



°CMSI

Climate Measurement Standards Initiative

Scenario analysis of climate-related physical risk for buildings and infrastructure:
Financial disclosure guidelines & climate science guidance

SUMMARY FOR EXECUTIVES

Task Force on Climate-Related Financial Disclosures

The Task Force on Climate-Related Financial Disclosures (TCFD) has developed a set of recommendations that companies can use to disclose information about climate risks. The disclosures include physical, liability and transition risks.

The TCFD recognises that incorporating scenario analysis into strategic planning processes will improve over time as organisations ‘learn by doing’. To facilitate progress, the TCFD encourages the following:

- further developing 2°C or lower transition scenarios that can be applied to specific industries and locations along with supporting outputs, tools, and user interfaces
- developing broadly accepted methodologies, data sets, and tools for scenario-based evaluation of physical risk by organisations
- making these data sets and tools publicly available to facilitate use by organisations, reduce costs, minimise expertise differences between jurisdictions, enhance comparability of climate-related risk assessments, and help ensure comparability for investors
- creating more industry specific (financial and non-financial) guidance for preparers and users of climate-related scenarios.



Climate Measurement Standards Initiative

The Climate Measurement Standards Initiative (CMSI) is an Australian industry-led collaboration established to assist with, and support, climate-related financial disclosures. CMSI involves insurers, banks, scientists, reporting standards professionals, service providers and supporting parties.

To determine the physical risks in a credible and comparable way, Australian companies need reliable information for scenario analyses. CMSI is developing technical, business and scientific standards for climate-related physical risk projections of the future costs of repairing and replacing Australian buildings and infrastructure.

By bringing together leading industry, scientific and financial experts, CMSI hopes to increase Australia's ability to address climate change by enabling companies to make informed, scientifically robust, strategic decisions.

Specifically, CMSI aims to develop open source standards and guidelines that will provide companies with:

- a consistent approach to disclosure under the TCFD, so that disclosure by each company adopting the standard is comparable
- increased confidence in disclosures, as the standards will be supported by science from Australia's leading climate experts
- a potential framework should regulators decide to mandate disclosures
- a roadmap for future research and development aligned with disclosure requirements
- guidance on issues relevant to specific industries
- guidance that will allow smaller companies to disclose their climate change scenarios
- lower likelihood of unintentionally adopting non-standard approaches
- modelling requirements that support provision of transparent advice to industry.

Scope and application of the CMSI recommendations

Table ES1: Scope of CMSI Phase 1

	In scope	Likely future scope
Purpose	<ul style="list-style-type: none"> • Disclosure of TCFD scenario analyses 	<ul style="list-style-type: none"> • Stress testing and vulnerability testing • Other types of analysis
Analysis	<ul style="list-style-type: none"> • Scenario specification 	<ul style="list-style-type: none"> • Stress testing including compound events • Sensitivity analysis • Modelling exposure changes • Modelling vulnerability changes • Developing data sets
Climate-related risks	Physical risk	Transition risk
Hazards	<p>Acute physical risks:</p> <ul style="list-style-type: none"> • Tropical cyclones • East coast lows • Extreme rainfall and riverine floods • Extreme sea level events • Large hail • Extreme bushfire events <p>Chronic physical risks:</p> <ul style="list-style-type: none"> • Average temperature and extreme heat events • Average rainfall • Sea level rise • Drought 	<p>Acute physical risks:</p> <ul style="list-style-type: none"> • Storm surge and coastal flooding <p>Transition risks:</p> <ul style="list-style-type: none"> • Technology • Policy and legal • Market • Reputation
Impacts	<ul style="list-style-type: none"> • Damage to property (buildings and infrastructure) 	<p>Physical risks:</p> <ul style="list-style-type: none"> • Loss of use of asset • Loss due to cross-dependency on other assets • Health and human impacts • Agriculture and other sectors <p>Macroeconomic impacts from both physical and transition risks</p>

