

QUESTIONS TO ASSIST NON-EXECUTIVE DIRECTOR OVERSIGHT OF PHYSICAL CLIMATE RISK MANAGEMENT

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MinterEllison

In brief

The climate is changing. For corporates, this means building resilience to the risks associated with a changing climate and adjusting to new stakeholder expectations and also meeting the changing needs and demands of customers and clients as they respond to the impacts of climate change.

Ensuring that companies are braced for these changes requires clear ownership and accountability. Robust climate risk protocols and practices must be mainstreamed throughout the corporate structure together with routine disclosure of material climate risks, be they physical, transition or liability-related in nature. This is an investor and financial regulator expectation and increasingly an explicit regulatory requirement.

This Guidance Note will focus specifically on the question of physical climate risk, as to date conversations about physical risk have been harder to have.. By asking pointed questions and understanding what is and is not a satisfactory answer, Non-Executive Directors play an instrumental role in driving informed and proportionate corporate action on physical climate risk, helping to ensure that companies are able to adapt and thrive in the new climate reality, and meet the objectives of the Paris Agreement.

“Climate change, and our response to it, will have a significant impact on economic and financial systems. The impacts will be far-reaching in breadth and in magnitude; subject to tipping points and irreversible changes; and are uncertain yet at the same time totally foreseeable. In particular, while we do not know now exactly what physical and transition risks will materialise, we do know for sure that we will face some combination of those risks. And, crucially, we also know that the size and balance of these future financial risks and economic costs will depend on the actions we take today.”

*Frank Elderson (De Nederlandsche Bank, Chair of the NGFS) and Sarah Breeden (Bank of England, Chair of the NGFS Macrofinancial workstream),
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1. Climate change – a resilience challenge that is here to stay

The warming of the Earth’s climate has brought the issues of physical climate risk, climate adaptation and resilience-building to the forefront of corporate attention.

The imperative for corporates, along with financial institutions, is to understand, manage, and disclose physical climate-related risks. This has progressed considerably in recent years due to the emergence and significant uptake of disclosures frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD) recommendations.

The economic fallout of the COVID-19 pandemic has illuminated the implications of failing to address systemic risks presenting foreseeable large-scale shocks. Like COVID-19, climate change harbours the potential to deliver large-scale shocks that pose a systemic risk. COVID-19 has many lessons for those overseeing and managing climate risks. It has shown how complex, over-optimised and inflexible systems can be highly sensitive to the fallout of such shocks, with effects transmitted throughout value chains, across geographies, and throughout the wider macro-economy. Recent events have demonstrated that prudent decisions about building resilience to such shocks must be taken today using the best-available intelligence. Waiting for a higher degree of certainty about the location, timing and impact of future threats may never come, and already be too late. This is because what is certain about physical climate risk is that historical experience is an imperfect indicator of the present and future.

Like COVID-19, some of the shocks associated with climate change are sharp, damaging, and hard to predict, and the associated risks can often be transferred or diversified. A distinctive aspect of climate change is that it gives rise to a plurality of physical risks - associated with both extreme events ('acute') and incremental ('chronic') change. These impacts have increased over the last 30 years and will continue to increase over the decades

and centuries to come. Physical risks will escalate as tipping points passed. The loss of the Amazon rainforest or the West Antarctic ice sheet, for example, may lead to catastrophic and irreversible impacts.¹ Evidence is mounting that we are getting ever closer to these tipping points are underway and exceeding them is more likely than was previously thought.²

Physical climate risks are now understood as presenting foreseeable financial risks that represent a critical business challenge – and opportunities.

Directors and boards must understand how physical climate risks could affect their companies, their stakeholders, value chains, their competitors, and to appropriately respond to and navigate these risks. Non-Executive Directors have a unique role to play in ensuring that corporates are appropriately and responsibly managing physical risks in a rapidly evolving physical and regulatory environment.

A practical guide for Non-Executive Directors

Acclimatise, a specialist advisory and analytics firm focussed on physical climate risks, has partnered with law firm MinterEllison to produce this Guidance for Chapter Zero's Non-Executive Director community to address this need. **This Guidance provides a set of key questions that Non-Executive Directors can use to hold informed and strategic discussions around physical risks with their boards and senior management.** The Guidance also provides a concise overview of the current state of the science regarding climate change. Aimed specifically to assist Non-Executive Directors, this Guidance is drafted to provide a foundational input across all sectors.



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2. Why do directors need to consider physical climate risks?

Corporates today – across sectors – are faced with a physical climate risk landscape that is dynamic and unprecedented. This rapidly evolving landscape is giving rise to material impacts that are often significant, not yet fully appreciated and that, in the absence of effective risk mitigation, may pose systemic risks to financial stability³

Due to the potential financial impacts of climate change, climate risk analysis and disclosure have quickly become – and will remain - a board level issue of critical interest to financial and corporate regulators.

To continue to act in the best interest of all the stakeholders of the companies on whose boards they sit, Non-Executive Directors should ensure that companies are appropriately and responsibly managing physical risks, and fully aware of the

rapidly evolving physical, regulatory, and investor relations environment.¹

This section provides a summary of two key issues Non-Executive Directors need to focus on:

- The impacts on business from the changing climate; and
- The implications for business of rapidly evolving climate risk governance and disclosure regimes.

2.1 A changing climate and growing impacts on business

Global mean temperatures have already risen by approximately 1.0°C above pre-industrial levels,⁴ and further increases are already 'locked in' until at least around 2040. This is because historic, current and likely near-term emissions will continue to contribute to warming. The rate of warming after 2040 is determined by how quickly we can cut emissions today.

This 1.0°C temperature rise is already causing more frequent and more extreme weather and climate events, as well as shifts in rainfall patterns, sea

levels, sea ice, and glacial retreat, among other changes. The consequences are already serious, involving financial losses, economic impacts, ecological damage, livelihoods disrupted, and increase in vulnerability, and reduced resilience.

Stabilising our climate at 1.5°C in line with the Paris Agreement is the best-case scenario in terms of the level of global warming that we can now achieve. Stabilising the climate at this level, however, is still not safe. The impacts are catastrophic and require investment in resilience alongside low-

¹ C.f. Companies Act 2006, Section 172: 'duty to promote the success of the company', available here: <http://legislation.gov.uk/ukpga/2006/46/section/172>

carbon investments to manage the impacts. Tipping points may be exceeded even between 1 and 2 °C of warming,⁵ including ice sheet collapse, major coral reef die-offs, large scale forest fires, among others,⁶ To avoid exceeding tipping points, and to meet the Paris Agreement, companies, governments, and individuals need to take dramatic action now to transition to low carbon economies by 2050.

Climatic extremes and long-term shifts in climate patterns can have the following impacts, among others:

- damage or reduce the efficiency of physical assets and/or crucial infrastructures;
- interrupt upstream supply chains and/or downstream distribution networks;
- alter demand for products or services;
- impact worker health and productivity;
- restrict or shift working hours for outdoor work (e.g. construction, agriculture);
- compel relocation of key assets;
- cause major population shifts as “climate migrants” flee extreme weather and civil conflict, in turn provoking political instability and undermining business operating conditions; and
- trigger breaches of environmental and other laws.

