millions of years.[4] At that time, temperatures were significantly higher than present, a potential harbinger of impending temperature increases that may be already locked in.[5]

The resulting physical climate risks from rising temperatures fall into two categories:[6]

Acute risks refer to those that are event-driven, including increased severity of extreme weather events such as cyclones and floods.

Chronic risks refer to longer-term shifts in climate patterns (e.g., sustained higher temperatures) that can drive impacts such as sea level rise and chronic heat waves.

The extent of future climate-related physical risks will depend on the rate, peak, and duration of continued global warming. Table 1 presents a summary of observed impacts of climate change to date and their potential implications. Note that the physical risks could be becoming more significant than previously understood.

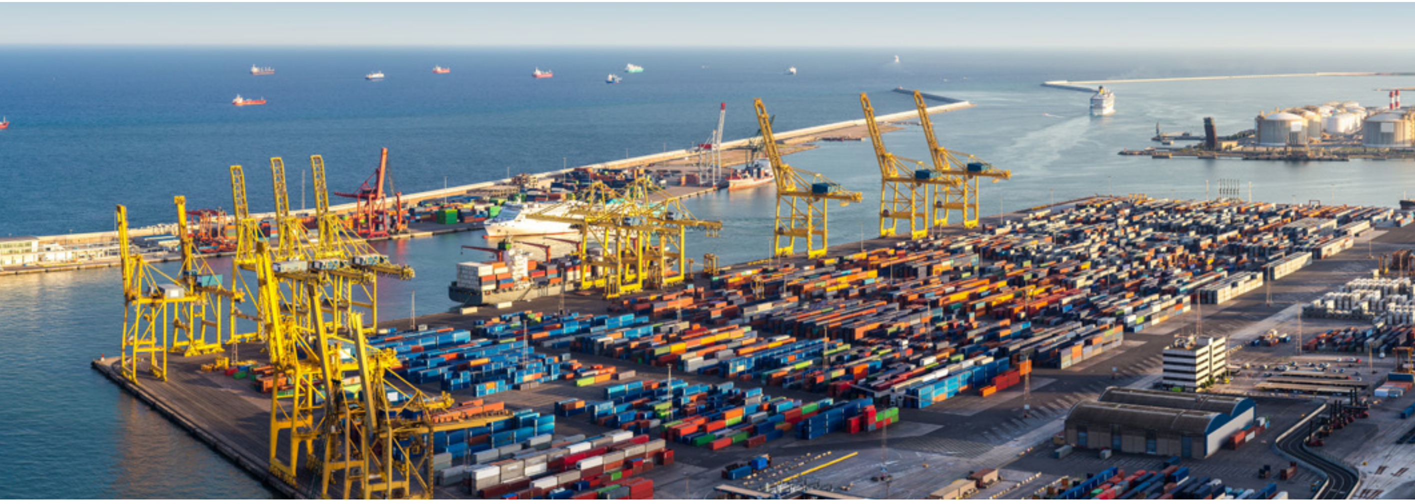
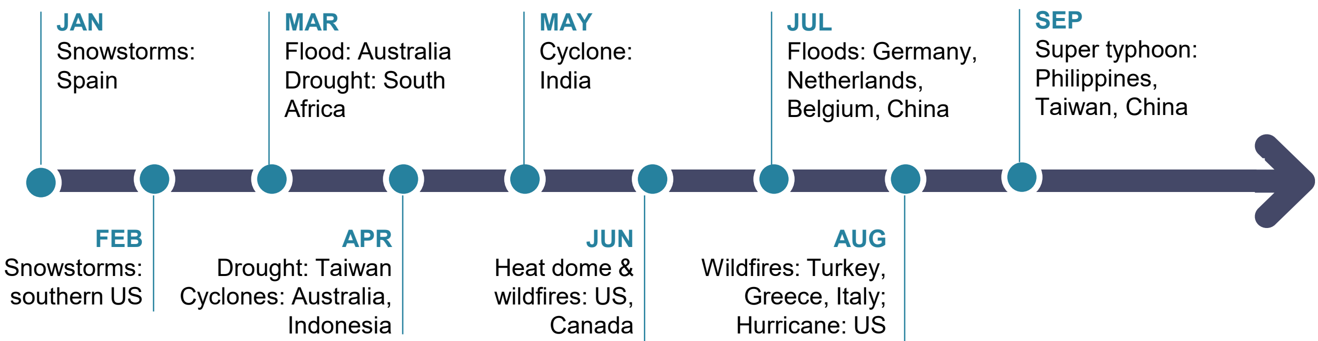


TABLE 1: EVIDENCE AND IMPLICATIONS OF CLIMATE CHANGE

Observed Impacts	Implications
Rise in global temperature	Each half-degree Celsius increase in global temperature has intensified the frequency of heat extremes, resulting in heatwaves, heavy precipitation, and agricultural and ecological droughts. The risk of large-scale singular events will increase at a steepening rate if warming climbs towards and beyond 2°C above pre-industrial levels.[7]
Changes in atmospheric circulation	Temperature and precipitation patterns have changed due to shifts in atmospheric circulation in both the Northern and Southern Hemispheres. These shifts are increasingly linked to the severity of weather events, heatwaves and droughts across various regions.[8]
Shrinking ice sheets	Both the Greenland and Antarctic ice sheets have been losing mass since 1990, with the highest loss rate occurring in the last decade.[9] Arctic sea ice has reached its lowest levels since at least 1850.[10] Ice sheet loss has contributed to rising sea levels, and it is projected that if all ice sheets were to fully melt in the coming centuries, sea level would rise by 70 meters.[11]

These longer-term trends in climate patterns are also contributing to the intensification of severe weather events. Figure 1 presents a summary of increasingly extreme weather events to date in 2021 and examples of their linkage to climate change.

FIGURE 1: EXTREME WEATHER EVENTS OF 2021



In June 2021, the Pacific Northwest areas of the U.S. and Canada experienced temperatures never previously observed. Multiple cities in the U.S. states of Oregon and Washington and the western provinces of Canada recorded temperatures far above 40°C, including setting a new all-time Canadian temperature record of 49.6°C in the village of Lytton, which was subsequently destroyed in a wildfire. The heatwave was triggered by a slow-moving high-pressure system, called an Omega-block or '**heat dome**', that can be attributed to a weakening of the summer jet stream.[12]

Before 2020, the odds of an Atlantic hurricane increasing in windspeed by over 55 kilometers per hour in a 24-hour period were only one in a hundred. However in 2020, driven by the significantly warmer ocean surface temperatures in the Atlantic Ocean and Gulf of Mexico, ten hurricanes experienced this '**rapid intensification**' phenomenon, with two of these hurricanes increasing by over 130 kilometers per hour in a 24-hour period.[13] In August 2021, Hurricane Ida 'explosively intensified' from Category 1 to 4 within five hours of its landfall in the southern US.[14]

1.2 TIPPING POINTS AND THEIR INTERCONNECTIONS

A **tipping point** is a threshold in a system that, when exceeded, leads to a large and often irreversible change in that system.[15] Multiple potential tipping points have been identified in Earth's planetary and ecological systems that are interconnected. If one system destabilizes or changes, it could trigger the destabilization of another system no matter how far apart they are.[16] The transition from one state to the next can often be disorderly, causing abrupt and drastic changes to prevailing climate conditions.

Figure 2 shows planetary and ecological systems elements that are approaching tipping points and the interconnections between them.

FIGURE 2: INTERCONNECTIONS OF EARTH'S SYSTEMS AND THEIR TIPPING POINTS[17]

- Increased vulnerability of the boreal forest spanning the Northern Hemisphere due to large-scale insect disturbances and wildfires is threatening this critical carbon sink;
- Reductions in Arctic sea ice coverage is amplifying regional warming, and driving changes to the strength and structure of the jet stream;
- Changes in the strength and structure of the Northern Hemisphere jet stream are leading to increased and more extreme weather events;
- Melting of the Greenland ice sheet is resulting in global sea level rise, and driving an influx of freshwater into the North Atlantic;
- Weakening of Atlantic Ocean circulation patterns including the Gulfstream is being accelerated by the Greenland meltwater, and could significantly disrupt North American and European climate conditions;
- Deforestation and decreased rainfall have resulted in the dieback of the Amazon rainforest, impacting regional weather patterns and threatening this critical carbon sink;
- Hotter and drier El Niño Southern Oscillation events are leading to more severe droughts in the Amazon rainforest, western North America and Asia-Pacific;
- Melting of the West Antarctic ice sheet and East Antarctic ice sheet are interconnected with Greenland ice sheet loss and Atlantic and Pacific Ocean circulation changes, and could lead to catastrophic sea level rise;
- The increased thawing of permafrost in the Arctic regions of North America and Siberia is resulting in the release of vast quantities of methane, a much more potent greenhouse gas;
- Mass bleaching of coral reefs due to prolonged exposure to increasing ocean temperatures threatens their survival and the key role they play in major global ecosystems and economies.

Such examples of feedback effects within the climate system suggest that we could face a global cascade of planetary tipping points.[18] The economic and financial implications of physical climate change risks could similarly reach a tipping point.

1.3 GLOBAL AWARENESS OF RISKS TO THE ECONOMY

In 2015, 196 national governments signed **the Paris Agreement to limit global warming to well below 2°C** (and preferably below 1.5°C) compared with pre-industrial levels.[19] It is a legally binding treaty that brings all nations into a common framework to mitigate climate change, and requires all parties to put forward their plans to reduce GHG emissions through nationally determined contributions (NDCs) every five years.[20] This agreement has also more broadly contributed to the increased awareness of climate risks to the global economy.

The annual World Economic Forum (WEF) Global Risk Reports from 2012-2021 have shown that climate and broader environmental risks have supplanted traditional economic risks as being the most significant to global economic performance.

In the 2021 WEF Global Risk Report, expert respondents ranked Extreme Weather and Climate Action Failure as among the most concerning risks to the economy (see Figure 3).[21]

If the planet continues on its current warming trajectory, the effects on the global economy and livelihoods could be catastrophic. For example, a global temperature rise of 3.2°C could result in an **18% loss of global GDP by mid-century compared to a world with no global warming.**[22] Further adverse socioeconomic impacts could include nonlinear shifts in livability and workability, food systems, infrastructure services and natural capital.[23]

FIGURE 3: WEF GLOBAL RISK REPORT 2021

Top global risks by likelihood - 2021

1st	2nd	3rd	4th	5th	6th	7th
Extreme weather	Climate action failure	Human environmental damage	Infectious diseases	Biodiversity loss	Digital power concentration	Digital inequality

Top global risks by impact - 2021

1st	2nd	3rd	4th	5th	6th	7th
Infectious diseases	Climate action failure	Weapons of mass destruction	Biodiversity loss	Natural resource crises	Human environmental damage	Livelihood crises

Economic Environmental Geopolitical Societal Technological

Chapter 2

CLIMATE SCENARIOS AND SIGNPOSTS

This section provides investors with an overview of climate scenario analysis and signposts, and how these tools can help investors better understand and manage climate risks.

2.1 CLIMATE SCENARIO ANALYSIS

The two key categories of climate change risks – transition risk[24] and physical risk – can be assessed independently or together using climate scenario analysis. **Scenario analysis** is an effective approach in helping investors understand the range of complexity and uncertainty around climate change and its potential impacts. It allows investors to model and develop responses to climate change risks and opportunities by mapping out possible outcomes under a defined set of assumptions over the relevant investment horizon at both the portfolio and individual investment level.