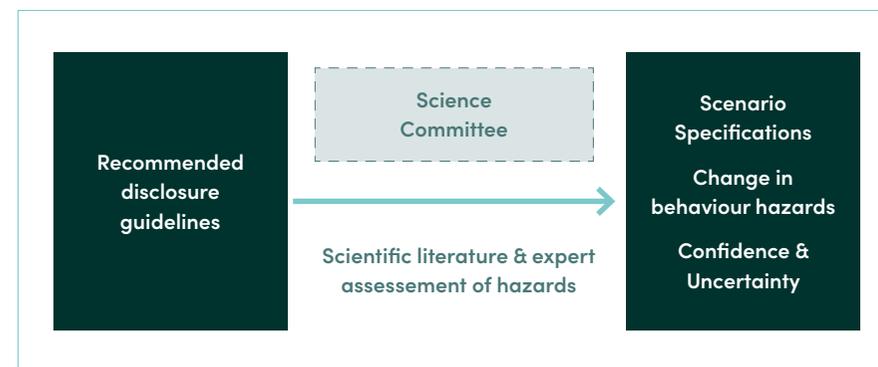
Scope and outputs

In its first phase, the CMSI has recommended **financial disclosure guidelines** and developed **scientific scenario specifications** for the purpose of disclosure of scenario analyses for climate-related physical damage to buildings and infrastructure. It considers a wide range of chronic and acute risks for the general insurance, banking and asset owner sectors. These guidelines and specifications are **open-source and voluntary**.



The **financial disclosure guidelines** seek to develop a common interpretation of the TCFD recommendations, considering the decision useful information for users of TCFD and the reporting practices of these sectors. The disclosure guidelines aim to improve comparability of disclosures in this specific area. These recommendations are considered in detail in the [Financial Disclosure Guidance Report](#).

Importantly, the financial disclosure guidelines build on a specific use case for the TCFD recommendations, and do not seek to provide general guidance on the development and disclosure under the TCFD recommendations. They should be read in conjunction with the recommendations and other guidance provided by the TCFD.



The **scientific scenario specifications** have been prepared based on a review of current scientific literature and independent expert assessment on the expected change in behaviour of physical risks under the climate scenarios recommended in the financial disclosure guidelines. These scenarios are summarised in Table TS1 and TS2 of the [Climate Science Guidance Report](#). The specifications aim to ensure that disclosures are based on the best available science, and to improve the comparability of disclosures.

In developing these scenarios, the CMSI’s science committee have focused on the **change in behaviour of extreme events**, as these are the phenomena that cause damage to buildings and infrastructure.

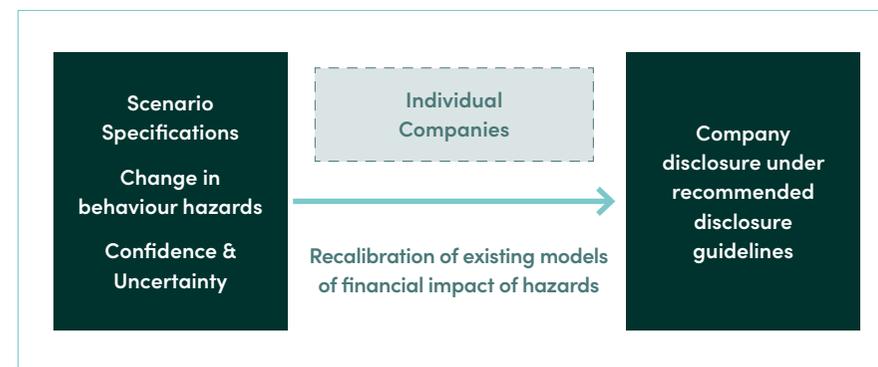
Importantly, the scientific scenario specifications also incorporate the level of scientific **confidence and uncertainty**, based on an assessment of current scientific knowledge.

Applications—Recalibration of existing models

Companies seeking to apply the recommended financial disclosure guidelines and scientific scenario specifications will need to adapt their existing models of the financial impact in line with the specifications set out in Tables TS1 and TS2 of the [Climate Science Guidance Report](#), and then to disclose the results according to the guidelines in [Financial Disclosure Guidance Report](#).

Companies will also need to consider aspects of reporting under the TCFD recommendations that are not in scope of the current CMSI reports, including:

- Considering relevant potential risks and impacts under the scenarios that are not in scope of the scientific scenario specifications—for example, transition risks and opportunities under a below 2°C global warming scenario.
- Developing company specific strategies to address climate-related risks and opportunities and to test their resilience under the scenarios—for example adaptation strategies to improve the resilience of buildings and infrastructure within the company’s portfolio.
- Considering the disclosure of Governance, Risk Management, other aspects of Strategy and Metrics and Targets as set out in the TCFD recommendations.