Firms that are exposed and vulnerable to climate risks will face higher insurance costs and an increase in operational and maintenance costs.

Changes in climate are already causing additional operational and capital expenditures, impacting businesses’ value chains and ultimately impacting revenues. Below is a list of examples of some of the financial impacts corporates have already faced as a result of climate hazards:ⁱⁱ

- **Storms, heavy rain, flooding, sea level rise and storm surge:** In 2012, Hurricane Sandy flooded several Verizon offices and resulted in the failure of 25% of all telecommunications masts in coastal areas across 10 states. Partly owing to these impacts, Verizon reported a quarterly loss of US\$4.23bn.⁷

- **High temperature extremes:** Extreme heat (120°F/49°C) at Sky Harbor International Airport (Phoenix, USA) lasted several days, causing disruption to the arrival and departure of aircraft. In the future, airports may need to invest in longer runways to deal with extreme heat. Excessively hot air is less dense and, in turn, reduces lift, thus requiring a longer runway. American Airlines was particularly affected due to the large number of aircrafts in its fleet unable to operate in these conditions. Heat ultimately decreased airport revenues and increased operational costs.⁸
- **Severe drought:** Prolonged drought affected major U.S. wheat-producing states, contributing to the largest spike in U.S. wheat futures in seven years in 2017⁹. Prolonged drought periodically causes supply chain disruptions along the Mississippi River in the U.S., which is used to transport \$7 billion commodities each year, including coal, wheat and maize. Low water in 2012 reduced the width of the navigable channel and draft height. This led to reduced export volumes and higher shipping costs and commodity prices.^{10,11} At the same time, whilst barge spot rates spiked owing to increased costs and bottlenecks, barge firms faced considerable financial losses by being locked into contracts signed before the onset of restrictions.
- **Heat stress** reduces labour productivity in both indoor and outdoor work environments. In some areas, outdoor workers face an increase in the number of days with temperatures beyond safe operating conditions, or even higher than ‘wet-bulb’ temperature, which is dangerous to life.¹² Areas accustomed to heat stress are activating hot weather protocols earlier on in summer and even office workers can suffer from heat stress if buildings are not properly air conditioned¹³. Record-breaking extreme heat and bushfires over the Australian summer of 2019/20 were estimated to cause a 0.4% impact on the Australian economy in the March quarter due to impacts on lost productivity, work-place closures and stand-downs, and loss of consumer

ii This is for illustrative purposes only and is not exhaustive.

confidence from the direct fire threat, extreme heat and smoke haze.¹⁴ This is in addition to the loss of more than 30 human lives, billions of wild animals, and 10 million hectares of forest ecosystems, with insurers reporting more

than 38,000 claims for property damage totalling AUD\$2.32 billion.¹⁵

Insurers are also facing substantial losses, as illustrated in Box 1.

Box 1: Hurricanes and wildfires cause massive insurance losses year on year

In London, hurricanes and wildfires bring two years of pain for 330-year-old insurance market

The exposure of corporates to physical climate risks, whether direct risks to assets and operations or indirect to supply chains, can precipitate major losses for insurers and reinsurers. In 2018, Lloyds of London reported losses of £1 billion – the second consecutive year the market reported losses, following a deficit of £2 billion in 2017.¹⁶

Like the companies whose risks they price and underwrite, insurers are reckoning with a new climate reality. For insurers in the Lloyds market, this means refining loss models to account for risk in a dynamic climate. This could mean their clients potentially facing higher premiums or withdrawal of coverage. In Australia, it has already been estimated that more than 5% of all real estate assets will be uninsurable within the next decade.¹⁷

Companies are also exposed to climate-induced risks in the wider macro-economy. Companies that operate in countries that are highly sensitive and poorly adapted to physical climate risks (noting that this applies equally to developed and developing economies) may not only experience demand shocks, but also increased currency, inflation¹⁸, and interest-rate volatility that can erode earnings and increase costs.¹⁹

Whilst the impacts of physical climate change raise direct implications for individual firms' assets, they also raise far-reaching structural and long-term implications across a host of factors that affect companies. These include access to critical material inputs, labour supply, household income, demand for goods and services, or ecosystem health. Failing to manage physical climate risks may negatively impact prices, companies' ability to service loans and reduce asset valuations. These impacts, as well as economic losses sustained following extreme climate events, can be transmitted throughout the

(global) financial system via creditors, derivatives, insurers, and others, ultimately influencing access to credit and insurance. The economic fallout of these mounting risks has been projected to greatly exceed that of the subprime mortgage crisis of 2008²⁰.

Addressing these systemic challenges calls for a far-sighted and broadminded approach. As Mark Carney, the former Bank of England Governor, has stated, 'You can't wish away the systemic risk...In the end, a small investment up front can save a tremendous cost down the road'.²¹ By working with external stakeholders, such as insurers, suppliers, trade associations and public authorities (national, regional or global), firms can help develop - and benefit from - timely intelligence about complex systemic risks precipitated by the physical impacts of climate change. They can help shape guidance, principles or strategies to stimulate coordinated action to manage these risks. This can also enhance corporate level climate risk management though

illuminating appropriate risk mitigation actions and potential residual risks.

Due to the highly contextual nature of physical climate risks, it is challenging to provide a definitive assessment of the extent to which a sector, geography, company, or asset, etc. is more at risk than others.²² Physical hazards in a given region may affect various locations in that region differently, as seen with variations in flood impacts. Because climate change causes impacts throughout value chains, the associated risks and opportunities raise strategic and operational implications for all companies, not only those that own or operate large fixed capital assets. In addition, the impacts are not limited to the location of key elements of a value chain, they also affect the intangible assets. In turn, the actual exposures from these direct and indirect physical risks for one business may not be the same for another business in the same sector due to their governance, strategic planning, risk management and ability to adapt and build resilience to the risk.

This is not cyclical. The new climate normal – of rapid, non-linear, and geographically diverse climatic change – will remain the unavoidable context to corporate decision-making at every level, from

strategy to procurement to logistics. **Importantly, it is possible for corporate decision makers to apply scientific understanding to take informed and prudent decisions today to build resilience to an array of physical climate risks.**

See Annex 1 of this report for a comprehensive overview of the physical climate science and more detail on how physical climate impacts manifest

Additionally, building resilience can lead to increased efficiency in the short- and long-term, such as by **extending asset lifetimes and reducing depreciation, lowering input costs, improving asset operational efficiency, reducing business interruption and improve competitiveness in volatile markets.** And as insurers, investors and lenders increasingly factor physical climate risk into their due diligence and decision-making, being ahead on climate risk will help to control premiums and debt-servicing costs, improve credit ratings, and potentially increase valuations.

Box 2 shares a case study which illustrates how climate change is precipitating disastrous impacts for business and the environment.