Transition scenarios are constructed around different policy options to achieve targeted global outcomes, and place a focus on transition risks and how energy and economic pathways may play out.[25]

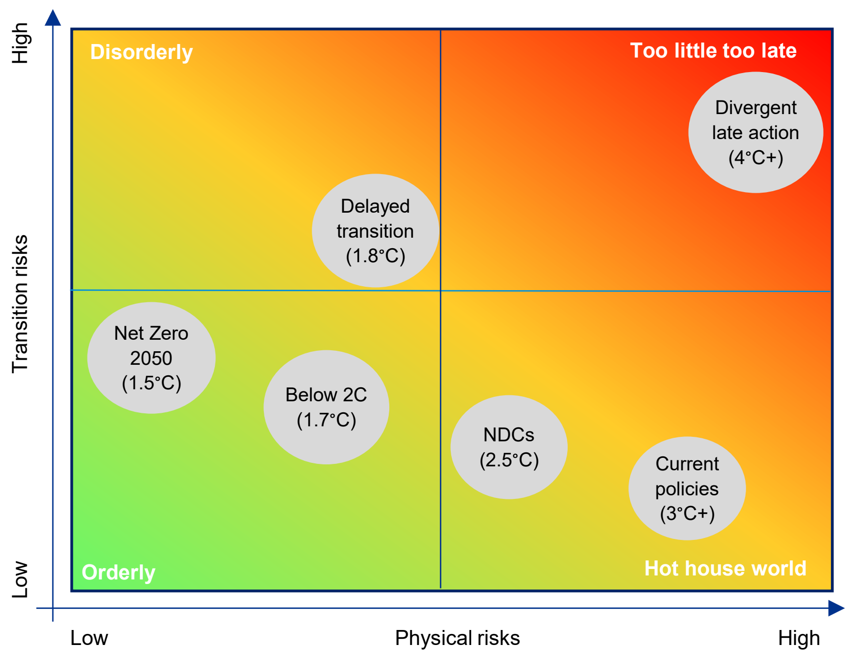
Physical scenarios are constructed around different emission and warming paths and place a focus on physical risks and the various orders of corresponding physical impacts (for example, first order impacts such as drought, second order impacts such as loss of crop production, and third order impacts such as famine).[26, 27]

Combined scenarios consider the interaction between energy transition and warming pathways.

Figure 4 illustrates the interaction between transition and physical risks using Network for Greening the Financial System (NGFS) based combined scenarios as an objective source, including the range of possible risk outcomes that could emerge from different policy and warming pathways.

When developing climate scenarios, investors should ensure that the overall scenario set has a reasonable range of potential future outcomes that are relevant to the business, and that tail risks are being considered.

FIGURE 4: INTERACTION BETWEEN TRANSITION AND PHYSICAL RISKS IN CLIMATE SCENARIOS



The positioning of scenarios in Figure 4 is approximate, and is based on NGFS climate risk assessments to 2100.

Table 2 provides examples of specific characteristics and assumptions underlying the seven example scenarios in Figure 4. These characteristics and assumptions are illustrative rather than authoritative given the degree of uncertainty around potential future outcomes, and can be customized by investors and tailored to their investment mandates.

TABLE 2: CHARACTERISTICS AND ASSUMPTIONS FOR ILLUSTRATIVE COMBINED SCENARIOS[28]

	Net Zero 2050	Below 2°C	Delayed transition	NDCs	Current policies	Divergent late action[29]
Policy ambition	1.5°C	1.7°C	1.8°C	2.5°C	3°C+	4°C+
Policy reaction	Immediate and smooth		Delayed	Aligned with current and anticipated NDCs	Preserving current policies	Reversal of some current policies, belated and divergent attempts to reinstate
CO_2 Emission peaking	Immediate		2030	2035	2040	N.A.
Global annual emission pathway	Immediate sharp decline	Immediate decline	Very sharp decline after peaking	Decline after peaking	Slow decline after peaking	Continued rising throughout

2.2 SIGNPOSTS AND SIGNALS

In order to track and monitor which scenarios our world may be more likely heading towards, various institutions are developing **signposts** to generate predictive signals.

Physical and transition signposts can be used collectively to inform views on how climate systems are changing, and how energy demand and sources are shifting.

The construction of signposts is based on scientific research, empirical evidence and systems analysis. An overall climate change signal can be generated by weighting a subset of these signposts. Table 3 highlights some of the commonly used physical and transition signposts, and the signals that they provide to investors on more likely pathways that both physical climate change and the low-carbon transition may follow.

TABLE 3: EXAMPLES OF PHYSICAL AND TRANSITION SIGNPOSTS AND THEIR SIGNALS

Physical signposts	Signals
GHG emissions	Annual global GHG emissions data signal which emissions pathway we are currently tracking towards, for comparison to IPCC warming scenarios.
Global mean temperature	Global mean temperature signals which warming scenario we are currently tracking towards, and in turn the degree to which physical risks are likely increasing.
Rate of ice sheet loss	Increased rates of ice sheet melting signal the effect that global warming to date is having, and the magnitude of physical climate risks that could be created by sea level rise.
Frequency and severity of extreme weather events	Increased frequency and severity of extreme weather events signals the magnitude of business disruptions and uninsured losses that could impact investment returns and impair government fiscal capacity.

Transition signposts	Signals
Policy development	National, regional and corporate policy development for achieving GHG emission reduction targets and transitioning to a low-carbon economy signal the potential speed and scale of emission reductions and investment return impacts.
Carbon prices	Carbon pricing will be a key feature of national and regional policies, signaling impacts on cost and demand curves and transition pathways in various sectors. Carbon border adjustments are increasingly likely as a transnational form of carbon pricing to limit imports from high-emissions jurisdictions, signaling effects on competitive positioning.
Investments in technology and innovation	The magnitude of government and corporate investment commitments in new technology and innovation signal the scale and timing of related transition risks and opportunities.
Market shifts	Trends in capital flows, commodity prices and consumer preferences help signal the effectiveness of stated government and corporate policies and commitments, and the pace at which the low-carbon transition in various sectors and regions is occurring.
Energy mix and demand	The pace of shifts in energy mix and demand towards renewables signals which transition and physical risk scenarios are more likely to ultimately play out.

Chapter 3

FINANCIAL IMPACTS OF PHYSICAL CLIMATE RISKS

This section discusses how physical climate risks can lead to significant economic and financial impacts.

3.1 PHYSICAL CLIMATE RISKS AND THE ECONOMY

Persistent and unpredictable changes in climate conditions can lead to lower productivity and reduced investment. Swiss Re predicts that global temperature rises will **negatively impact GDP in all regions by mid-century** under all scenarios relative to a world without global warming, with economies in Southeast Asia potentially hit hardest.[31]

Physical risks can manifest through **both demand-side and supply-side impacts,** leading to significant disruptions in economic activity. Demand-side impacts are those that affect the components of aggregate demand, such as private (household) and public (government) consumption and investment, business investment and international trade. Supply-side impacts affect the productive capacity of the economy acting through the components of labour, physical capital and technology.[32]

Table 4 provides examples of how acute and chronic physical risks could impact businesses and economies over different time horizons.

TABLE 4: EXAMPLE ECONOMIC IMPACTS FROM PHYSICAL CLIMATE RISKS

Types of impacts		Short term (e.g. 1-5 years) for acute physical risks	Long term (e.g. 10+ years) for chronic physical risks
Demand	Consumption	Unanticipated change in consumption of goods and services due to changing consumer demands in face of extreme weather events	Shifts in consumption behavior due to permanent changes in living and/or working conditions caused by shifts in climate patterns
	Trade	Disrupted import/export flows and trade networks	Shifts in value chains to avoid disruptions through relocation, vertical integration
	Investment	Unanticipated change in investment activity in response to physical asset damage caused by extreme weather events	Shifts in investment strategies and portfolios to mitigate longer term physical risk exposures
Supply	Labour	Reduced productivity due to weather-related disruptions and adverse working conditions	Reduced workforce availability and productivity due to climate-related displacement effects
	Commodities	Shortage of commodities; higher price volatility	Reduced long term supply of commodities; structural price increases
	Capital stock	Damaged physical assets, disrupted supply of components	Untenable operating costs due to energy and cooling requirements if clean energy transition is interrupted
	Technology, R&D	Diverted resources due to reconstruction/replacement spending	Resource reallocation and diversion for climate adaptation.

3.2 ADDRESSING SYSTEMIC RISKS TO GLOBAL MARKETS

Policy makers and central bankers are increasingly focused on the potential for the physical impacts of climate change to destabilize the global economy:

2015

Mark Carney, then Governor of the Bank of England and Chairman of the Financial Stability Board, called on central banks globally to act on the systemic risk posed by climate change to the international monetary system.[33] He described a potential 'Minsky moment' in which investors' expectations adjust sharply, causing a widespread repricing of risk.[34]

2019

According to a 2019 study, the cost of rescuing insolvent banks from the climate crisis could cause a fiscal burden of 5 to 15% of GDP per year and double the ratio of public debt to GDP.[35]

2020

The US Commodity Trading Futures Commission in a major 2020 report concluded that "climate change poses a major risk to the stability of the US financial system."[36]

2021

The US Federal Reserve established both a Financial Stability Climate Committee and a Supervision Climate Committee, and addressed in its Financial Stability Report how vulnerabilities in the financial system could further amplify financial shocks caused by climate change.[37]

Against this backdrop, it will be increasingly important for investors to evaluate how climate change could fundamentally reshape the global economy and financial systems. Investors will also need to anticipate how policymakers might respond, which could lead to significant changes in valuations and investability across all asset classes.

3.3 PHYSICAL CLIMATE RISKS AND THE INVESTOR

Climate change has the potential to create both investment wins and losses. This section provides context into how investors should anticipate the impacts that physical climate risks could pose.

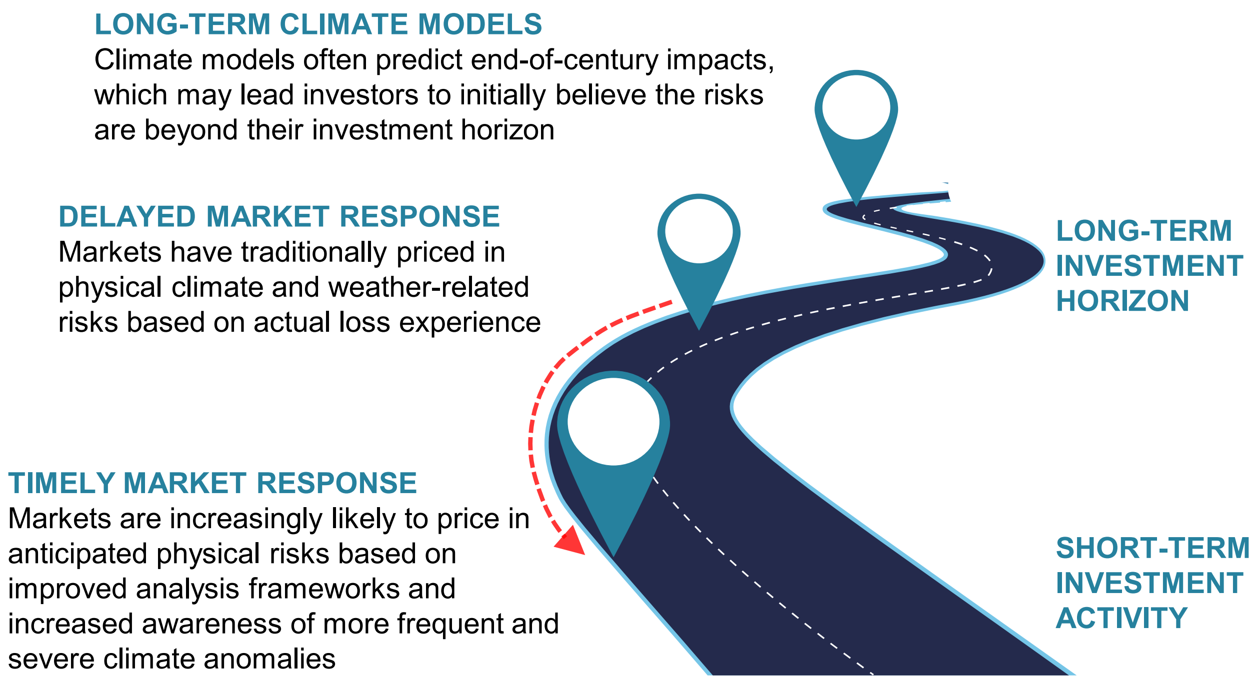
3.3.1 INVESTMENT AND CLIMATE TIME HORIZONS

Physical climate risks will manifest over different time horizons. Although typical investment hold periods may end before physical climate risks fully materialize, the markets — including future buyers of these investments — are increasingly likely to have priced in these risks before the hold period is complete. As a result, expected investment returns and exit values may prove materially lower than anticipated. Figure 5 illustrates how the timeline for pricing physical risks into investments is accelerating.