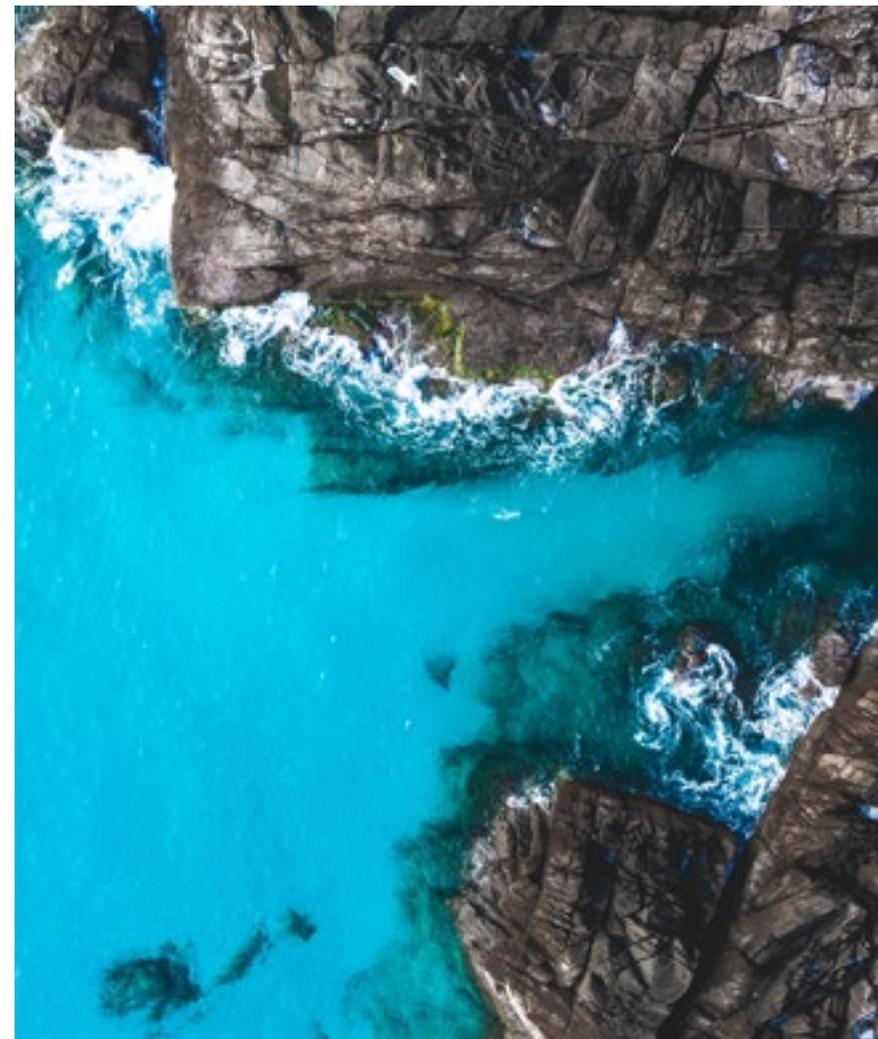


Climate science findings

Stakeholder engagement indicated that weather- and climate-related risks arise from tropical cyclones, floods, hailstorms, fires, droughts, heat and coastal inundation. Key timeframes of interest are up to five years in the future, 2030, 2050 and 2090. In line with the TCFD requirements, two warming scenarios were considered – a low case representing warming of less than 2°C, and a high case representing warming of greater than 2°C.

Table ES2: Attributes of low and high greenhouse gas emission scenarios

Sector	Carbon dioxide emissions	Likely global SSP*	Global warming relative to 1850-1900**	Transition risk	Physical risk
Low case	Net zero by around 2070 (RCP2.6)	Sustainability (SSP1)	1.3–2.2°C by 2050 0.9–2.4°C by 2090	Higher challenges	Lower challenges
High case	High and accelerating (RCP8.5)	Fossil fueled development (SSP5)	1.8–3.0°C by 2050 3.2–5.4°C by 2090	Lower challenges	Higher challenges



* There is an emerging system of socio-economic pathways (SSPs) that can be related to different RCPs.