Box 2: Climate change in the Arctic leads to an environmental catastrophe

On shaky ground: how increasing temperatures in the Arctic are eroding the foundations of infrastructure and corporate value

Norilsk is a small industrial city located in the Russian Krai of Krasnoyarsk, northern Siberia. In May 2020, a diesel storage tank owned by one of the city's largest employers, Nor Nickel, failed, leading to over 150,000 barrels of diesel contaminating surrounding land, entering the Ambarnaya River, and contaminating the biologically important Lake Pyasino. The event is one of the worst environmental disasters to have affected the Arctic region. With clean-up costs estimated at least \$80 million, shares in Nor Nickel fell by 8.7%, whilst the Russian Investigative Committee has launched a criminal investigation into pollution, violations of safety rules, and potential negligence.

The disaster rapidly triggered a debate as to whether climate change may have caused the disaster: temperatures are increasing in the Arctic region at a rate twice the global average. At the same time, 2020 has broken new temperature records, with Siberia registering temperatures 3 to 5

deg. C above average since January,²³ reaching a maximum of 38 deg. C,²⁴ This rapid increase in temperature is causing chronic and costly impacts, from accelerating permafrost melt, to ground instability, to the destruction of building foundations and structures. With the number of permafrost-damaged buildings in Norilsk was higher during the last 10 years than the preceding 50²⁵, and 60% of buildings in the city having been damaged by the impacts of permafrost melt²⁶, it is likely that permafrost melt was a factor in this disaster also. These city-wide impacts illustrate the far-reaching and systemic risks that climate change poses.

In the wake of Roshydromet's climate risk report in 2017,²⁷ and in recognition of these foreseeable risks, the Russian Government now requires new oil infrastructure to take physical climate change into account²⁸. However, as the possible impacts of permafrost melt on existing assets are little different from new assets, firms that inadequately manage climate risks to their existing asset portfolio could find themselves with considerable unmanaged liabilities.

This disaster illuminates how the climate and the environment are changing in manifold ways that are rendering past norms concerning asset construction and management, obsolete. These changes are precipitating disastrous impacts for the environment, material and reputational risks for firms, and require that past assumptions about the resilience and value of assets be revised and risks be properly managed and disclosed.

2.2 Maturing climate risk governance and disclosure regimes in many jurisdictions

When the G20 Financial Stability Board (FSB) framed climate risks as posing a risk to global systemic financial stability and set up the Task Force on Climate-related Financial Disclosures (TCFD) in 2015, the climate risk governance landscape accelerated rapidly. The TCFD published recommendations for a new form of voluntary reporting of climate-related risks and opportunities in 2017 that has quickly evolved into the de facto norm of soft law. See Box 3 for more information

on the TCFD framework and recent uptake. Thanks in part to the TCFD framework, a changing climate is increasingly understood as having significant financial risks by corporate boards, financial institutions, governments, and international organisations.^{29,30,31,32} The TCFD recommendation prompts companies to sharpen their focus on physical climate risk and begin to recast it as a board governance and C-suite responsibility.

Box 3: TCFD overview and current uptake

To help investors, lenders, and insurance underwriters better understand how climate-related risks and opportunities are likely to impact investees and counterparties, the TCFD recommends disclosures on climate-related risks into two major categories:

- (1) risks related to the **transition** to a lower-carbon economy; and
- (2) risks related to the **physical** impacts of climate change.³³

The TCFD framework is structured around four key areas to facilitate useful disclosures that will allow more informed financial decisions:

- Governance;
- Strategy;
- Risk Management; and
- Metrics and Targets.

The TCFD recommendations are now widely recognised as the leading guidance on the reporting of financially material climate-related information and are becoming mandatory in first-mover jurisdictions such as the UK. Financial institutions are actively engaging with the TCFD recommendations, as are actors in the real economy. Unsurprisingly, the demand for decision-useful, climate-related financial information by financial institutions, especially investors, has continued to grow³⁴. As of February 2020, the TCFD had over 1,000 official supporters across a broad range of sectors with a combined market capitalization of nearly \$12 trillion. The supporters are headquartered in 55 countries, including non-financial companies, national governments, regulators, credit rating agencies, non-profit organisations, and 473 financial companies responsible for assets of over \$138 trillion.³⁵

The TCFD Recommendations are among a groundswell of action on improved management and disclosure of the financial risks and opportunities from climate change. Alongside the TCFD, there are significant moves towards regulation of the financial system to manage financial risks from climate change, and drive capital towards sustainable investments:

- Investors are increasingly asking corporates for decision-useful climate risk information;
- More and more financial supervisors are making clear their expectation that corporates and financial institutions appropriately manage and disclose climate risks, and explicit regulation of climate risks is on the horizon;

- First-mover accounting standards bodies are setting out guidance on climate risk disclosures in the financial statements, bringing these within the scope of external audit remit; and
- Corporates' customers and clients are also increasingly interested in climate risk management and disclosure.

See Annex 2 for more detail on emerging climate risk governance regimes and regulations.



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3. How can firms successfully manage physical climate risks?

The success of corporates in managing physical climate risks will be to a great extent determined by:

- their recognition of the spectrum of risks and opportunities of climate change to the business;
- their updating of governance and risk management policies and procedures in ways that ensure clear ownership and thorough, cross-departmental command of the issue;
- their alignment with climate risk strategies and measures being taken at local and regional level;
- their investment in the right human and technical resources; and
- their ability to monitor progress on climate risk and resilience.

This section provides a high-level review of some of the actions corporates can take to successfully manage physical climate risks.

3.1 Understand the risks and opportunities of climate change to the business

By making use of the best available evidence to anticipate, avoid, manage, or insure against climate-related shocks – and longer-term risks, – corporates can ensure they are well placed to maintain business continuity and rebound. A sober appraisal of up-to-date evidence on how current and future physical climate risks could lead to material financial implications can allow firms to take risk management actions. These include making changes

to the design and operation of physical assets that allow them to function efficiently and with minimal interruption in a dynamic climate. These changes, or risk management actions, can cut across all areas of the business and cover multiple dimensions (Table 1), including working in partnership with stakeholders to manage risks to the supply chain (e.g. engaging with water utilities to ensure continuity of supply in a context of changing rainfall patterns).

Table 1: Types of risk management actions to address climate-related risks (non-exhaustive)

Type of action	Examples
Informational	<ul style="list-style-type: none"> • Undertake quantitative climate risk assessments • Undertake cost-benefit analysis of adaptation actions
Institutional / policy	<ul style="list-style-type: none"> • Oversight and governance of adaptation • Modify processes, standards, guidelines
Insurance	<ul style="list-style-type: none"> • Extend cover • Engage with insurers on adaptation measures that have been implemented
Operational (OPEX)	<ul style="list-style-type: none"> • Increase maintenance • Change frequency of activities which manage weather or climate risks (e.g. dust suppression)
Physical modification (CAPEX)	<ul style="list-style-type: none"> • Upgrade to higher specification equipment • Increase the height of flood defences

Financial climate risk management strategies can include maintaining larger capital reserves; introducing or expanding the use of hedging contracts, catastrophe and/or resilience bonds; raising pricing to reflect a more volatile cost base; negotiating shorter financial contracts; negotiating shorter lease terms on physical and property assets; or expanding insurance coverage to cover the direct and indirect effects on physical operating conditions attributable to physical climate risk³⁶. Legal strategies can identify and mitigate risks to comply with existing disclosure and government obligations as applied to the foreseeable and material financial risks associated with climate change (e.g. mandatory disclosure regimes, accounting standards, and directors' duties set out under applicable corporate governance laws, such as the UK Corporations Act) as well as new and existing climate or environmental-related regulations. Legal due diligence can assess how physical climate risks give rise to commercial risks or potential liabilities in

material contracts, financing or M&A transactions, and provide efficient risk allocation strategies to mitigate these risks.