"There's evidence that climate risks are currently not well understood… We all know that underpricing can lead to abrupt and disruptive repricing as markets discover the anomaly. We may see cascading events that could trigger significant disruptive repricing."

– **SEC Commissioner Allison Herren Lee,** December 2020

FIGURE 5: ACCELERATING TIMELINES FOR PRICING OF CLIMATE CHANGE



By formalizing approaches to physical climate risk assessment today, investors could avoid negative future outcomes such as high investment turnover, capital misallocation or impairment, and increased cost of capital (e.g. caused by higher insurance premiums, increased uncertainties of returns, and shifting demand).

3.3.2 PHYSICAL RISK IMPACTS ON BUSINESS VALUATION

At the individual corporate level, physical risks can negatively impact business activities including the demand for goods and services, business operations, physical assets, technology and R&D, and cost of capital. Efforts are underway globally to advance **methodologies that reflect climate risk impacts in the business valuation process.**

One way to do so is through the commonly used discounted cash flow (DCF) valuation method. Depending on the visibility, quantifiability and degree of certainty of the various potential impacts on the business, investors can adjust cash flows and terminal values, and/or adjust the discount rate.

FIGURE 6: INCORPORATING CLIMATE RISKS AND OPPORTUNITIES IN BUSINESS VALUATIONS[38]

- Such adjustments are preferred for reflecting climate impacts into business valuations, where practical.
- Climate risks could have impacts on all cash flows including revenues, costs, and capital expenditures.
- Consider elasticities in value drivers (e.g. between price and demand).
- Consider alternative time horizons of climate risks for the terminal value estimation.
- Example of approach: The impact of seasonal flooding on a company's facilities is assessed to be financially material in the next five years. Insurance premiums are likely to increase significantly and business interruptions will become common. Adjustments to projected cash flows should be made accordingly.

- Such adjustments are used when financial impacts are not directly estimable, but the discount rate can be adjusted to account for the uncertainty.
- Consider if climate risks are already priced by the market into the observed discount rate of comparators based on available research.
- Perform sensitivity tests to size the discount rate adjustment. 'Upside' and 'downside' scenarios could be used to capture the range of outcomes.
- Example of approach: The impact of shifting precipitation patterns is assessed to be financially material to a company's operations, since production of raw materials could be persistently affected. The discount rate should be adjusted upward to reflect this risk, as the timing and size of impacts on cash flows would be hard to estimate.

3.3.3 HELPING INVESTORS RESPOND TO PHYSICAL CLIMATE RISKS

Investors are becoming increasingly aware of the impacts that physical climate risks could pose to their investments.[39] Climate change has also started to shift investors' approach to asset pricing and valuation.

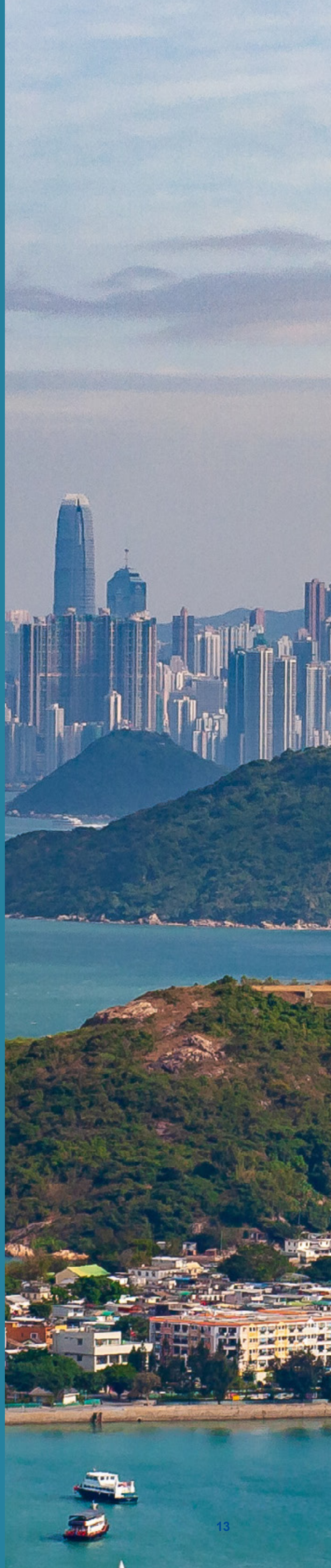
However, formally incorporating physical climate risks into investment decision making processes is still not mainstream. Both the 'known unknowns' and the 'unknown unknowns' of climate change scenarios make it challenging for investors to contemplate the full impact that physical climate risks could have on investments and broader markets over time.

To help address these challenges, **ILN recognizes that additional guidance is required** to help investors incorporate physical climate risks and opportunities into their existing investment analysis processes. The following sections of this toolkit contribute to addressing this need, by providing:

A step-by-step scoping methodology to (i) identify and analyze potentially material physical risks and opportunities based on the characteristics of a business, including its geographies, sectors and value chains; (ii) assess the ability of the business to mitigate the risks and capitalize on the opportunities; and (iii) incorporate these findings into the company's overall investment profile.

A Disclosure Guide with criteria for assessing the completeness and quality of climate-related information being received from current and target investees, with examples of better corporate practices; and

A web-based Resource Guide of credible sources for researching physical climate risks and opportunities, which is searchable based on a business' characteristics.



Chapter 4

SCOPING GUIDE

Purpose, application and limitations

This scoping guide is a suggested methodology for investment professionals which, when used alongside other traditional methods of investment analysis, will support the identification and assessment of physical climate risks at the company level. A case study has been included to illustrate the application of the step-by-step methodology.

Application and limitations

Intended for:

- Consideration of the range of potential physical risks for both new and existing investments (see Table 5)
- Use within private equity, real estate, infrastructure and private debt asset classes and for large investments in individual publicly traded companies

Not intended for:

- Portfolio-level assessments*
- Quantitative public market strategies
- Replacing the potential need for further quantitative analysis or engagement of expert advisors

*Although the scoping guide is not designed for portfolio-level assessments, the proposed step-by-step approach also lends itself to sector and asset class level assessments.

TABLE 5: SCOPING GUIDE USE

New Investments

The scoping guide can be used in evaluating potential new investments, for example during:

- **Origination:** identifying initial sectoral and geographic physical risks.
- **Pre-investment due diligence:** analyzing investment-specific physical climate risks along with related resilience and adaptation considerations to incorporate into investment decision-making processes.

Existing Investments

The scoping guide can be integrated into existing asset monitoring and management processes, for example during:

- **Hold periods:** better understanding the present and future physical risks associated with the investment, and how company-specific resilience and adaptation initiatives could be pursued to reduce risk.
- **Engagement with company management:** improving the depth of engagement with company management on their identification, assessment, mitigation and reporting of physical climate risks.
- **Exit planning:** periodically evaluating if identified physical risks may manifest sooner or otherwise adversely impact divestment strategies and pricing compared to the planned exit strategy.

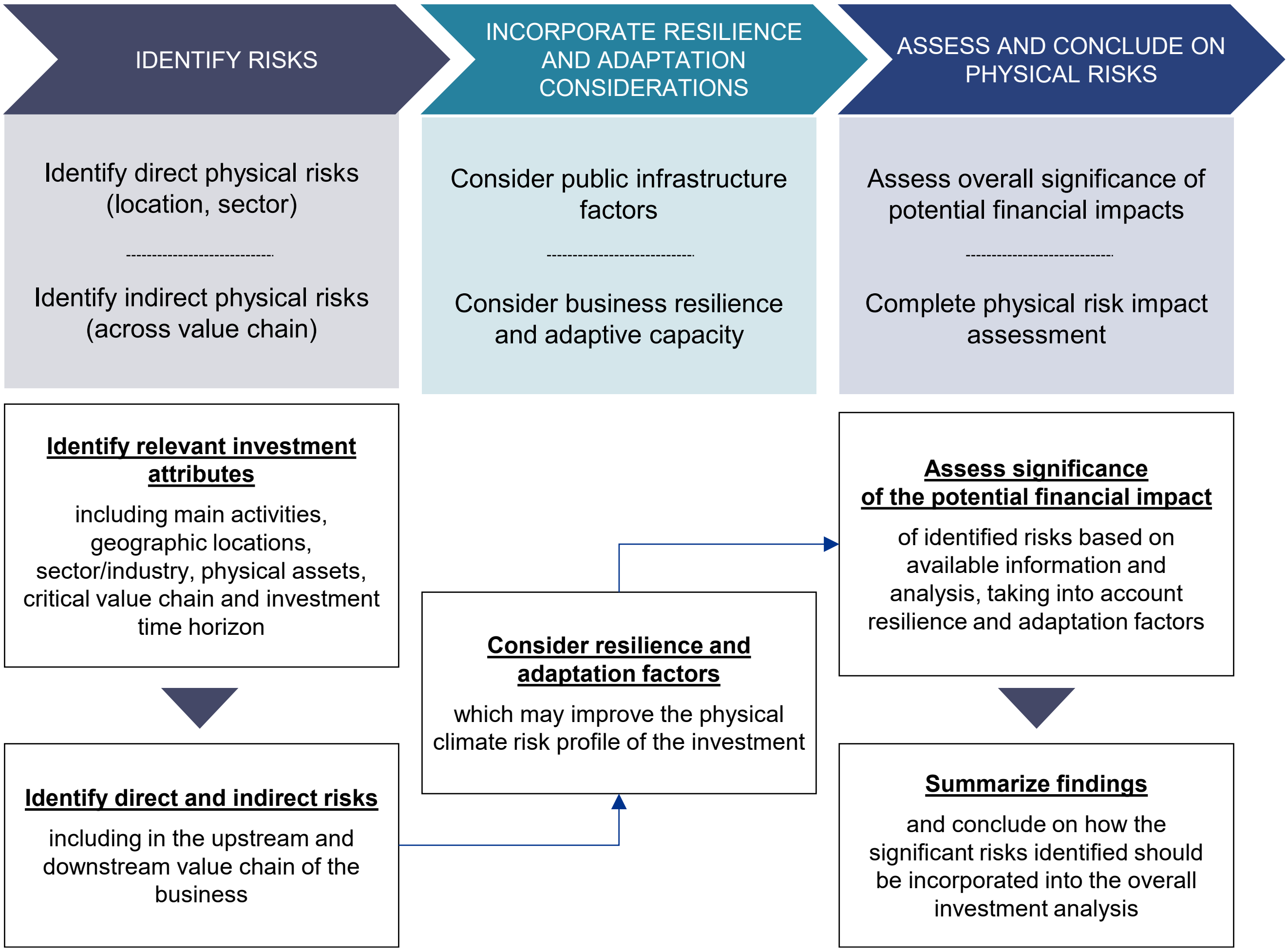
RESOURCES

A variety of sources of information will provide helpful inputs for identifying company-specific physical climate risks when applying this scoping methodology. The range of available resources are summarized in Table 6, representing both 'sector and regional resources' such as those found in the Resource Guide section of the toolkit, and additional 'company-specific resources' that should be obtained by the investment team.