** CMIP5 models reported in IPCC (2013), but new generation climate modelling suggests that even greater warming late in the century than cited here can't be ruled out (see Grose et al. 2020).

Climate risks

There are three factors that determine the climate, and hence physical climate risks, in future scenarios: ongoing natural climate variability; global socio-economic development and resulting emissions of greenhouse gases and aerosols; and the regional climate responses to these emissions.

Determining the likely impact of climate change requires an understanding of past variability and its impacts. Researchers need to assess sensitivity of buildings and infrastructure to weather and climate extremes, as well as determining damage thresholds.

Using the lowest and highest international-standard scenarios for atmospheric greenhouse gas concentrations, known as representative concentration pathways (RCPs), provides the range of future climate possibilities, and meets international TCFD guidelines. RCP 2.6 aligns with low emissions and has a 2-in-3 chance of staying below 2°C global warming by the end of the century relative to the preindustrial period (1850-1900). RCP 8.5 aligns with high emissions and projects 3-5°C (or more) global warming by the end of the century.

There is an emerging system of socio-economic pathways (SSPs) that can be related to different RCPs. The most likely for RCP 2.6 is 'Sustainability' (SSP1), predicated on a gradual but pervasive shift towards sustainable development. The most likely SSP for RCP 8.5 is 'Fossil-fuelled development' (SSP5), with rapid economic growth and a strong reliance on fossil fuels.

Researchers use multiple lines of evidence to assess observed and projected climate change, presenting the latter as plausible ranges of change. Assessments of the confidence in projected changes are consistent with approaches recommended by the Intergovernmental Panel on Climate Change (IPCC).

The climate science report presents projected changes for 2 categories of climate hazards that can damage buildings and infrastructure:

- 1 Acute—extreme weather events including changes in tropical cyclones, east coast lows, extreme rainfall, hail, storm surges and fire weather, with confidence ratings presented for RCP 2.6 and RCP 8.5 for 2030, 2050 and 2090.
- 2 Chronic—gradually emerging aspects of climate risk, including changes to annual average temperature, rainfall and sea level, time in drought and days over 35°C. These are also presented for RCP 2.6 and RCP 8.5 for 2030, 2050 and 2090.

Chronic physical risks, such as sea-level rise and temperature increases, are likely to exacerbate losses from acute physical risks such as tropical cyclones, storms, flooding, coastal inundation and erosion, as well as heat waves and drought-caused soil contraction. These risks, and the compounded multiple hazards, will increase with climate change.

Future climate hazards

The climate of Australia is virtually certain to get warmer, with increased impacts from heat extremes. Ongoing drying of the climate of much of southern and eastern Australia is likely. Other threats to buildings and infrastructure include ongoing sea-level rise and an increase in extreme weather events such as short-duration heavy rainfall (Figure ES1).

Tables TS1 and TS2 in the Climate Science Report provide quantified details of these changes at each point in time under both the low and high case, including any important regional variations, together with confidence estimates and ranges for each change.

These details are also summarised in the [CMSI Technical Summary](#).

Figure ES1: Projected changes in climate hazards that influence physical risks for Australian buildings and infrastructure. Confidence estimates are provided in parentheses.



Vision and roadmap for future work

CMSI's vision is for a resilient finance, insurance, banking and investment sector with understanding of climate change embedded into rigorous assessment and disclosure of risk at the institutional level.

The ideal is for climate risk information to be based on a comprehensive, fully evaluated set of high-resolution climate projections. These should depict all the relevant hazards and phenomena of interest with high confidence and narrow ranges of spread in future change, with a full description of natural variability in the hazards. This includes useful projections of averages, 'moderate' extreme events and 'major' extreme events that have the greatest impacts. The full range of required information should come from delivery platforms that are accessible, quality-controlled and available for commercial purposes. Information would be at spatial and temporal scales relevant to assessing climate risks, extending from the present to a century into the future, with implementation supported by climate services.

There are limitations to consistent analysis of climate risk for disclosures. Hence improvements to weather and climate data, information and services are needed. Achieving the CMSI vision requires investment in short-term actions (the next 1-3 years) and longer-term actions (next 10 years).