Whilst corporates have much to gain from building appropriate levels of resilience to physical climate risks, they can also leverage market opportunities linked to climate change-driven demand shifts and global investments in resilience. For example, with an estimated \$90 trillion worth of infrastructure yet to be built³⁷, there is a sizeable opportunity for corporates to design and build infrastructure that is adapted to future climate risks. In addition, corporates can exploit new markets for products and services precipitated both by changes in the climate itself and by emerging green finance (e.g. resilience bonds)³⁸. In addition, as the Global Commission on Adaptation notes, investments in adaptation can bring a 'triple dividend', through avoided losses, positive economic gains, and additional social and environmental benefits³⁹.

3.2 Reform policies and practices and prioritise resilience investments

The severity of climate-related shocks on business activity significantly depends on their resilience of the business, as well as that of their supply chains, customers, stakeholders, and operational environment. A climate-resilient business is ultimately more insurable, more profitable, and more investable. Building climate resilience does not mean reinventing the wheel. It means integrating climate considerations within existing risk management and planning procedures, from setting corporate strategy to upgrading the design and operation of assets in light of current and horizon physical risks. It also means having an integrated view of the market conditions for your business, your sector and the economies in which you operate over short, medium and long time scales. A business that is watching,

monitoring and assessing the changes taking place in markets and the changes in customer needs and demands, driven by a changing climate will have greater financial stability and sustainability.

As legal settlements have recently shown⁴⁰, improving ownership and oversight of climate-related risks at the boardroom level is an essential step in ensuring that physical risks are addressed at every level of a firm, from Board level to operations. Assuring that actions are aligned with emerging frameworks can form part of this process, and companies should undertake audits of their physical risk management to gauge where they stand relative to evolving good practice for their particular circumstances.



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Nine questions for Non-Executive Directors



KEY



Governance



Risk Management



Strategy



Metrics and Targets

4. Nine questions for Non-Executive Directors to ask boards

Strong oversight and accountability can help to ensure that corporates institute the best governance processes and mainstream consideration of climate change at the appropriate levels throughout the business. The following are 9 key questions to help Non-Executive Directors in their governance and oversight of corporate responses to physical climate risks and opportunities.

Whilst effective oversight and assurance will be unique in the circumstances of each company, this guidance provides a foundational set of questions that are useful across all sectors. These will be complemented with tailored sector-specific questions in future guidance.

The questions are organised by theme (e.g. governance and impacts) and relate to a pillar of the TCFD recommendations: Governance, Strategy, Risk Management, or Metrics and Targets.

Governance



1. What governance mechanisms are in place for the management of current and future physical climate risks?

- a. Are oversight, strategy, assurance and disclosure mechanisms in relation to climate risk adequate to fulfil our directors' duties, such as those to act with due care and diligence in governing foreseeable climate risks and to act in the company's best interests / promote its success?
- b. Are they compliant with regulatory expectations on governance of climate risks in the jurisdictions of operation?
- c. Who is responsible for overseeing management and disclosure of climate-related physical risks throughout the company?
- d. What incentives are in place - at the board level and throughout the company - to achieve climate resilience goals and are these in conflict with any other incentives?
- e. How is the company bringing teams - strategy, risk, operational, finance, audit, procurement, legal, environmental, health and safety, human resources and government affairs - together to promote cross-company ownership of climate strategy and embedding a consistent approach across the company?
- f. How does it engage with governmental, non-governmental and business stakeholders to influence policy aimed at delivering effective climate resilience outcomes?
- g. How does the company account for and disclose its assessment of physical risks – as an input to both qualitative and quantitative reports?

Resourcing



- 2. Does the Board have access to the right skills and knowledge it needs to institute a robust physical climate risk management strategy and monitor performance?**
- Does the company have the right skills across departments to implement its physical climate risk strategy in a context of climate uncertainty?
 - Are we being supported by appropriate experts and advisors?
 - What is the company's plan to build cross-company buy-in and individual as well as cross-departmental capacity to manage physical climate risk?

Assurance



- 3. How is the company assured of the adequacy and rigour of its climate risk management policies and practices and disclosures?**
- Has the company obtained appropriately qualified external specialist advice in the area of physical climate risk? How has this contributed to enhancing in-house capabilities and challenge internal bias?
 - Are material physical climate risks disclosed consistent with annual, periodic and continuous reporting obligations, including in prospectuses and other fund-raising disclosures?
 - Have physical climate risks been raised as key audit matters?
 - Is the company reporting in accordance with the TCFD Recommendations and emerging mandatory regulatory requirements, as well as the positions of investors and regulators concerning physical climate risks?

Resilience



- 4. Has the company defined a strategy to build resilience to climate-related physical risks?**
- What actions is the company taking to ensure physical risks are managed effectively throughout the company, and across our value/supply chains, in accordance with our objectives and risk appetite?
 - What operational and / or financial strategies does the company have in place to manage physical climate riskⁱⁱⁱ?
 - How are changes in extreme weather events and incremental climatic changes considered in the design phases for new developments and refits for existing assets?
 - How does the company prioritise and financially provision for climate resilience actions?
 - Are disaster recovery plans (including those concerning critical suppliers) regularly reviewed to assess their adequacy in ensuring continued delivery of services following extreme events?
 - Has it defined the actions it can take to contribute to developing effective systemic responses aimed at optimising adaptation measures?

ⁱⁱⁱ see Table 1 for a non-exhaustive list of management actions

Risks



5. Has the company conducted a baseline assessment of physical climate risks and opportunities for hazard types relevant to the company's footprint, operations and supply chains?

- a. Have we considered physical climate risks under our financial risk management framework, and included it on our risk register as appropriate?
- b. Does the company assess direct and indirect physical risks using at least two scenarios (including a 2°C scenario and a 4°C scenario)?^{iv}
- c. Are physical climate risks evaluated objectively and consistently across the company?
- d. How does the company determine materiality and exceedance thresholds – including levels of 'intolerable risk' to individual assets and transactions and/or the wider company?
- e. Has the company identified trigger points for adapting, shutting down, or disposing of assets?
- f. How is the company addressing the systemic challenges associated with physical climate risk?

Impacts



6. What are the key material impacts of long-run climate change and extreme events on the company?

- a. What constraints do climate-related physical risks place on being able to accomplish strategic objectives?
- b. How does the company estimate the nature, scope and severity of how climate-related physical material risks could evolve? Does it map its exposure using base case, best-case (2°C) and worst-case (4°C) scenarios when doing this?
- c. What are the impacts of physical climate risks on depreciation and operational costs? How are internal and external audit processes incorporate these considerations into existing processes, including provisions and impairment exercises? Is the Audit Committee properly trained to oversee these aspects of the audit process?
- d. What are the key physical climate risks that could affect communities, ecosystems, and supply chains which our business depends, and how are these interconnected? What risks - market, reputational, competitive, litigation - do projected climate impacts raise vis-à-vis the company's strategic goals and day-to-day operations?
- e. Has the company assessed the broader systemic risk factors to which it is exposed?