TABLE 6: RESOURCES

Sector and regional resources (see Resource Guide)	**Company-specific resources** (to be obtained by investor)
Databases/tools	Corporate reporting (see Disclosure Guide for examples)
Guidance/Framework documents	Equity analyst reports and credit agency ratings
Legislation/regulation	Additional investment-specific research
Authoritative research	Engagement discussions with company
Other third-party research and insights	Reports from climate specialists/advisors
Disclosure frameworks	Media searches

FIGURE 7: SCOPING GUIDE METHODOLOGY



4.1 PART 1: IDENTIFY RISKS

The identification of physical climate risks based on specific characteristics of the investment will help the investor to understand the risk exposures the business may face. Table 7 illustrates the wide range of extreme weather events and changing climate patterns which could contribute to the risks identified.

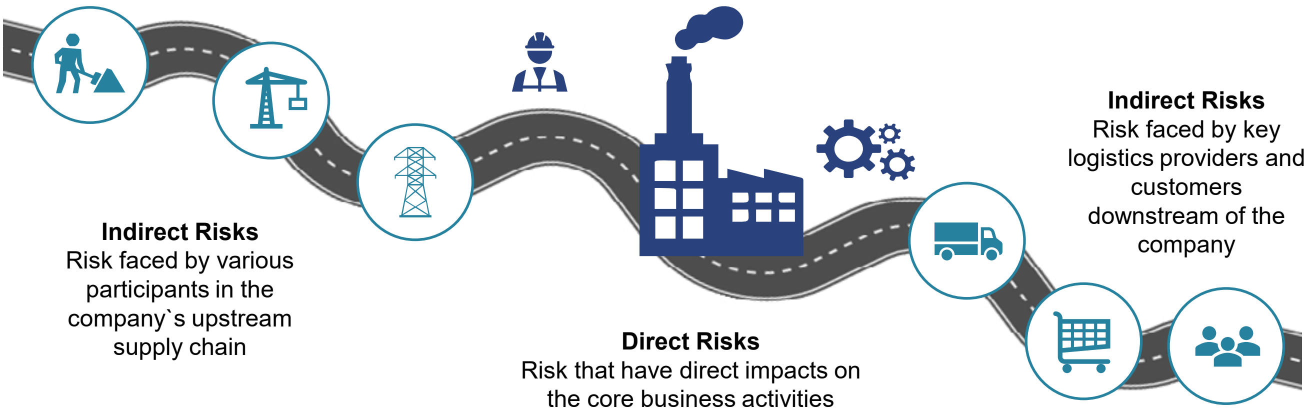
TABLE 7: EXTREME WEATHER EVENTS AND CHANGING CLIMATE PATTERNS[40]

Types	Water related	Wind related	Temperature related	Solid mass related
Extreme weather events that lead to **acute risks**	Heavy precipitation (rain, hail, snow/ice)	Cyclones (hurricanes, typhoons)	Heat waves	Avalanches
	Inland flooding	Tornados	Cold waves (including polar vortex effects)	Landslides
	Storm surge	Other extreme storms	Wildfires	
Climate patterns that lead to **chronic risks**	Changing patterns and types of precipitation	Changing atmospheric circulation patterns (jet streams)	Changing temperature averages (affecting land/oceans/atmosphere)	Coastal erosion
	Pervasive droughts and water stress		Extreme temperature variability	Permafrost thawing
	Changing ocean circulation patterns		Pervasive heat stress	Soil degradation/ erosion
	Sea level rise			
	Ocean acidification			
	Saline intrusion			

To better understand the exposure of a company to these risks based on sector, geographical and other attributes, and understand how these risks may manifest over time (e.g. expected changes in the frequency and severity of extreme weather events and pace of change of climate patterns), the Resource Guide includes databases and tools that investment professionals may find helpful. This should be complemented by company-specific analysis, using external advisors as required.

There are a range of factors which define the operational attributes and potential physical risk exposures of an investment. A comprehensive view of the company's direct risks (attributable to the physical asset footprint of the investment) and indirect risks (attributable to various participants in the company's upstream and downstream value chain) should be included within the scope of analysis, as shown in Figure 8.

FIGURE 8: SCOPE OF DIRECT AND INDIRECT RISKS



4.1.1 DIRECT PHYSICAL CLIMATE RISKS

Both sector and location considerations for a company's business activities can provide an initial view of the range of potential direct and indirect physical risks.

Sector-specific risks

Sector-specific characteristics introduce distinct dimensions of physical climate risk. For example, sectors which are asset, energy and/or labour intensive would have a distinct risk profile. Table 8 provides examples of how different sectors could be uniquely exposed to physical climate risks.

TABLE 8: EXAMPLES OF PHYSICAL RISKS THAT COULD IMPACT SPECIFIC SECTORS

Sector	Example impacts[41]
Infrastructure and buildings	The impacts of physical risks are particularly pertinent to infrastructure and buildings given their long-life span and high initial cost. Buildings and infrastructure can be vulnerable to climate change due to their: • Design (e.g. low resistance to storms); and • Location (e.g. in areas prone to floods, wildfires, landslides and permafrost thawing).
Energy and utilities	Rising temperatures and extreme weather events will shift energy supply and demand patterns, often in opposite directions (e.g. increases in temperature and droughts may limit the availability of cooling water for thermal power generation in summer, whereas increased requirements for air conditioning will increase energy demand at the same time.) Physical distribution and transmission infrastructure could also be impacted and create additional risks, including wildfires. Increased uncertainty in weather patterns could have negative impacts in the long term on the production of renewable energy. Examples include: • Reduced sun or wind in areas where these are currently abundant; • Heat and droughts affecting crops intended for biomass in the production of energy.

Sector	Example impacts
Agriculture	The physical impacts of climate change are projected to have substantial effects on agricultural production in terms of: • Reduced crop yields; • The location where different crops can be grown.
Insurance	The frequency and intensity of most types of extreme weather events are expected to change significantly as a result of climate change, which will lead to further increases in weather-related insurance claims. • The increasing uncertainty of climate change will make it more challenging for insurers to correctly price climate change risk, especially if its impact accelerates unexpectedly; • Insurance premiums could rise and become unaffordable in the most vulnerable regions and sectors as a result.
Cross-sector	Physical climate risks will have a range of impacts on businesses across sectors, including: • Disrupted business operations; • Property damage; • Insurability; • Volatile production costs due to adverse impacts on energy and commodity inputs; • Disruption to supply chains and transportation infrastructure.

Location-specific risks

Identification of location-specific acute and chronic risks for a business' main operating locations will include determining **general climate characteristics, previous extreme weather events,** and specific geo-locational factors such as elevation and coastal proximity. Consideration should be given to which extreme weather events could impact day-to-day activities or business operations, and how risks could intensify due to broader climate patterns over the investment period. Table 9 provides examples of how different acute and chronic risks could impact certain regions around the globe.

TABLE 9: EXAMPLES OF REGION-SPECIFIC RISKS AND IMPACTS

Nature of physical risk	Example impacts
Temperatures are rising faster in high latitude regions than regions closer to the equator.	Canada's overall climate is warming twice as fast as the global average[42] with the greatest increases in the Arctic regions. There have also been steadily increasing heatwaves and droughts in Western Canada, leading to a decrease in agricultural production,[43] the closure and loss of businesses to devastating wildfires and extreme heat,[44] and prolonged declines in air quality.[45]

Precipitation is expected to increase at higher latitudes and decrease at mid/low latitudes, causing greater incidence of both flooding and droughts.	Taiwan has been grappling for months with its worst drought in more than 50 years, with such droughts becoming more frequent and intense due to climate change. Its already strained chipmaking industry (during pandemic-induced labour shortages) has been put under significant additional stress given the lack of fresh water required in the manufacturing process,[46] causing major disruptions in supply for electronics manufacturers and automakers globally.
Rising sea levels are causing more frequent flooding in some low-lying coastal regions, where permanent inundation is possible.	China's two major trade and manufacturing hubs located on the Pearl River Delta, Guangzhou and Dongguan, are significantly exposed to sea-level rise. Global supply chains depend on this increasingly at-risk region. For example, sea level rise will affect more than 13% of rail assets and more than 12% of roads in the Pearl River Delta.[47]

4.1.2. INDIRECT PHYSICAL CLIMATE RISKS

Identifying both acute and chronic physical risks that could manifest for key participants within the company's upstream and downstream value chain has often been a critical missing element in investors' physical risk assessments. Table 10 provides examples of how such indirect risks could manifest and in turn impact the company's operations, revenues and costs.

TABLE 10: EXAMPLE VALUE CHAIN IMPACTS

Value chain	Example impacts
Upstream	Raw material and component supplies could be affected by acute or chronic risks upstream of the business, causing potentially prolonged disruptions to business activities. Examples include: • Textile companies being impacted by availability and pricing of cotton, as severe droughts have impacted the irrigation-dependent growing of cotton in India and China. • Purchasers of electronic components manufactured in Thailand experiencing significant delays due to the flooding of supplier facilities. • Businesses in the Gulf region of the US experiencing prolonged shutdowns due to the poorly designed electrical grid being heavily damaged by hurricanes and record-setting winter storms.
Downstream	The company's ability to maintain demand and get its products to market could be affected by acute or chronic risks downstream of the business. Examples include: • Disruptions to transportation logistics for various sectors due to infrastructure damage caused by storm surge and sea level rise at seaports along the Atlantic and Pacific Oceans. • Major real estate development customers of a US building materials manufacturer being required to shift to another supplier to meet increasingly stringent building code and insurance standards in the face of pervasive wildfires in California. • Major global customers of the drought-afflicted Taiwanese chipmakers referenced in Figure 8 needing to restructure their supply chains to geographically diversify sources and reduce physical risk exposures, negatively affecting the chipmakers' market share and profitability.

4.2 PART 2: INCORPORATE RESILIENCE AND ADAPTATION CONSIDERATIONS

Resilience and adaptation factors influence the extent of exposure and vulnerability the company has to the identified direct and indirect risks. Resilience measures relate to initiatives taken by businesses and governing bodies that increase the ability of existing systems to absorb or recover from the impacts of physical climate events (mainly related to new programs)[48]. Adaptation measures relate to initiatives taken by businesses and governing bodies that harden and expand systems in order to preclude harm from actual or expected climate trends (mainly related to new investments).[49]

4.2.1 CONSIDER PUBLIC INFRASTRUCTURE FACTORS

Public programs and investments relevant to a company's sector and location can help to mitigate the range of potential direct and indirect physical risks.

Understanding the initiatives and measures taken by regions will help to assess the exposure and vulnerabilities posed to the company at a more complete level.