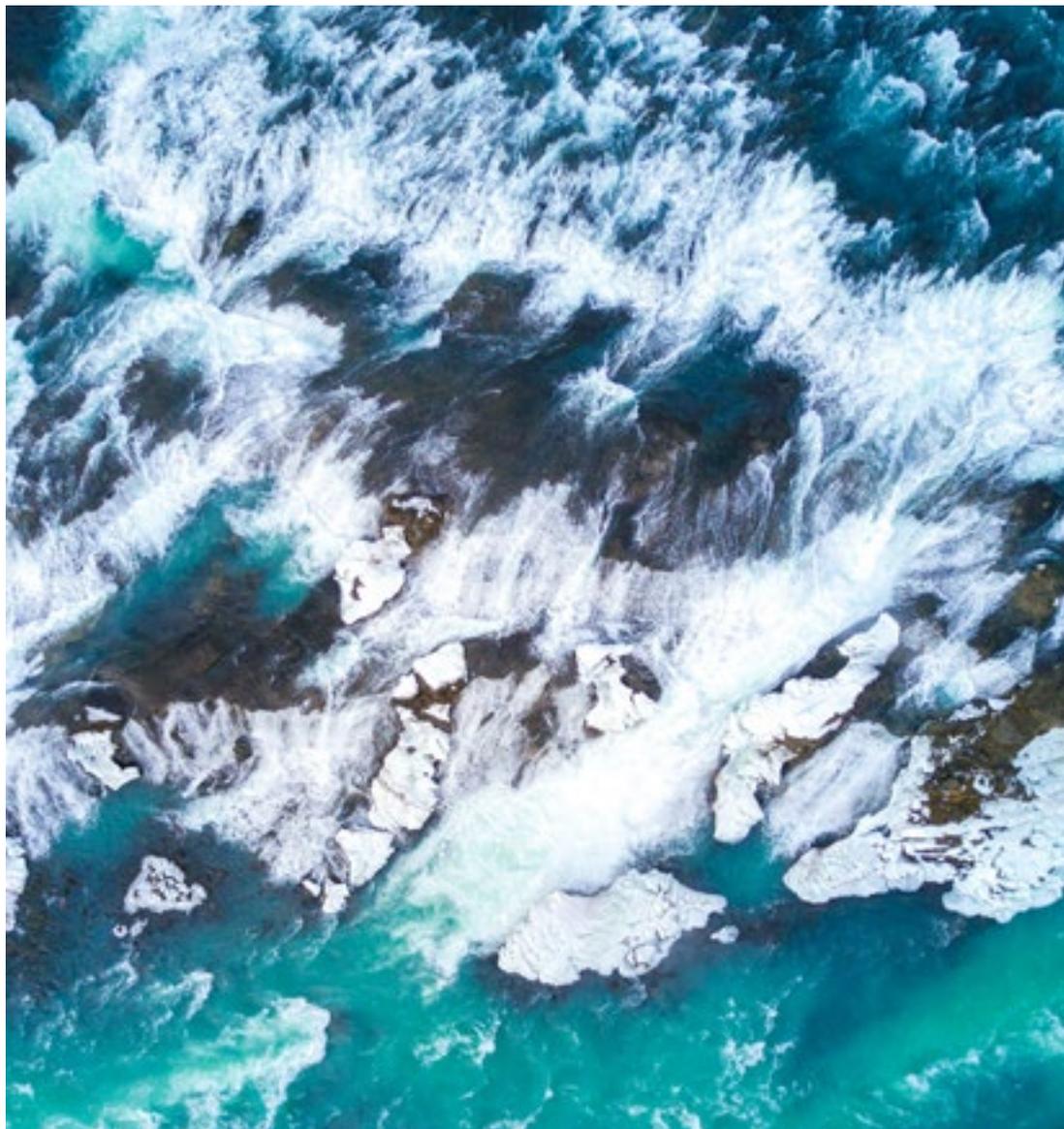
Short-term actions

- Collect feedback on CMSI guidelines and update them, including the use of the most recent climate observations and projections.
- Compile and quality-check observations of climate hazards, including their extremes.
- Evaluate present-day simulations of extreme climate hazards.
- Analyse future changes in extreme climate hazards.
- Analyse recent compound events.
- Perform Coupled Model Inter-comparison Project phase 6 regional climate projections for Australia.
- Implement climate services that support uptake of hazard projections in impact assessment, planning and action.