^{iv} The differences in the physical impact between the two targets of the Paris Agreement - to keep mean global temperatures increase below well below 2 deg. C and aim for 1.5 deg. C - are significant. Of these temperature scenarios, the 2 deg. C scenario is the more precautionary for projecting physical risks. This scenario is also referred to in the Technical Annex to the TCFD Recommendations.

Opportunities



7. Has the Board identified the opportunities associated with physical climate impacts that have the potential to boost the accomplishment of strategic goals and increase value to shareholders and other stakeholders?

- a. What opportunities - market, operational, competitive, reputational - do projected climate impacts raise vis-à-vis the company's strategic goals and day-to-day operations?
- b. What opportunities could the company leverage more effectively than it currently does?

Liability



8. Has management identified instances where physical climate impacts could create or increase liability risks?

- a. How might the company or board be exposed to litigation or liability connected with a failure to adequately oversee, manage or disclose physical climate risks?
- b. Could the materialisation of a physical climate risk trigger a breach of environmental or health and safety regulations, licence terms, covenants and/or insurances?
- c. How do we proactively manage or provision for physical climate risks in our material contracts both upstream (procurement) and downstream?
- d. Does the company routinely diligence contracts (e.g. procurement, mergers and acquisitions, joint ventures, asset disposals) for liabilities potentially affected by physical climate risks?
- e. Have we integrated specialist climate risk modules into our due diligence procedures?
- f. Does our approach to force majeure and contractual risk allocation remain fit for purpose?

Metrics



9. How will the company measure success regarding its management of physical climate risks?

- a. What are the company's climate resilience targets?
- b. What are the company's success criteria regarding physical climate risk and what indicators are used to monitor these?
- c. Have we stress-tested our vision across different future warming scenarios?

Annex 1: Summary of the climate science for physical climate risks

What does the latest science suggest about current and future change to the climate?

The current concentration of greenhouse gases in the atmosphere (e.g. carbon dioxide) is the highest in over 3 million years. There is high confidence that human activity (e.g. burning of fossil fuels and land cover change) is the key driver of the unprecedented rate of increase in greenhouse gases and resulting temperature increase.⁴¹

The Earth's climate has warmed significantly over the last century, and human activities such as burning fossil fuels have already caused 1.0°C of global warming above pre-industrial levels.⁴² The rate of increase in average temperature observed over last century is unprecedented.

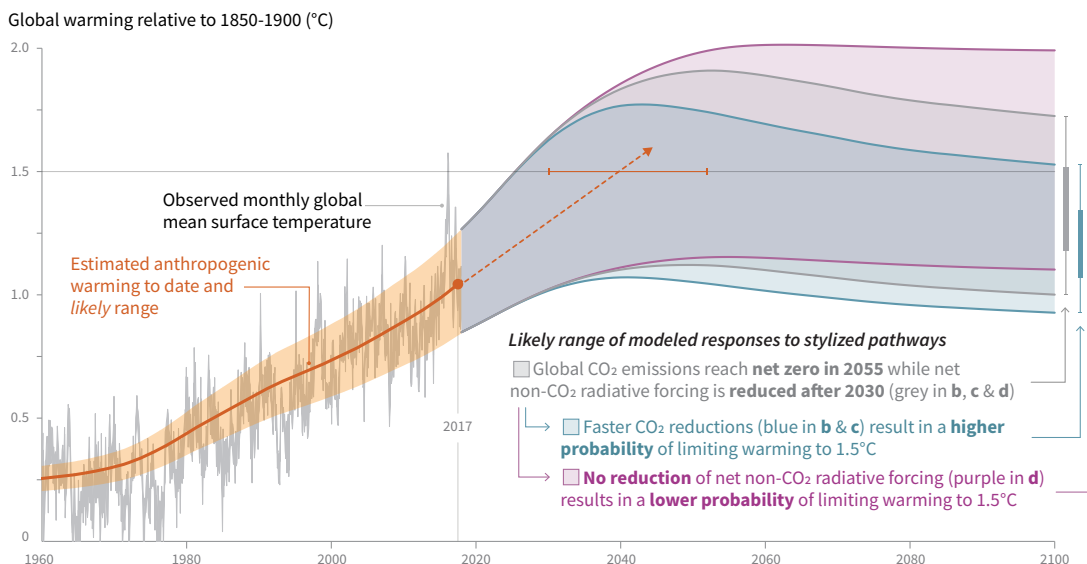
Recent years have been the hottest since direct temperature observations began (in the 1880s), and the six warmest years on record have all occurred since 2010.⁴³ This temperature increase influences the energy balance and exchanges around the world, and result in changes in the weather we experience. More frequent and more extreme weather and climate events are already being experienced, along with gradual shifts in other climate-related factors (rainfall patterns, sea levels, sea ice, glacial retreat).

Consequent changes in the climate system are locked into the earth's climate system over coming decades and centuries, regardless of the success and rate at which global GHG emissions are controlled. Sea level rise for example, will continue to increase for several hundred years even if we can stabilise the climate at 1.5 deg. C by 2040.

Global mean surface temperatures are set to increase by a minimum of 1.5°C above pre-industrial levels by 2040. This will mean unavoidable far-reaching consequences on social, human and natural systems⁴⁴. After 2040, there is less certainty about what will happen, as this depends on how quickly GHG emissions are reduced now (see Figure 1). If we continue with our current emissions trajectory, it is projected that global warming may reach up to 4°C by the end of the century with associated widespread impacts; within the lifetime of many children born today.⁴⁵

- Related **chronic impacts** include an increase in global precipitation over the 21st century, and 0.45 to 0.82m sea level rise by 2081–2100, among others; and
- More **heat extremes** are also expected, along with more intense individual storms and associated extreme precipitation events. Decreases in soil moisture and increased risk of drought are also increasingly likely in currently dry regions.⁴⁶

Figure 1: Temperatures are set to increase by a minimum of 1.5°C by 2030 with far reaching consequences on social, human and natural systems



Source: IPCC, 2018⁴⁷

The IPCC's^v 1.5 Special Report illustrates that whilst adapting to the impacts of 1.5°C is a challenge, it is far greater for a 2.0°C warming. See Box 4 for a review of what this additional half degree is projected to lead to.

Box 4: What is in half a degree? The impacts of 2°C warming

The IPCC's 1.5 °C Special Report⁴⁸ illustrates that whilst adapting to the impacts of 1.5 °C warming is a challenge, it is far greater for a 2.0°C warming. The additional 0.5 °C is projected to lead to:

- 37.9 million additional people exposed to river flooding;
- 0.06m higher sea levels;
- 10x higher frequency of Arctic ice-free summers;
- 2.6x larger share of the world's population exposed to severe heat at least once every five years;
- 1.5x larger reduction in corn harvest;
- 2x loss of species.