TABLE 11: EXAMPLES OF PUBLIC RESILIENCE AND ADAPTATION EFFORTS

Physical risk	Resilience initiatives	Adaptation initiatives
Drought	Ensuring an equitable distribution of freshwater supply.[50]	Development of infrastructure that can capture and store freshwater.[51]
Increase in frequency and severity of extreme weather events	Strengthening meteorological institutions to improve weather forecasts and projections, accurate early warning signals, and disaster risk management systems.[52]	Investing in public infrastructure that can withstand more severe and frequent extreme weather events e.g. underground electrical grids.
Sea level rise	Strengthening institutional ability to better understand trends in the drivers of sea level rise e.g. rates of ice sheet melting, changes in ocean circulation patterns.	Construction of levees, sea walls, surge barriers and overflow chambers. Adoption of environmental approaches through land recovery and urban redesigning.[53]
Coastal erosion	Land use planning along coastal regions such as decreasing traffic flows and tourism or establishing building restrictions to reduce erosion caused by human activity.[54]	Using nature-based solutions to decrease coastal erosion such as planting dune grass on beaches and restoring mangroves.[55]
Increased temperatures (heat waves)	Establishing cooling shelters and ensuring the health care system has the capacity to accommodate patients during extreme heatwaves.	Installation of cool roofs, where roofing materials have a higher solar reflectance and transfer less heat to the buildings below them.[56]

Key considerations:

- Existence of regional contingency planning techniques for extreme weather events;
- Extent of resilience and adaptation regulations, incentives or standards (e.g. for buildings, transportation, energy services);
- Measures being taken to ensure the overall health and wellbeing of the public, which in turn could ensure the strength of the labour market; and
- Availability of government programs for specific sectors unduly impacted by climate change to ensure they are operable in the long-term.

4.2.2 CONSIDER BUSINESS RESILIENCE AND ADAPTIVE CAPACITY

The ability of the business to withstand and adapt to the impact of significant identified physical risks is critical. To reduce their exposure and vulnerability to these risks, the company can integrate resilience and adaptation measures and initiatives such as those illustrated in Table 12.

TABLE 12: EXAMPLES OF CORPORATE RESILIENCE AND ADAPTATION INITIATIVES

Physical risk	Resilience initiatives	Adaptation initiatives
Disruption to business activities due to extreme weather events	Establishing comprehensive business interruption insurance coverage where available to offset the costs of extreme weather event impacts on business activities.[57]	Capital investments made to harden physical assets to withstand extreme weather events (e.g. protective barriers, strengthened roof systems, impact resistant windows).
Changes in productivity due to increasing temperatures	Shifting production schedules from daytime to nighttime to protect employees from extreme heat and reduce costs of air conditioning facilities.	Agricultural producers expanding range of crops and seed variety as growing seasons and water availability has shifted due to increased temperatures.
Energy supply disruption caused by flooding	Business continuity planning to ensure key business activities can function in the event of electrical supply disruptions (e.g. relocating back-up generators to high ground).	Electricity transmission and distribution utilities ensuring structures are tall enough for safe clearance during flood events, and that underground lines are adequately safeguarded.[58]

Key considerations:

- Management's current and planned resilience and adaptation initiatives, and whether traditional return on investment calculations have caused delays in necessary investments;
- Scope of business continuity plans and scenarios, ensuring that trends in climate-related events are encompassed;
- Sector-specific resilience and adaptation initiatives the company could undertake;
- Current and potential local regulations that mandate companies to implement resilience and adaptation measures; and
- Known and potential changes to insurance coverage (both property and business interruption) that currently protect against losses due to climate-related events.

4.3 PART 3: ASSESS AND CONCLUDE ON PHYSICAL RISKS

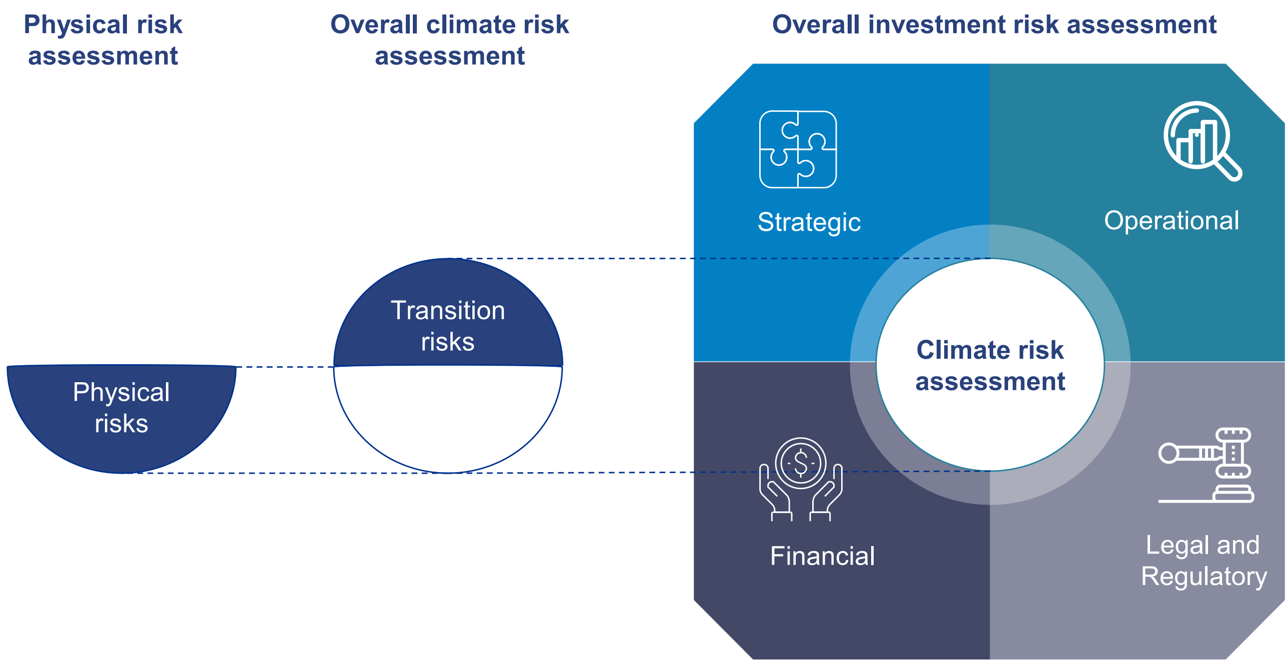
4.3.1. ASSESS OVERALL SIGNIFICANCE OF POTENTIAL FINANCIAL IMPACTS

The overall assessment of the direct and indirect physical risks identified will require a meaningful level of judgment, given the uncertainties regarding alternative future climate-related events and scenarios that could play out over the investment time horizon and beyond.

Physical risks themselves form just part of a comprehensive climate risk assessment, which will also need to address various transition and liability risks associated with the potentially disruptive transition to a low-carbon economy (including impacts on the business from a technology, policy and legal, markets and reputational perspective).

This climate risk assessment in turn will need to be integrated into the overall assessment of the investment's future risks and opportunities, including the assumptions underlying the initial financial model (at time of potential investment) or ongoing valuation model (for existing investments).

FIGURE 9: FACTORING CLIMATE CHANGE INTO THE OVERALL INVESTMENT RISK ASSESSMENT



The range of potential actions that investment professionals can take to reflect their conclusions on the more significant physical climate risks in their overall investment analysis include the following:

- **Adjusting cashflow forecasts** for reasonably ascertainable decreases in revenues and terminal values, and/or increases in costs and capital expenditures, based on observable market trends.
- **Adjusting other base case assumptions** in the investment's financial model/valuation to take relevant potential physical risk impacts into account.
- **Performing sensitivity analysis** to assess the potential range of future growth and profitability outcomes under adverse climate conditions compared to the base case projections.
- **Increasing the discount rate** to account for significant but not quantifiable uncertainties surrounding the potential impacts of future climate-related events and patterns e.g. on growth and profitability projections.
- Including findings in the investment's **climate risk profile** for ongoing monitoring.

Efforts are underway globally to advance methodologies that reflect climate risk impacts in the investment valuation process. For investment professionals seeking additional guidance on how to incorporate physical climate risk impacts in the financial assumptions modeling of an investment, useful resources include A4S Essential Guide to Valuations and Climate Change and the Intact Centre on Climate Adaptation's Factoring Climate Risk into Financial Valuation (see links in the Resource Guide).

In addition to taking any such actions, investment professionals should provide analysis in their investment memos and ongoing periodic reviews that summarizes the significant risks identified, analysis performed (including engagement of specialist advisors as necessary), conclusions reached on potential impacts, and recommended action plans to further reduce or transfer these risks (at both the investment strategy and company management level).

4.3.2. COMPLETE THE PHYSICAL RISK IMPACT ASSESSMENT

The results of the physical risk assessment can be summarized in a Physical Climate Risk Profile such as the illustrative example in Table 13.

TABLE 13: EXAMPLE PHYSICAL CLIMATE RISK PROFILE

Physical risk	Hazard (Location Specific)	Vulnerability	Resilience and Adaptation Measures	Residual Potential Impact
Direct	List all significant direct acute and chronic risks identified.	For each risk, describe potential impacts on business assets, revenues, costs, capital requirements, and the relevant time horizons for these impacts.	Note relevant measures taken by public bodies and management that serve to partially mitigate the potential severity of each identified risk.	Rate the potential impact of each risk as **High, Medium or Low**, taking resilience and adaptation measures into account.

Actions Taken in Investment Analysis

Summarize any resulting actions taken in the investment analysis based on the options noted in 4.3.1.

Physical risk	Hazard (Location Specific)	Vulnerability	Resilience and Adaptation Measures	Residual Potential Impact
Indirect	List all significant indirect acute and chronic risks identified both upstream and downstream in the company's value chain.	For each risk, describe potential impacts on key value chain participants and the flowthrough impacts to the business, and the relevant time horizons for these impacts.	Note relevant measures taken by public bodies and management of both the key value chain participant and the business that serve to partially mitigate the potential severity of each identified risk. These may include structural changes to the company's supply chain or business model.	Rate the potential impact of each risk as **High, Medium or Low,** taking resilience and adaptation measures into account.

Actions Taken in Investment Analysis

Summarize any resulting actions taken in the investment analysis based on the options noted in 4.3.1.

Key considerations in assigning a residual potential impact rating (low – high) from physical climate risk:

- Does the climate risk present a recoverable cost, or does it have the potential to affect the long-term viability of the company or have significant near-term financial implications?
- When are the impacts expected to materialize and how does that correspond to the hold period or divestment strategy?
- Does the climate risk affect a subset of company assets and/or non-critical operations, or affect a significant portion of assets and/or critical part of company operations or value chain?
- If the effects are expected to be felt in the supply chain, does the company have the ability to access alternative sources of supply relatively easily (e.g. commoditized products or services) or does it have dependency on select suppliers (e.g. specialty products/rare earth metals)?
- Could the climate risk be mitigated with relatively low-cost measures and be addressed within traditional planning (e.g. updates in wind turbine programming to tolerate higher and volatile wind speeds), or is the required intervention expected to be substantial (e.g. water blockade system to provide core facilities with flood protection at the 500-year flood level)?

The following Case Study illustrates application of the scoping methodology, including a completed version of the Physical Climate Risk Profile table.

CASE STUDY:
INVESTMENT IN ELECTRIC VEHICLE MANUFACTURING INDUSTRY

Firm Investment Corporation (FIC) is targeting a US$500 million equity investment in Miraitowa Co., a quickly growing electric vehicle manufacturer in Asia. The deal would reduce the target's debt levels after recent major capital expenditures and make FIC a significant minority shareholder in the privately held company.

Miraitowa Co.'s new headquarters and main manufacturing plant are located in Osaka, Japan, the capital city of Osaka Prefecture. It has a smaller control system assembly plant in Toyonaka, north of Osaka. Collectively, the plants have the capacity to employ over 2,500 workers including 1,800 employees in the Osaka main plant, and produce over 350,000 vehicles a year. Miraitowa's main product is a compact two passenger electric vehicle, the Someity, which utilizes in-wheel drive technology. The company is also developing a market with traditional Original Equipment Manufacturers (OEMs) for drive systems that utilize this technology.