Longer-term actions

- Improve observation systems for extreme climatic hazards.
- Improve understanding and modelling of extreme climatic hazards.
- Assess likely future changes in compound events.

The finance committee report describes the CMSI and its objectives and scope, and relevant aspects of the TCFD report, along with recommendations. The recommendations are summarised overleaf.



Risk disclosure recommendations

In examining physical risks resulting in damage to Australian buildings and infrastructure, the finance committee considered the following questions:

- 1 What are the 'short, medium and long terms' in relation to the CMSI scope? What are the 'life of the assets' for insurers, banks and asset owners in relation to buildings in Australia? What is the 'profile of climate physical risks' in relation to buildings in Australia? How do these vary across Australia?
- 2 Should disclosure be based on current or future portfolio exposure? If future exposure is to be used, how should assumptions on portfolio growth or contraction be developed?
- 3 What sectoral splits of information should be provided? For example, by type of peril or by region?
- 4 What inflation and discounting assumptions should be used in estimating the cost of damage to buildings and infrastructure?
- 5 How should uncertainty in the results be described?
- 6 What high level scenarios should be considered?
- 7 In TCFD recommendation strategy (c), how should 'resilience' be interpreted and how should entities disclose this?
- 8 What expense, revenue, asset and liability items should banks and insurers reveal when disclosing financial impact?

The finance committee has developed 7 recommendations for Australian banks, general insurers and asset owners disclosing climate-related physical risks scenarios under TCFD.

RECOMMENDATION 1:**Scenarios for physical risk disclosures under TCFD**

Disclosures should be made under the following RCP scenarios:

- for a 2°C or lower scenario, RCP 2.6
- for a greater than 2°C scenario, RCP 8.5.

In forming their recommendation, the committee considered the TCFD guidance and technical supplements, including the scenario design criteria; compatibility with climate-related transition risk disclosures; scientific research on scenarios; and challenging scenarios that tested the boundaries of potential climate-related physical risk.

There is significant scientific work on regional climate change and extreme weather events for each of the RCPs, so they provide a useful way of framing scenarios. RCP 2.6 gives a 2/3 probability of limiting global warming to below 2°C by 2100 and is the only available and widely-used physical-risk scenario compatible with the less than 2°C target.

RECOMMENDATION 2:**Time periods for scenarios**

Disclosure of the financial impact of climate change under each scenario should be made for 2030 and 2050. In addition, disclosers should also consider disclosing the financial impact for timeframes within the next 5 years (to align with business planning), and 2090.

This recommendation is based on the TCFD guidance. The lifetime of assets and liabilities exposed to climate change varies between 1 and 30 years depending on the sector. The recommendation accounts for the profile of climate-related physical risks and available data, the importance of 2050 as a date for achievement of the Paris Agreement (reducing greenhouse gas emissions to net zero) and shorter-term management decisions.

The committee considered opinions from investment managers and environmental, social and governance analysts. Some had a short time horizon in considering investing in banks and general insurers; in many cases, one year. Others were interested in the strategies that these companies deployed in order to manage longer-term climate risks and opportunities.

The committee recommended considering disclosing for timeframes within the next 5 years in order to take account of a shorter-term horizon, noting that physical impacts will be far smaller than at longer durations. Given the availability of data on scientific impacts for 2090, this was the recommended date for consideration in disclosures on a very long timeframe.

RECOMMENDATION 3:**Portfolio assumptions**

Disclosures should include a static scenario for both cases outlined in Recommendation 1, which assume that the existing portfolio of assets or liabilities potentially exposed to climate risk remains static over time, with no changes in the vulnerability of the assets or liabilities due to adaptation or resilience measures. Where additional scenarios are disclosed based on changes in portfolios over time, underlying assumptions made on exposure changes and the impact of adaptation or resilience measures should also be disclosed.

Insurers traditionally consider risks arising from weather-related events in terms of exposure, hazard and vulnerability. Exposure arises from property location, value and building features. Hazard depends on the type of extreme weather, locations affected, frequency and severity. Vulnerability is the relationship between hazard and financial loss, such as the cost of damage to a building relative to its value given a hazard of a particular severity. Vulnerability depends on building design and materials, and any risk mitigation measures taken.