The report indicates that this additional half a degree of warming will have \$15 trillion in costs.⁴⁹

^v The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change, providing regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. For more information, please see: <https://www.ipcc.ch/about/>

Climate change is a complex issue, with inherent uncertainty about the timing, pace, tipping points, and severity of possible impacts. By responding to the risks and opportunities associated with future climate change methodically and comprehensively, investors can ensure they implement prudent and cost-effective actions, which ensures resilience and delivers strong financial returns even in the face of uncertainty.

Which hazards and impacts are associated with a changing climate?

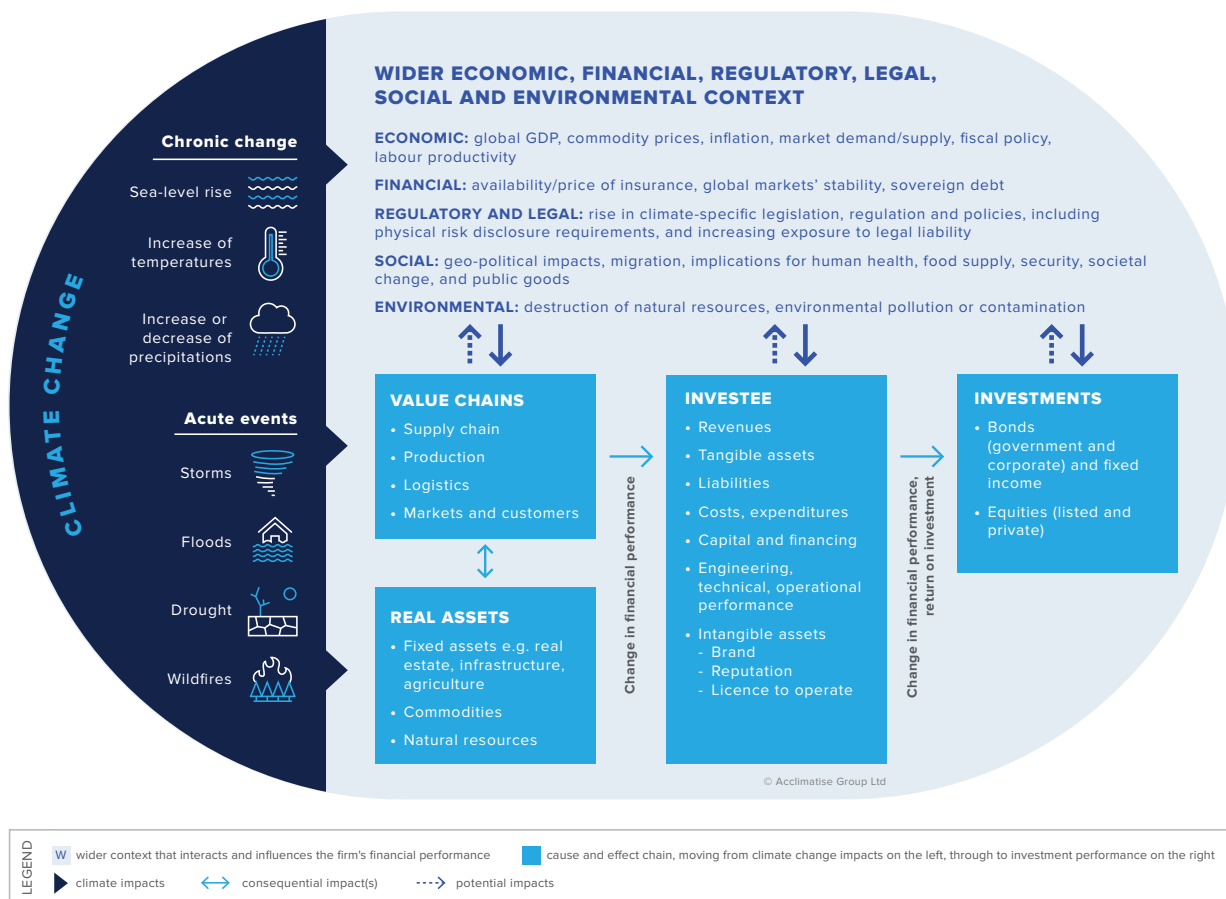
A changing climate can lead to changes in the frequency and severity of extreme or incremental hazards. The TCFD recommendations refer to these hazards as acute and chronic, respectively (Table 2). Acute hazards represent severe and extreme events and are location specific (e.g. droughts, heatwaves, storms, wildfire, etc). Chronic climate change represents the background incremental changes in, for example, temperature, precipitation, sea-level rise over several decades.

Table 2: Examples of acute and chronic climate-related hazards.⁵⁰

Acute	Chronic
<ul style="list-style-type: none"> • Storms (cyclones, hurricanes, typhoons) • Extreme rainfall • Extreme heat • Heatwave • Flood • Drought • Wildfires • Heatwaves <p>Example impact: loss of crops in the agricultural sector following extreme heat/precipitation.</p>	<ul style="list-style-type: none"> • Variability in precipitation • Variability in temperature • Water stress • Sea-level rise • Land degradation <p>Example impact: reduced river flow negatively affects the operability of hydropower facilities.</p>

Climate impacts that materialise through both chronic changes and acute climate events have both direct and indirect impacts on corporates. Real assets can be damaged and value chains disrupted, affecting their financial performance, e.g. revenues, costs and expenditures. Climate change may also affect the economic, financial, regulatory, legal, social or environmental contexts that corporates operate in, further influencing financial performance (Figure 2).

Figure 2: Climate change impacts and consequences for corporates



Source: Acclimatise, 2019

Due to the highly contextual nature of physical climate risks, it is challenging to provide a definitive assessment of the extent to which a sector, geography, company, or asset, etc. is riskier than others. Exposure is a function of both inherent vulnerability and proactive resilience measures. Physical hazards in a given region may affect various locations in that region differently. In turn, the actual exposures from these direct and indirect physical risks for one business may not be the same for another business in the same sector, due to their governance, strategic planning, risk management and ability to adapt and build resilience to the risk. Whether and when physical risks are recognised or priced will also differ depending on the asset class.

Primary economic activities are often particularly sensitive to the consequences of climate change due to their immediate dependence on the natural environment, however. Examples include agriculture, forestry, fishing, and extractive industries. Other particularly climatically sensitive sectors include water, electric power and transport.⁵¹ On the basis that they have the highest potential cost of insuring their physical assets, Schrodgers found that that oil and gas, utilities and basic resources are the sectors most exposed to the physical impact of climate change⁵². That analysis also identified the sectors least at risk are technology, personal & household goods and healthcare. However, these sector assessments can be misleading: other

recent analysis found that parts of the technology sector (e.g. Information and Communications Technology) are extremely vulnerable to high temperatures due to the increased need for cooling.⁵³ Similarly, healthcare including hospitals and care homes are extremely vulnerable to the health impacts of extreme events, e.g. the 2003 heatwave in Europe.⁵⁴ See Box 5 for a case study on how physical climate risks have played out for utility company PG&E in the Western United States.