The company's electric vehicle production relies heavily on the timely supply of essential microchips which are sourced from Hsinchu, Taiwan and are used for the various control systems in the vehicle. Its upstream value chain also includes raw materials from China and battery systems from South Korea. Remaining components are either manufactured by the company's subsidiaries located within a 15 km radius of Toyonaka or sourced locally from other Japanese suppliers.

As part of the due diligence efforts under FIC's Sustainable Investing policy, the FIC investment team is required to identify and assess physical climate risks that the business may be directly or indirectly exposed to.

Physical Risk Assessment – Scoping Investment Profile

Using details from publicly available sources and discussions with management, the investment team has gathered the following details on the target:

Issuer name	Miraitowa Co.
Headquarters	Osaka, Japan
Other significant locations of operation	Toyonaka, Japan
NAICS Code	336111
Sector Identification	Manufacturing

Sub-sector Identification	Automobile
Investment time horizon	10 years for FIC; a future buyer would hold for at least another 10 years
Business activities	R&D and Design, Parts Manufacturing, Parts Sourcing and Integration, Vehicle Assembly, Distribution and Sales, Marketing and Services
Upstream Value Chain	Sourcing and in-bound logistics from China (steel, rubber, plastics and aluminum), South Korea (battery systems), Taiwan (microchips), and suppliers in Japan (instrument panels, seats and HVAC systems, glass, tires)
Downstream Value Chain	Shipping through traditional land-based and marine transportation companies. Distribution and retail sales and service through franchised dealers. End-of-life component recycling program through regional third-party specialty providers
Markets served	Japan (60%), growing Asia-Pacific (30%) and European (10%) markets
Annual production capacity	350,000 vehicles
Revenue (current / projected)	$2.5 billion FY20; $10 billion FY24
Physical asset profile	Owned facilities with operating control

4.1.1 IDENTIFY DIRECT PHYSICAL CLIMATE RISKS

Identify sector-specific risks

Using the SASB Materiality Matrix[59] and IPCC[60] the investment team identified relevant sector- and location-specific physical climate risk exposures:

TABLE 14: AUTOMOBILE MANUFACTURING SECTOR

Sector-specific Characteristic	Relevant physical climate event	Describe relative sector risk exposure
Complex infrastructure & manufacturing equipment	Flooding, typhoons	Complex infrastructure and heavy machinery equipment increase the exposure to business disruptions due to acute risks such as flooding.
Energy intensive	Extreme temperatures, storms	Vehicle assembly and production lines demand high energy consumption and therefore increase the exposure to business disruptions should energy sources fail due to extreme weather events and extreme temperatures.
Labor intensive	Severe weather events, heat waves	Significant labor-intensive operations increase the exposure to the risk of employee availability and productivity being negatively impacted by physical climate events such as heat waves.
Water intensive	Drought	Vehicle assembly and production lines demand high water consumption and therefore increase the exposure to business disruptions should freshwater sources deplete due to dry spells and prolonged drought.

Identify location-specific risks

Using data from Climate Central[61],the investment team determined that Osaka is susceptible to flood and sea level rise, with about 90% of its urban area including the production plant location located on flat lowlands vulnerable to flooding and tsunamis. The plant is also exposed to river and inland flooding.

TABLE 15: OSAKA, JAPAN

Location-specific Characteristic	Relevant physical climate event	Describe relative sector risk exposure
Flat lowlands and proximity to river inlets[62]	Flooding	Flat lowlands make natural water drainage a challenge and the city is extremely vulnerable to flooding due to heavy rains. There is high risk exposure to flooding which could result in business disruptions to manufacturing facilities.
High population density and heat intensity	Heatwave	Osaka has had the hottest mean summer temperatures in Japan in the past 30 years and greater daytime urban heat with a drier climate. Osaka high population density exposes residents to both high temperature and humidity with high risk of both heat stress and heatstroke during heat waves.
Proximity to coast and wind damage	Flooding and dislocation due to sea level rise	Osaka is in close proximity to the coast, and therefore is exposed to continuing sea level rise over FIC's and a future buyer's investment time horizons.
	Windstorms	The City is highly exposed to coastal flooding and wind damage due to its proximity to the coast.

TABLE 16: TOYONAKA, OSAKA PREFECTURE, JAPAN

Location-specific Characteristic	Relevant physical climate event	Describe relative sector risk exposure
City includes low land areas located on a major river[63]	Inland flooding	Lowland areas in the south of the city may be at risk of flooding due to heavy rains. This could lead to inland flooding in the event of high precipitation or river overflow.
Wind damage (typhoon)	Flooding, dislocation and windstorms	Toyonaka is highly exposed to wind damage from typhoons. The city experienced Typhoon Jebi and Trami in 2018.

Due to the distance of the Toyonaka plant facility from the shore and using data from Climate Central[64] the team subsequently determined that the Toyonaka facility was not at risk of sea level rise nor flooding from tsunamis.

4.1.2 IDENTIFY INDIRECT PHYSICAL RISKS (ACROSS UPSTREAM AND DOWNSTREAM VALUE CHAIN)

Indirect risks were identified across the value chain by considering both the upstream and downstream levels. FIC's investment team researched the exposure of the target to these risks based on the sector and location vulnerabilities using inputs from SASB Climate Risk Technical Bulletin[65] and IPCC Key Economic Sectors.[66]

TABLE 17: AUTOMOBILE MANUFACTURING SECTOR

Value Chain	Business Function	Describe relative indirect risk exposure
Upstream	Sourcing	• Miraitowa's Taiwanese semiconductor chip supplier's production process was disrupted by drought-induced water shortages (extensive cleaning required between chip layers), leading to significant supply shortages. This has slowed Miraitowa's monthly production by up to 5,000 vehicles. • Other electronic components (e.g. hard drives) are sourced from Thailand which has recently faced flooding leading to significant local production disruptions. • The company's Chinese raw material suppliers are involved in the extraction and processing of resources such as aluminum that are susceptible to a range of potential disruptions due to climate impacts.
Downstream	Logistics and Distribution	• Globally the movement of parts, materials and finished vehicle relies heavily on various modes of transportation by land and sea, which may be affected both by sea level rise and flooding, thus creating bottlenecks. Transportation costs are increasing as investments in the hardening of infrastructure assets to address these physical risks are passed through.
Public Infrastructure	Utilities	• Miraitowa's facilities rely on electricity from Kansai Electric Power Co. All thermal generating stations are situated near the coastline and may be affected by flooding events and sea level rise.
	Infrastructure	• Public infrastructure like transportation facilities and roadways are very susceptible to flooding damage. • Osaka could suffer the loss or damage of up to US$1 trillion in assets due to coastal flooding by year 2070. Over US$200 billion in economic assets of the city are currently vulnerable to flooding with over 4 million people exposed.[67] • Under extreme conditions, some models predict that sections of Osaka may disappear under water due to increase in sea level rise and its topography.[68]

4.2.1 CONSIDER PUBLIC INFRASTRUCTURE RESILIENCE AND ADAPTATION MEASURES

Through research, the investment team determined that the Osaka municipality is building climate resiliency and adaptation measures against floods and tsunamis.

Identified physical climate risk	Public resilience measures	Public infrastructure adaptation measures
Flooding (from extreme precipitation and inland flooding)	The city has launched a climate countermeasure plan.[69] Osaka is investing in public education on flood management. Flood mapping has been conducted to identify flood prone areas. The city has a publicly available flood disaster prevention map for all of its 24 wards.[70] The city has comprehensive flood control measures that integrate different components of flood management including facility maintenance, flood fighting drills, flood run-off areas and flood disaster management plan. Toyonaka has developed a City Resilience Regional Plan that considered 30 worst case scenarios and how to minimize damage/fatality in each case.[71]	The city has constructed a super levee to serve as a flood barrier, along with open space and evacuation areas along the inland rivers.[72.] Osaka has upgraded its sewage system to handle up to 60 mm/h of rainwater.[73]
Extreme temperatures	Osaka suffers from heat island effects* both due to rising temperature and urban canyons within its metropolis both of which aggravate the extreme heat. To address this the city has introduced district heating and cooling and use of untapped energy through its urban renewal project. *Heat islands are urbanized areas that experience higher temperatures than outlying areas	Osaka is installing geothermal heat pumps to help reduce CO_2 emissions and reduce heat island effects. The city is increasing its green energy infrastructure to reduce its footprint. The city has a heat reduction plan that includes greening of buildings and adoption of water retention materials.

Identified physical climate risk	Public resilience measures	Public infrastructure adaptation measures
Sea level rise	NA	Osaka has increased its coastal defenses through the development of a network of seawalls and other coastal defenses.[74] The city is expanding its coastal erosion protection plan to support its first line of defense against erosion and sea surges. The government has built several above ground and underground flood control channels. The city is expanding and redesigning its existing dykes and flood gates after Typhoon Jebi to withstand future flood, tsunami and sea rise impacts.
Windstorms	The city is expanding its physical infrastructure to respond to windstorm impacts. Wind gusts in Osaka were up to 155 miles per hour during Typhoon Jebi and with increasing losses in the last 2 years.[75] The city is studying this both to control the impact of the wind and to help in addressing the city heat island challenge.[76]	NA

4.2.2 CONSIDER BUSINESS RESILIENCE AND ADAPTATION MEASURES

The team discussed the direct and indirect risks they had identified with company management and inquired regarding steps being taken to build necessary resilience and adaptation against these physical climate risks. The following actions were highlighted by management:

Identified risk	Business resilience measures	Business adaptation measures
Direct		
Acute physical climate events (flooding, heat waves, storms)	An early warning system has been developed by management which includes hazard and vulnerability mapping; diversifying water resources; improved drainage; flood and cyclone shelters. Business continuity plans (BCPs) have been developed that anticipate the inability to use key operations and facilities as a result of flooding. Business interruption insurance is in place, although premiums are increasing and coverages are tightening.	NA
Chronic physical climate trends (sea level rise, temperature rise)	NA	As Japanese renewable energy sources are in short supply, management is exploring potential Power Purchase Agreements with independent power producers, where the company would be the sole beneficiary of a new project. Significant capital investments were made in the prior fiscal year aimed at reducing water consumption requirements through software-based solutions.
Indirect		
Flooding and drought-related impacts on suppliers	Management has undergone a supplier risk assessment through point of failure scenario planning exercises which has resulted in plans to further diversify the supplier base across geographies to reduce exposure.	NA
Sea level-related impact on upstream and downstream transportation of supplies and finished vehicles	Management is engaging a third-party logistics service provider to conduct a transportation and distribution route optimization study that factors in climate-related risks at key delivery points (e.g. shipping lanes and ports).	NA

4.3 COMPLETE PHYSICAL RISK IMPACT ASSESSMENT

The investment team has aggregated their research and analysis and formed the following conclusions on the residual potential impacts of the identified direct and indirect physical risks on Miraitowa's business. These conclusions have been focused on the next twenty years, covering the anticipated investment hold periods for FIC and a subsequent buyer. The actions taken by the team in finalizing their overall investment recommendation to FIC's Investment Committee are also noted:

Physical risk	Hazard (Location Specific)	Vulnerability	Resilience and Adaptation Measures	Residual Potential Impact	Actions Taken in Investment Analysis
Direct	Inland flooding (extreme precipitation) Wind damage (typhoons)	• Plant inability to perform optimally. • Heavy rain affects logistics, distribution and production process. • Water damage of critical equipment. • Risk of death/injury to personnel. • Steadily increasing insurance premiums.	Measures taken by management and the local government will only partially mitigate the potential severity of flooding events. Wind damage risk remains substantially unmitigated.	High	• Cashflow forecasts adjusted for increased insurance costs. • Discount rate increased for potential flooding and wind damage risk impacts on growth and profitability projections.
	Sea level rise (coastal flooding)	• No immediate direct risk as plant is not situated by the coast but the city is on low land making it susceptible. • Toyonaka plant is 26 km from the coast.	Municipal seawall system will provide meaningful protection against sea level rise and tsunamis for at least the next two decades.	Low	• No incremental adjustments made to cashflows or discount rate. • Included in climate risk profile for ongoing monitoring.
	Extreme heat	• Adverse impacts on availability and productivity of workforce during increasingly extreme heatwaves. • Equipment needs more cooling to be able to work optimally, increasing electricity costs.	Measures taken by management and the local government will have very limited mitigating effects on recurring heat events.	Medium	• Cashflow forecasts adjusted for increased electricity costs. • Discount rate marginally increased for chronic heatwave impacts on growth and profitability projections.