Climate change is expected to change hazards associated with physical risks, but not directly influence exposure and vulnerability. Indirectly, increasing hazard may incentivise action to construct more resilient (less vulnerable) buildings and to build in less hazard-prone areas.

Companies will make different assumptions about future growth and vulnerability depending on their strategies and target markets. The recommendation that disclosure is based on the assumption of a static portfolio is made to allow comparability between companies within a sector.

Under the TCFD recommendations, companies disclose the resilience of their strategy to climate-related risks and opportunities under the different scenarios. In forming their strategy, companies could, for example, consider strategies that avoid high-risk areas. In such cases, the committee recommends that companies disclose details of the assumptions used to derive the changes in portfolio over time.

RECOMMENDATION 4:**Sectoral splits**

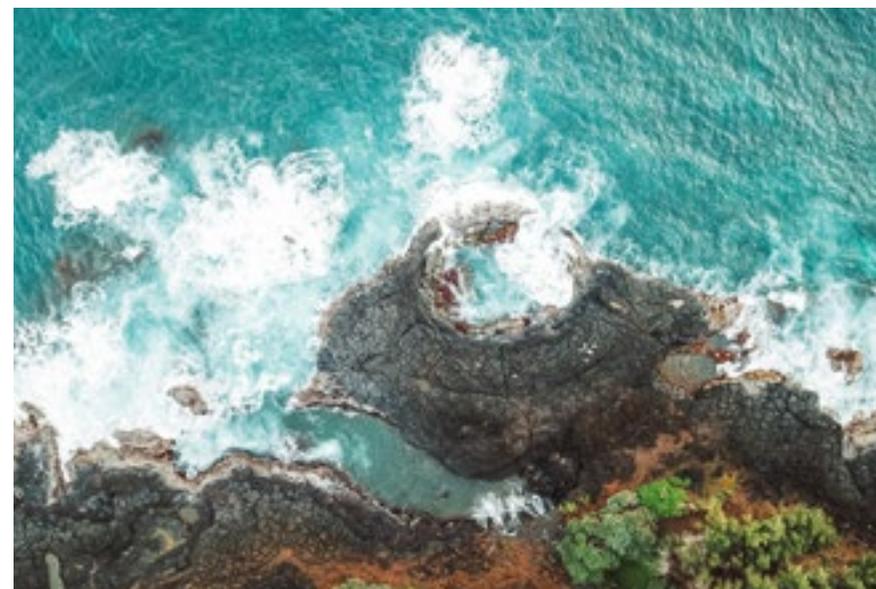
As well as in aggregate, disclosures should also consider the following sectoral splits where they are material to the business:

- by portfolio (for example, home loans, commercial loans, commercial insurance, personal insurance)
- by hazard (for example, tropical cyclones, floods, convective storms and hail, coastal inundation, bushfire, soil contraction)
- by geographic region.

Any material climate-related physical risk exposures that have been excluded from the above analyses should be disclosed together with reasons for the exclusion.

The committee made its recommendation based on the importance of materiality, acknowledging that not all hazards may be material to a particular company or industry sector, and each discloser should consider the relevant sectoral splits. The actual sectoral splits will vary by company, and allows them to retain sensitive commercial information and protect privacy.

There is considerable uncertainty about the impact of climate change at a regional level. Providing disclosure at too fine a resolution may give the impression of greater certainty and higher confidence than the science justifies. Accordingly, individual disclosures should make their own determination of the appropriate geographic resolution.



**RECOMMENDATION 5:
Accounting items**

Material impacts to the following accounting items and metrics at each future time period for disclosure (Recommendation 2) should be disclosed. Where relevant, accounting items should be disclosed in line with existing financial reporting accounting standards adopted by the discloser.

	Banks	General Insurers	Asset Owners
Balance sheet	Loans to firms and households Provisions for loan impairment	Outstanding claims Reinsurance recoveries on outstanding claims	Total value of investments Values of investments in physical infrastructure and/or other real estate
Income statement	Loan impairment charges	Gross incurred claims Reinsurance recoveries on incurred claims Gross premium income Reinsurance expenses	Adjustments to the value of income from investment in physical infrastructure and/or other real estate
Other metrics	Impact on probability of default Impact on loss given default	Portfolio Annual Average Losses for weather-related events Portfolio Annual Exceedance Probabilities for 1 in 100-year events Portfolio gross and net of reinsurance Probable Maximum Losses for 1 in 200-year weather related events	Overall % of value of investments subject to material physical risk

Where inflation and discounting assumptions are material to the results of the scenario analysis, preparers should disclose inflation and discounting assumptions used in the calculation of the disclosed accounting items and metrics, and disclose reasons for any differences in these assumptions compared to those used in financial reporting disclosures.