Box 5: Physical climate risks cause substantial problems for PG&E

A bolt out of the west: what PG&E's woes mean for corporate climate governance

Failure to keep pace with the evolving physical risk landscape is not only triggering claims for loss and damage but leading to new types of climate litigation that seek to hold firms accountable for failing to address climate risks.⁵⁵

- Wildfires in 2017-18 sparked by the failure of PG&E, California's largest energy utility, to adequately maintain its equipment and vegetation led to it pleading guilty to 84 counts of involuntary manslaughter, settling \$25.5 billion in claims for damages including with shareholders and insurers⁵⁶, receiving the largest ever fine (\$1.8 billion) issued by the California Public Utilities Commission, and the downgrade of its credit rating to 'junk' status. Other utilities were tarnished by association, with ratings agencies downgrading other Californian utilities and investors.
- PG&E was reported by Forbes as the 'first of many climate change bankruptcies, attributable to the firm's failure to proactively manage physical climate-related risks, including those associated with increasing wildfire hazard driven by climate change⁵⁷.
- An important condition of PG&E's settlement is that the firm is required to reform its corporate governance to better manage to hazards such as wildfire in future.
- Firms benefitting from public support following (increasingly frequent) weather extremes, can expect settlements to require effective alignment of their management and oversight processes (including of climate risks) with current voluntary frameworks, such as the TCFD Recommendations.
- The example of PG&E demonstrates that the impacts of climate change pose an existential threat even to firms once viewed as 'perpetual investments', perceived as less risky and requiring less investor scrutiny⁵⁸.
- Proliferating climate risks in economically straitened times will inevitably constrain public resources available to support corporates in future emergencies. In such circumstances, governments are likely to adopt a more proactive stance in encouraging the green (resilience) bonds market, the removal of price and other distortions that promote risky activity, and mandate disclosure of material climate risks.

How are climate scenarios used to model and assess physical climate impacts?

Scientific institutions around the world develop climate models that numerically represent the components and feedback processes of the climate system. These models simulate the physical condition of the atmosphere, land, and oceans in response to changes in composition of the Earth's atmosphere and other parameters. The skill of each model in simulating historical climate change - and climatic change in response to increasing emissions - can be validated against observations. Climate scenarios are not forecasts or predictions, and in turn stress-testing business models against future climate scenarios is not a prediction of future performance, but rather a 'tool to enhance critical strategic thinking'.⁵⁹

Models skill varies, with some models stronger in some regions than others. Models are, however, constantly being refined and updated, and they have been largely correct in the predicting the warming observed during past decades; a level consistent with that projected by the 'worst-case' climate scenario (RCP 8.5).^{vi} Successfully modelling historical climate change provides confidence in being able to project future change, even though uncertainties remain, especially over longer future time-scales, for parameters such as precipitation and wind over longer timescales, extremes (e.g. floods and cyclones), and tipping points in the climate-ocean system.

Physical climate impact assessments integrate climate change projections and responses of natural and human systems to such projected changes. Outputs from climate models are the main data source for deriving climate change projections, or climate change scenarios.^{vii} Climate models use, as key inputs, estimates of atmospheric concentration of greenhouse gases as provided in RCPs. RCPs prescribe alternative GHG concentration (not emissions) trajectories and have been adopted by the IPCC for its most recent Assessment Report (AR5). Four particular RCPs, describing contrasting but plausible climate futures, have been selected for climate modelling and research: RCP2.6, RCP4.5, RCP6, and RCP8.5.^{viii} Driven by RCPs and other datasets, climate models simulate, in an internally consistent manner, changes in a wide range of climatic variables (e.g. temperature, precipitation, wind speed) throughout the 21st century and beyond.

To assess impacts of projected changes in climate variables, the ways that economic sectors and activities respond to changes in climatic conditions are studied, in either a statistical (e.g. econometrics) or process-based (e.g. crop modelling) manner.

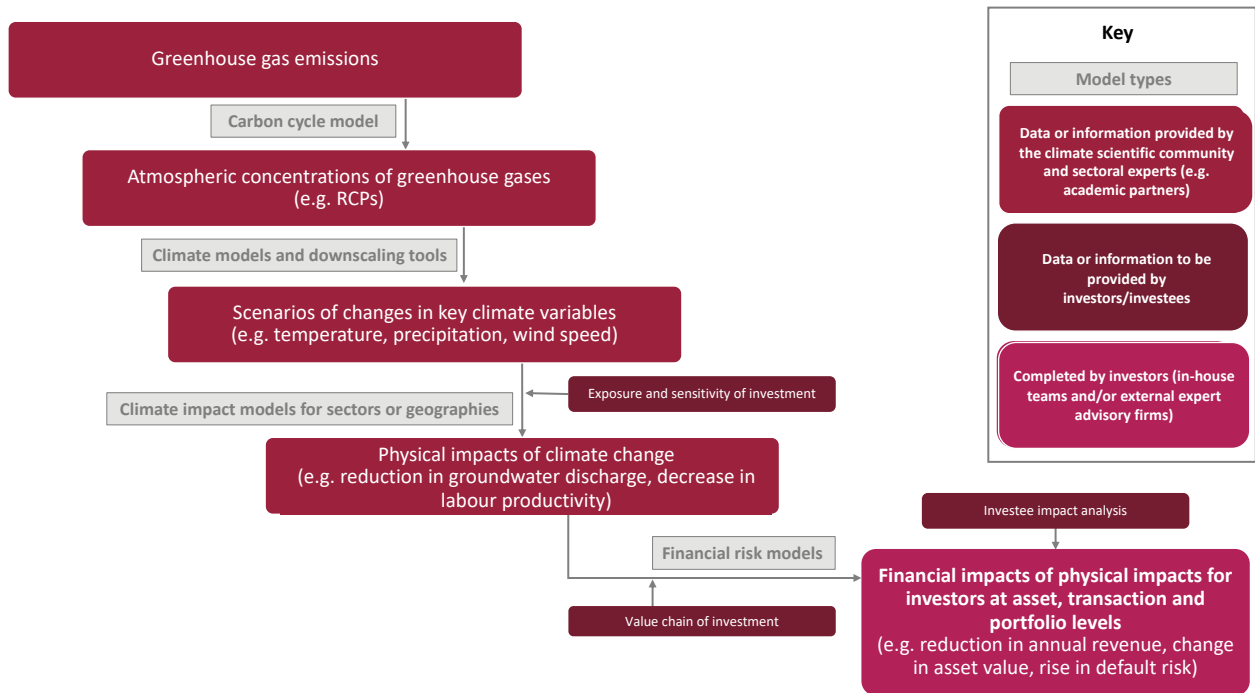
Figure 3 provides a stylised overview of this modelling chain, showing how RCPs are interpreted into expected physical climate impacts. As shown in the figure, much of the modelling and analysis will be completed by the climate scientific community, which will then need to be translated into impacts by investors, corporates, and / or their external advisors.

vi A scenario is a story or image that describes a potential future, developed to inform decision making under uncertainty. A scenario is not a prediction of what the future will be but rather a description of how the future might unfold.

vii Climate change scenarios can also be developed from other sources/methods, for example, by synthetically adjusting baseline climatology (e.g. +0.5, 1.0, 1.5oC to annual average temperature; + or - 5%, 10%, 15% of annual rainfall amount for a particular location), or stochastically generated from observed climate.

viii RCPs are labelled after a possible range of radiative forcing values in the year 2100: 2.6, 4.5, 6.0, and 8.5 W/m², respectively. In turn, these four RCPs are associated with a range of average global annual temperature rise (scenarios) in the year 2100 with respect to 1986-2005: ~ 1.0, ~1.8, ~2.2, and ~3.7oC, respectively. See Chapter 6 for more information on selection of scenarios and RCPs for use in physical risk assessment.