Physical risk	Hazard (Location Specific)	Vulnerability	Resilience and Adaptation Measures	Residual Potential Impact	Actions Taken in Investment Analysis
Indirect	Drought (water scarcity impact on chip supplies)	• Semiconductor chip supplier in Taiwan has experienced water shortages due to extreme drought. • Has caused unscheduled disruptions in vehicle production process.	Planned development of alternative sources of supply, although a broader global semiconductor capacity shortage will limit options.	High	• Annual manufacturing capacity lowered by 5% to allow for this type of recurring supply disruption.
	Extreme weather (impact on electricity supply)	• Increasingly severe flooding and wind events including typhoons have caused periodic disruptions in electricity supply to both Miraitowa and its local suppliers' operations.	Planned diversification of energy sources will partially reduce reliance on Kansai Electric.	Medium	• Covered by discount rate increase for potential flooding and wind damage risk impacts on growth and profitability projections.
	Sea level rise (impact on global transportation networks)	• Potential seaport, road and railway closures. • Delayed distribution of goods and services. • Increased transportation costs as facilities and transportation logistics companies recover their increasing investments in hardening infrastructure for climate change impacts.	Transportation and distribution route optimization study intended to identify climate related risks at key delivery points (e.g. shipping lanes and ports), but there will be limited alternatives available.	Medium	• Cashflows adjusted for anticipated upstream and downstream transportation cost increases. • Otherwise covered by 5% reduction in manufacturing capacity which is intended to cover various forms of supplier induced production disruptions.

Chapter 5

DISCLOSURE GUIDE

Purpose

Investors require a full picture of a company's climate change risks for effective investment decision making, and physical climate risk is a crucial dimension. This Disclosure Guide will:

- help investment professionals understand 'what good disclosures look like' when researching and engaging with portfolio companies; and
- help companies enhance their physical risk disclosures for more effective communications with investors.

The overall state of corporate physical climate risk reporting remains relatively underdeveloped, with the majority of climate disclosures focused on transition risks and opportunities.

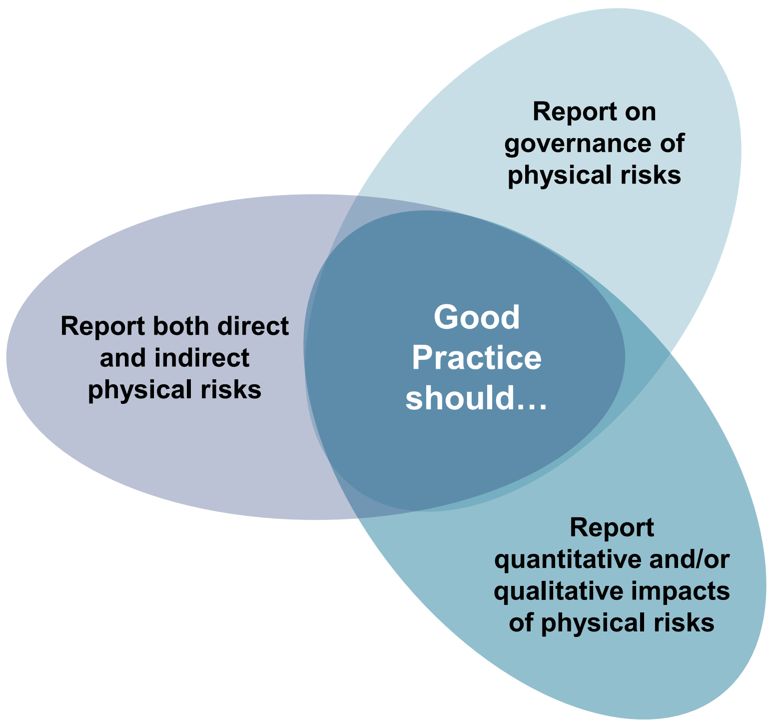
To help advance efforts in this regard, this Disclosure Guide applies 'good practice' criteria from three key perspectives:

1. The governance of physical climate risks;
2. The consideration of both direct and indirect physical risks – direct risks from core business activities and indirect risks from the broader value chain; and
3. The assessment of the potential impacts of physical risks – both quantitative and qualitative, at a sufficient level of detail to inform investment analysis.

Climate related disclosures can be found through various reporting channels such as a company's annual reports, sustainability reports, climate change/TCFD reports, CDP responses and other company filings, press releases and investor presentations.

Examples of better current practices from these reporting channels have been included following each category of recommended assessment criteria.

FIGURE 10: COMPONENTS OF 'GOOD PRACTICE' IN PHYSICAL RISK DISCLOSURES



5.1 GOVERNANCE OF PHYSICAL CLIMATE RISKS

To ensure climate related risks and opportunities are being appropriately addressed by companies, financial stakeholders need to understand the roles that both the Board and management team play regarding climate related matters. By understanding relevant governance processes and frameworks, financial stakeholders are able to evaluate whether climate risk is receiving the appropriate oversight[77]. The TCFD suggests that climate reporting should be subject to internal governance processes that are identical or very similar to those used for financial reporting.

EVALUATION CRITERIA

Do the company's disclosures:

Address how the Board of Directors ensures it has adequate oversight of existing and/or future physical climate risks, including:

- How the Board monitors physical climate risks and any related investments and programs associated with increasing the company's resilience to these risks.
- Whether the Board approves or guides physical climate risk integration into business strategies and/or risk management policies or processes, including standalone climate policies.
- Board and committee mandates for overseeing and monitoring physical climate risks, and how often physical climate risk is on the Board's agenda.
- Board's involvement in overseeing climate reporting and assessment of material climate risks.

Describe management's role in assessing and managing existing and future physical climate risks, including:

- Management monitoring of physical climate risks and any related investments and programs associated with increasing the company's resilience to these risks.
- Management level positions or committees with responsibility for physical climate risks, and whether these positions report to the Board.
- Explanation of how management monitors trends in various extreme weather events and climate patterns, and how they factor the corresponding risks and opportunities into long-term strategies or business decisions.
- Use of third-party climate specialists engaged to support management.
- Management positions and committees responsible for climate disclosures, and related disclosure control programs that address material physical climate risks.
- Linkage of climate risk management and achievement of targets to management remuneration where material.

FIGURE 11: DISCLOSURE EXAMPLES

Examples of current practices

A large rail transportation company[78] disclosed within its 2019 TCFD report the role the Board plays in overseeing climate related issues by reporting:

- **Board positions/committees involved:** The Board of Directors, Audit Committee, and Environment, Safety and Security Committee have responsibility for overseeing climate issues.
- **Frequency on which Board reviews climate issues:** The Board reviews climate issues approximately 10 times per year during Board meetings, and the Environment, Safety and Security Committee meets every quarter.
- **Governance mechanisms used:** The Board of Directors supervises the management of climate related risks and opportunities, and all Board members receive regular updates on the company's climate change strategy and performance. The Audit Committee has responsibility for monitoring risk management, internal controls and compliance – all of which include climate related issues. In addition, the Committee approves climate risk mitigation controls, MD&A disclosures, initiatives to integrate climate risk into business plans, and alignment with commitments to climate disclosure. The Environment, Safety and Security Committee has responsibility for overseeing the development and implementation of environmental policies, assessing practices, and ensuring environmental issues are adequately integrated into business plans.

A leading cosmetics company[79] disclosed how its Board of Directors oversees climate change within its 2020 CDP Climate Change response:

- **Board positions/committees involved:** The company's Board, Audit Committee, and Chairman of the Board and CEO oversee and are responsible for climate related issues.
- **Governance mechanisms used:** The Audit Committee reviews the company's risk mapping, which includes both transition and physical risks and their consequences, as well as related risk management policies. In addition, the Chairman of the Board and CEO is accountable for climate related policy, risk information, and adaptation of the business strategy – which includes ensuring commitments related to climate change are monitored for progress.

A multinational consumer goods company[80] disclosed management's responsibilities for climate risk within its 2020 Climate Change report:

- **Management levels involved:** A Sustainability Leadership Council is in place which consists of the CEO, Chief R&D Officer, Chief Marketing Officer and various other officers. A Climate Council is also in place which is chaired by the VP Global Sustainability.
- **Management's responsibility:** The Sustainability Leadership Council maintains overall oversight of climate change, including performance monitoring, providing strategic direction, alignment to program objectives, and allocation of resources. The Climate Council monitors external climate trends and developments, develops and maintains the company's overall climate strategy, and monitors progress against climate goals.
- **Management's actions and involvement:** The Climate Council reviews transitional and physical risks to better inform their climate risks identification and impacts, and has conducted a qualitative scenario analysis.

A large technology company[81] disclosed management's role in climate risk management within its 2020 Environmental Sustainability Report:

- **Management levels involved:** President and Chief Legal Officer (CLO), Chief Environmental Officer, Carbon Program Manager, Environmental Compliance and Climate Risk and Resilience Lead, and the Climate Council which includes of a number of executives from across the company.
- **Management's responsibility:** The President and CLO (via corporate affairs group), monitor the company's progress towards climate objectives and goals; The Chief Environmental Officer leads the overall environmental strategy, vision, and execution of initiatives; The environment and sustainability team assess and manage climate risk; The Carbon Program Manager leads carbon mitigation initiatives; The Environmental Compliance and Climate Risk and Resilience leader has established a new climate risk and resilience working group; The Climate Council is responsible for monitoring climate related risks and opportunities.
- **Management's actions and involvement:** The environment and sustainability team comprises the subject matter experts on climate risks, and assesses the company's climate-related physical and transition risks across the entire business. Both qualitative and quantitative scenario analysis along with other internal risk processes are used to conduct assessments.

5.2 EXPOSURES TO PHYSICAL CLIMATE RISKS

Investors require visibility into physical risks that could potentially impact both the company's core business activities and its value chain. Extreme weather events and volatile climate patterns could manifest into different types of financial risks depending on the locations and sectors of the company, its suppliers and major customers.

EVALUATION CRITERIA

Do the company's disclosures:

- Specify the approach/methodology used to assess physical climate risks.
- Include historical extreme weather events that have impacted the business activities and disrupted supply chains.
  - Example metrics: frequency and scale of the extreme weather event; operation delays, % of facilities damaged, % loss of labour productivity
- Specify location/sector/company-specific physical climate risks.
  - Assess the level of exposure to both direct and indirect physical climate impacts.
  - Assess the level of vulnerability of the exposed assets/operations/value chains and public infrastructure that the business relies on.
- Assign ratings to or specify criteria for the identified risks to indicate their significance or materiality.
- Include plausible scenarios to assess short-, mid- and long-term physical climate risks.
- Specify the relevant timelines for the assessment, e.g. short (1-3 years), mid (3-10 years), and longer term (10 plus years).
- Assess climate shifts and extreme weather events that could have impacts on the business under plausible scenarios.
- Assess level of exposure and vulnerabilities of the core business and its value chain under plausible scenarios.