The TCFD guidance recommends that insurers disclose the impact on revenues, expenditures and assets and liabilities, and that banks and asset owners consider the impact on revenues and assets and liabilities.

RECOMMENDATION 6:**Uncertainty**

Disclosures should describe both the confidence and uncertainty in the critical assumptions made regarding the impact of climate change on hazards driving physical risk losses under each scenario. Uncertainty and confidence are based on the IPCC descriptions:

- uncertainty—a quantitative range associated with each assumption
- confidence – a qualitative assessment of the scientific evidence supporting the assumption.

Disclosures should place the uncertainty and confidence in the physical risk assumptions in context with other non-climate related assumptions used within the scenario analyses, such as financial models used to derive financial impacts, and assessing the resilience of strategies to manage climate-related risks and opportunities.

The CMSI climate science report describes critical physical risk assumptions for scenario analyses and their associated uncertainty and confidence, and disclosers may reference this report in providing the above disclosure.

The finance committee made its recommendation based on the sources of uncertainty in the scenario analysis process, the TCFD recommendations, the information that should be disclosed, and the scientific approaches used to describe uncertainty.

In summary, there are 2 sources of uncertainty related to climate-related physical risk: future emissions, and changes to climate (including extreme events). The remaining 2 (financial impact of extreme events, and impact on strategy) are uncertainties that companies face regardless of climate change.

The finance committee determined that the sources of uncertainty related to climate-related physical risk should be disclosed through the choice of RCP, and through quantitative and qualitative disclosure of the uncertainty and confidence used in the critical assumptions for changes in extreme events under the emissions scenario. Assessment of resilience should be disclosed through qualitative descriptions.

RECOMMENDATION 7:**Resilience**

The finance committee did not provide a recommendation on how resilience should be disclosed, and instead has provided commentary on some factors that could be used in assessing the resilience of different strategies. As practice matures over time, this question could be reconsidered in order to improve comparability of disclosures.

The committee considered the following factors as relevant to assessing the resilience of different strategies:

- High risk assets and liabilities—to what extent did the resulting portfolio include high risk assets, such as high loan-to-value ratios or assets with high vulnerability to extreme events? Where the company was able to set a threshold for high risk, this would allow quantitative disclosure.
- Portfolio concentration—portfolios containing significant risks in particular locations could be less resilient to future extreme events than strategies involving diversified assets and liabilities.
- Risk management—strategies that reduce risk through mitigation, transfer and avoidance could be considered more resilient than strategies that accept risk.
- Capital and other expenditure associated with resilience plans—companies should disclose the relative costs associated with implementing particular strategies.
- Impact on customers—hardship on banking customers and insurance affordability are examples of customer impacts that could be part of strategy assessments.
- Greenhouse gas mitigation.
- Adaptation and resilience measures – strategies could be assessed for impact on the disclosing entity, and on the wider community.



Feedback and next steps

The CMSI invites feedback from both preparers and users of TCFD disclosures in the banking, general insurance and asset owner industries on the above recommendations.

Going forward, the CMSI intends to iterate the recommendations provided in this report in line with further developments in climate science and the application to financial disclosure. The CMSI is particularly interested in:

- Any practical challenges in the implementations of the above recommendations
- Any areas where further guidance is required
- Any clarity sought in the application of these recommendations
- Any areas that may assist companies in making informed decisions on climate related risks
- Any additional means to improve comparability between disclosers.

Please send any such feedback to: CMSI@Climate-KIC.org.au

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The CMSI is being coordinated by Climate-KIC Australia, and a group of industry partners, these include: QBE, Suncorp, IAG, RACQ, NAB, Westpac, Commonwealth Bank, HSBC Australia, Munich Re, Swiss Re, Leadenhall CP, MinterEllison and Investor Group on Climate Change. The National Environmental Science Program Earth Systems and Climate Change Hub developed the Scientific Guidance. Technical support has been provided by the Institute for Sustainable Futures, UTS.