Figure 3: Stylised overview of how RCPs and other climate data and information are translated into expected physical climate impacts



Source: Acclimatise, 2020

To assess the economic and financial impacts of climate change, climate data (e.g. observational and climate projections) needs to be combined with other data sets and information (e.g. financial, business and market data, and wider socio-economic data). Climate model outputs based on RCPs are used to analyse how different climate scenarios may affect various sectors of the economy or regions of the world. Climate model outputs, for example, are combined with asset-level data, e.g. exposure and sensitivity data, including location, quality, or critical thresholds data. Together, this information can develop climate impact assessments (also called climate risk assessments or impact modelling). Financial modelling then allows for impact assessments to capture how physical climate change can impacts have financial impacts, e.g. how an economy is impacted through changes in yield and price of agricultural commodities, or how property values in locations exposed to extreme weather events will be impacted.

The TCFD Recommendations suggest the use of multiple scenarios when assessing and managing physical climate risks, including the so-called 2°C scenario; equivalent to the use of RCP 6.0 or RCP 8.5 (see Table 3).

Table 3: Equivalent average change (deg. C) in global mean temperature at 2050 and 2100 projected by different RCPs and current warming above pre-industrial levels.

Representative Concentration Pathway (RCP)	Equivalent average change in global mean temperature (2050 wrt 1850-1900)	Equivalent average change in global mean temperature (2100 wrt 1850-1900)
2.6	1.6°C	1.6°C
4.5	1.9°C	2.4°C
6.0	2°C	2.8°C
8.5	2.3°C	4.0°C
Increase in global average temperature above pre-industrial levels (2019)	1.1°C	

Source: Acclimatise, 2020.

Annex 2: An evolving climate risk governance landscape

While the practice of climate risk analysis and disclosure develops, regulatory and supervisory bodies are considering or developing mandatory frameworks which include physical climate risk considerations⁶⁰.

Country-level climate risk disclosure frameworks are also now established in some jurisdictions and unfolding in others, e.g. France, the UK and New Zealand. The following list provides a non-exhausted set of examples:

- UK: The UK released a green finance strategy in 2019, which sets out for the UK government's expectation for all listed companies and large asset owners to disclose in line with the TCFD recommendations by 2022;⁶¹ The Bank of England has set out its expectations of climate risk management for regulated financial institutions in Supervisory Statement 3/19 and issued a climate risk stress test in 2020 (currently delayed until 2021 due to the COVID-19 pandemic)⁶², and the Financial Conduct Authority has published proposals requiring mandatory TCFD disclosures on comply-or-explain basis for premium listed issuers.⁶³
- Canada: The continuous disclosure regime set out in National Instrument 51-102 Continuous Disclosure Obligations (NI 51-102) requires reporting issuers in Canada to disclose material risks affecting their businesses and, where practicable, the financial impacts of such risks in their annual information form (AIF) and management's discussion and analysis (MD&A).⁶⁴ Large companies receiving Canadian government support during the Covid-19 pandemic through the Large Employer Emergency Financing Facility will be required to publish annual TCFD reports, including disclosures on how their future operations will support environmental sustainability and national climate goals for net zero by 2050.⁶⁵
- Australia: In August 2019, the Australian Securities and Investments Commission (ASIC) released its revised Regulatory Guides 228 and 247, to incorporate the types of climate change risk described by the TCFD into the list of examples of common risks that may need to be disclosed in a prospectus to highlight climate change as a systemic risk that could impact an entity's financial prospects for future years and that may need to be disclosed in the operating and financial review in an annual report..⁶⁶ The Australian accounting and auditing standards boards have published guidance on climate risk assumptions in accounting estimates and in the financial statements, bringing climate risk disclosures within the remit of external audit scrutiny.⁶⁷
- New Zealand: In October 2019, the New Zealand Government released a Discussion Paper outlining mandatory principles-based disclosure of climate risks for all companies.⁶⁸
- Italy: July 2018 the Italian insurance supervisor IVASS released a comprehensive reporting requirement for Environmental Social Governance (ESG) risks, including climate change.⁶⁹

The Australian accounting standards guidance is particularly significant, and the issue was taken up by the International Accounting Standards Board in a November 2019 article explaining how existing requirements within IFRS Standards relate to climate change risks.⁷⁰

Other prominent initiatives include the Network of Central Banks and Supervisors for Greening the Financial System (NGFS),⁷¹ and the body of work taking place under the EU Action Plan on Sustainable Finance.⁷²

The Network for Greening the Financial System (NGFS), is indicative of this progress as a global coalition of central banks and supervisors. As of 2020, the NGFS has 66 central banks and supervisors and 12 observers, which represent five continents, half of global greenhouse gas emissions and the supervision of over two thirds of the global systemically important banks and insurers⁷³. The network shares best practice and contributes to the development of environment and climate risk management in the financial sector and to mobilise mainstream finance to support the transition toward a sustainable economy. The NGFS has called on central banks and supervisors around the world to integrate climate risks into their supervisory and financial stability mandates and their own risk management practices and policies. To assist, it has published a guide to climate scenarios with three reference scenarios (orderly, disorderly and hot house world) and five alternate scenarios exploring different assumptions of temperature targets, policy responses and technology pathways to facilitate more robust analysis.⁷⁴

The EU has been active in developing tools like the EU Taxonomy and regulations that will drive the need for financial institutions to understand their climate risks and opportunities. The Taxonomy is a tool to help plan and report the transition to an economy that is consistent with the EU's environmental objectives⁷⁵. Banks can use the Taxonomy to identify which of their activities are already contributing to climate adaptation (i.e. addressing physical risks), and to screen new investments. The European Commission has also published new guidelines on reporting climate-related information, that reflect and integrate the recommendations of the Taskforce on Climate-related Financial Disclosures (TCFD).⁷⁶

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Chapter Zero is a network of non-executive directors, currently with more than 860 members, providing information, support and guidance to put climate change firmly on the Boardroom agenda. It is part of the World Economic Forum Climate Governance Initiative.

Chapter Zero supports the non-executive community in enhancing its knowledge, understanding and experience of this complex and critical business challenge through providing learning events with experienced speakers where members can build their knowledge and their network; toolkits and other resources which facilitate boardroom discussion; and access to relevant content.

We have been delighted to partner with Acclimatise to create this guidance, drawing upon their knowledge of physical climate risk and resilience building. For more information, please visit www.chapterzero.org.uk