FIGURE 12: DISCLOSURE EXAMPLES

Examples of current practices

A leading food products company[82] in its 2020 CDP Climate Change response disclosed:

- **Direct and indirect physical climate risks** that the organization faces.
- **Heat waves in 2013, 2016 and 2018** that impacted feed for cattle and caused a decrease in milk production, which led to supply and business disruptions.
- **Rising mean temperatures and changing precipitation patterns** that are more likely than not to lead to chronic physical risks to the supply chain.
- **Direct operations that are exposed to extreme weather events** such as cyclones and floods are unlikely to experience material financial impact due to implemented mitigation measures.
- **The WRI Aqueduct tool and the Water Risk Filter tool** that are used to assess the company's past and present water risk profile and identify which sites are a high priority for water-related risks.
- **The company's approach to mitigating the long-term risk** through conducting a risk exposure analysis to natural hazards for new sites to choose the least vulnerable location and screen the existing sites annually to determine their exposure. The company's level of exposure and vulnerability to these risks is considered medium.

A global leader in packaging and paper[83] disclosed in its 2020 Integrated Report and Sustainable Development Report:

- **Location-specific physical risks** including droughts in South Africa that could result in lost production at their pulp and paper mills, and windstorms in Russia that could lead to wood fiber yield losses resulting in a shortage of wood supply in the long term.
- **Industry and business specific physical risks** such as the increase in amount of water required for cooling processes in the mills if average temperatures rise, resulting in higher water temperatures.
- **The approach to managing such risks** by diversifying regions and forest types to mitigate supply chain risks, and by incorporating the RCP 8.5 scenario to monitor the associated financial implications over the short-(up to 3 years), mid-(3-7 years) and long-term (more than 7 years).

An American financial services company[84] disclosed how its own operations may be affected by physical climate risks in its 2020 TCFD report:

- **Risk assessment Processes:** IPCC RCP 8.5 was applied to evaluate the exposure to physical climate impacts and integrate mitigation strategies into financial planning.
- **Location-specific:** Site-level physical risk assessments are used to determine which sites would require resilience investment and which would be considered for relocation in the long-term.
- **Chronic Risks:** The vulnerability to chronic climate patterns is assessed as low for sea-level rise and medium for heat and water stress. 44% of its sites and data centers are exposed to a high level of heat stress, and 34% are exposed to a high level of water stress.
- **Acute Risks:** The company's vulnerability to acute physical risks from floods, hurricanes, and typhoons is considered low, and to wildfire is considered medium.

A mobility technology company,[85] which supplies the automotive industry, in its 2020 Sustainability Report disclosed:

- **Exposure to extreme weather events:** Extreme weather events could significantly disrupt the company's supply chains and cause damage to the business. In February 2021, the extreme winter storm in Texas disrupted oil production and, as a result, the supply of materials required for automotive seating.
- **Acute Risks:** 7 percent of the company's properties are located in hurricane risk zones. To minimize potential disruptions, the company plans to maintain higher inventories of various materials and components required for production.
- **Chronic Risks:** 13 facilities are located five kilometers or closer to a coastline and are at higher risk from the effects of sea rise. Water scarcity threatens some of the company's manufacturing locations, particularly in Mexico. To mitigate the impact of water scarcity, water reduction and re-use activities are being considered.
- **Risk Assessment Processes:** The company has retained an advisor to map its global footprint against direct and indirect physical climate risks. Risk assessment processes include pre-screening of locations for new facilities; frequent facility inspections; facility construction design review; and risk management training.

A Finnish forest industry company disclosed how it predicts the future physical long-term impacts of climate change on its businesses in Finland, Uruguay, Southern Germany and Eastern China with advice from the Finnish Meteorological Institute in its 2019 annual report:[86]

- **Three scenarios with forecasts to 2040** are incorporated into the analysis.
- **The most significant risks identified** are related to more frequent and severe extreme weather conditions such as heavy rainfall, storms and drought.
- **Finland's business would experience the biggest impact,** with temperatures expected to rise more significantly and rapidly than the world average.
- **In Eastern China,** the biggest physical risks would be caused by the flooding of the Yangtze River due to potential increase in rainfall.
- **In Southern Germany,** the biggest physical risks would be caused by forest fires due to higher temperatures.

5.3 FINANCIAL IMPACTS OF PHYSICAL CLIMATE RISKS

To understand how physical risks can manifest into financial losses and ultimately lower investment returns, investors need to have visibility into the corresponding financial impacts that could potentially be material to the company. Considerations of resilience and adaptation measures should be part of the assessment to form a more concise picture of how the company would be impacted if physical risks were to manifest.

EVALUATION CRITERIA

Does the disclosure:

- Provide quantitative and/or qualitative metrics to describe and/or quantify financial impacts of past and projected climate and weather events.
    - Direct impacts on the core business activities and indirect impacts on its value chain;
    - Macro-economic impacts that could cascade down to the business;
    - Example metrics: financial losses caused by the identified physical risks.
- Include resilience and adaptation measures/initiatives for risk impact assessments and management.
    - Business-level resilience and adaptive capacity;
    - Public infrastructure factors;
    - Example metrics: investments in climate adaptation and mitigation; financial losses avoided due to implemented measures.
- Provide a materiality assessment of the physical risk impacts.
    - Including residual potential impact assessment.
    - Including thresholds to indicate if the impacts are financially material.
- Include both current conditions and plausible scenarios in forward-looking physical risk impact assessments.
    - Scenarios designed to reflect plausible global warming pathways with clear timeframes.
    - Scenarios with enough coverage to assess tail risks.
    - Frequency with which scenario analysis is performed/updated.
- Describe how scenario analysis has helped to inform business strategy decisions and other decisions related to management of physical climate risks.
- Describe risk management processes used to manage the impacts of physical climate risks.

FIGURE 13: DISCLOSURE EXAMPLES

Examples of current practices

A multinational food-products[87] corporation disclosed:

- **The thresholds for determining the materiality of financial impacts** in its 2020 CDP Climate Change response.
- **Financial impact metrics** for the past 3 major milk production drops caused by changing climate patterns which led to upstream disruption.
- **Implementation of regenerative agriculture practices within its supply chain** to address these risks, including detailed plans, timelines, approach, associated costs, and outcomes.
- **Use of climate scenario analysis** covering warming pathways up to RCP 8.5 to monitor water stress. The company redefined its water strategy in 2019 based on its scenario analysis, which covers its entire value chain.

A large Japanese food product company,[88] that offers vegetable oils and fats, industrial chocolate, emulsified and fermented ingredients and soy-based ingredients, provided in its 2021 Integrated Report:

- **Measurements for the projected degree of financial impact by 2050** under two climate scenarios
- **Potential impacts from storms and floods** which increased from level two (medium impact) for a 2°C scenario to level three (high impact) for a 3°C scenario given likely operational disruptions in locations such as Japan and Louisiana, US.
- **Initiatives including creative food solutions and sustainable procurement** to improve its supply chain resilience.

A British multinational consumer goods company[89] disclosed its methodology and impact outcomes for its key agriculture commodities in the 2020 annual report:

- **The company worked with field experts to develop crop-specific and climate models** for soybean oil, black tea and palm oil to forecast future yields.
- **An econometric model has been developed to estimate the impact of climate-induced yield changes on future prices,** isolating other factors such as technology.
- **Future yields and price impacts were used for financial impact estimation.** For example, black tea shows decreased yields and increased prices in two of the four countries modelled in certain specific scenarios.
- **The company has actively engaged with local groups** to manage risks such as decreased yields of black tea. For example, in Kenya, the company:
    - Has established a long-term partnership with the Rainforest Alliance to support smallholder farmers for sustainable practice.
    - Has been working with the Sustainable Trade Initiative to reverse deforestation and improve rainfall to support tea growing.
    - Created the Enhancing Livelihoods Fund with Oxfam, which supports women team farmers with access to finance, skills, and training to cultivate drought- resistant tea crops.

A UK water utility disclosed in its 2020 Climate Change Adaptation report[90]:

- **The approach to assessing physical climate risks** using a scoring system of 0-25 for both the likelihood of an identified risk occurring and the consequence if it did occur.
- **The quantification of risk to public water supply from drought** for the occurrence of a 1-in-200-year drought. The inherent risk rating (risk without any adaptation/ mitigation measures) is 25. With the existing level of adaptation effort, the current risk rating is 9.
- **Adaptation measures to address drought-related risks,** investing £3 million in relocating one of its intakes on the River Wensum to address a deficit in the Norwich and the Broads resource zone and restore favorable hydro-ecological conditions in the river.
- **The target risk ratings** for different timelines based on various adaptation measures: 6 by 2025, and 3 by 2045.

The world's largest primary producer of platinum disclosed in its 2020 ESG report[91] that:

- **Investment decisions on mine projects could be significantly affected by physical climate risks.** In order to improve its portfolio resilience, the company has developed climate change scenarios based on the best-available science.
- **The company has worked with South Africa's Council for Scientific and Industrial Research** to model possible impacts of climate change and extreme weather with high resolution on the African continent.
- **The design of mitigation controls** has been informed by on these outcomes, including changes in monitoring, infrastructure design and emergency preparedness.
- **Specific financial impact from physical risks** (as included in its CDP response). For example, the changes in precipitation patterns and extreme variability in weather patterns are likely to lead to decreased revenues due to reduced production capacity in the short-term, i.e. within 3 years. The resulted potential financial impact is considered high.

An agriculture, food, and forest products company disclosed the identification and impact of physical climate risks within its annual report and TCFD risk assessment report[92]:

- **Risk analysis:** performed analyses to assess the degree of climate exposure on 12 priority sites in three of its business groups in six countries. Analysis also included a value chain assessment.
- **Acute risks and their impact:** increased severity of extreme weather events such as cyclones and floods could have a potential impact to the business by increasing operating costs, early write off of assets, supply chain disruption, production and capacity disruption, and financially by impacting revenues, expenditures, assets and liabilities, and capital in the long-term (10 years).
- **Chronic risks and their impact:** changes in precipitation patterns and extreme variability in weather patterns, as well as rising mean temperatures could have a potential impact to the business by increasing operating costs and impacting capital expenditures in the long-term (10 years).
- **Impact to company's value chain:** extreme weather events could isolate their production facilities and therefore would be unable to receive or ship products by land or sea. In addition, their operations could be impacted if extreme weather events stopped the flow of materials.
- **Specify the industries they are reliant on and the impact extreme weather could have to their business.** Reliant on agriculture industry and specify that if agriculture production was disrupted by climate change, the company could see a decrease in farmers being able to invest in their products.

Chapter 6

RESOURCE GUIDE

In conjunction with this toolkit, ILN has curated a comprehensive selection of credible sources of external research, databases and tools, guidance documents, disclosure frameworks and regulatory and legislative sources to help investors and other stakeholders in further researching the physical risks and financial impacts of climate change.

The Resource Guide is accessible through a dedicated portal on the ILN website (link: https://investorleadershipnetwork.org/en/climate-toolkit/). To facilitate use of the Resource Guide portal, filters have been created to allow users to search for relevant sources by type, topic area, regional coverage, sector coverage, and/or key words. These search functions will allow users to find resources that address the regions, sectors and risks most relevant to their current and targeted investments.

The Resource Guide will be periodically updated to include new and updated sources as research and guidance into the physical risks and financial impacts of climate change continue to expand.

Authoritative Research	Other Third-Party Research
Databases and Tools	Disclosure Frameworks
Guidance	Regulations and Legislation

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