



# CLIMATE HORIZONS

REPORT

*Scenarios and Strategies for  
Managing Climate Risk*



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**JUNE 2018**

With input from



**Published by the Centre for Policy Development**

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This report has been supported by research and analysis from ClimateWorks Australia and Monash Sustainable Development Institute (MSDI), including through direct authorship of *Section 4: Understanding deep uncertainty through exploratory scenario analysis*. CPD and the authors would like to recognise and thank the ClimateWorks and MSDI teams for their contribution to this research, especially Amandine Denis, Marine Dehayes, Iain Stewart, Rob Kelly and Dr Shirin Malekpour. ClimateWorks Australia is an expert, independent adviser, co-founded through a partnership between Monash University and The Myer Foundation and working within Monash Sustainable Development Institute. You can read more about ClimateWorks and MSDI here: <https://climateworksaustralia.org> and <https://www.monash.edu/sustainable-development/sustainability-institute>



## ACKNOWLEDGEMENTS

The authors would like to thank the many organisations and individuals at home and abroad who provided feedback on our November 2017 discussion paper and suggestions for this report. The authors would also like to extend their appreciation to all those who assisted with internal and external review of this report, including CPD's Research Committee, Dr Claire Molinari, Professor John Wiseman, Peter Mares, Hamish McKenzie, Dr Nick Wood and Sharanjit Paddam. Kate Mackenzie would also like to thank Climate-KIC Australia for supporting her research for this project since August 2017.

This discussion paper is part of CPD's Sustainable Economy Program. The principal focus on this program is identifying ideas and policies that can help build a fair, sustainable and prosperous economy that provides a secure future for all Australians. The ongoing work of the Sustainable Economy Program is possible because of contributions from CPD's program and organisational donors. CPD would particularly like to thank MinterEllison Lawyers, Magellan Financial Group, Sue Mathews and Mark Burford, Brian and Diana Snape, the Curlew Fund, the Mullum Trust, the Hamer Family Fund, the Digger and Shirley Martin Fund, the Fairer Futures Fund, the Garry White Foundation, the William Buckland Foundation, the Australian Environmental Grantmakers Network, Qantas, the Australian Communities Foundation and the Community and Public Sector Union for their generous support for our work.

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## GLOSSARY

APRA	Australian Prudential Regulation Authority
ASIC	Australian Securities and Investment Commission
ASX	Australian Stock Exchange
BAU	Business as Usual
CCA	Climate Change Authority
CCS	Carbon Capture and Storage
CFR	Council of Financial Regulators
CPS	International Energy Agency Current Policies Scenario
EBRD	European Bank for Reconstruction and Development
GCECA	Global Centre of Excellence in Climate Adaptation
GCMs	Global Climate Models
IAMS	Integrated Assessment Models
IEA	International Energy Agency
IEA 450	International Energy Agency 450 Scenario
IEA 2DS	International Energy Agency 2DS Scenario
IEA Bridge	International Energy Agency Bridge Scenario
IPCC	Intergovernmental Panel on Climate Change
NDC	Nationally Determined Contributions
NEM	National Electricity Market
NPS	International Energy Agency New Policies Scenario
OECD	Organisation for Economic Cooperation and Development
OFR	Operating and Financial Review
RBA	Reserve Bank of Australia
RCP	Representative Concentration Pathway
SDS	Sustainable Development Scenario
SSP	Shared Socioeconomic Pathways
TCFD	Taskforce on Climate-Related Financial Disclosures
UN PRI	United Nations-supported Principles for Responsible Investment
UNEP	United Nations Environment Programme
UNEP FI	UNEP Finance Initiative
WEO	International Energy Agency World Economic Outlook

# EXECUTIVE SUMMARY

Climate change is not some distant threat. It is a global tragedy unfolding before our eyes, disrupting ecosystems, communities and economies. For companies, investors and financiers the risks and opportunities are immediate and pressing. The expectations of markets and policymakers on emissions reduction targets and adaptation measures are ramping up. Customers, shareholders and regulators demand increasingly sophisticated responses. If Australian businesses and company directors fail to react urgently and coherently, then they will jeopardise their own future: assets will be stranded or uninsurable, investment will stall, debts will go unpaid, and companies will collapse.

An effective response requires effective disclosure — a frank acknowledgement of the threat that climate change poses to fixed assets and financial liabilities, and the potential for stricter controls on emissions and rapidly changing technology to disrupt established business practices profoundly. Adequate, timely disclosure is essential for appropriate pricing of risk and opportunity. Otherwise, capital will not flow to where it can be best used, profits will fall, and investments will fail.

This report focuses on a pivotal component of this bigger picture — the use of climate scenario analysis to help businesses plan for, and adapt to, an uncertain future.

One year ago, the International Taskforce on Climate-Related Financial Disclosures (TCFD) called on firms and investors to conduct scenario analysis in order to assess and disclose potential business, strategic, and financial implications of climate-related risks and opportunities. Since then, leading financial regulators, institutions and global investors have backed the TCFD recommendations as best practice. They have emphasised that scenario analysis can be a key driver of better corporate reporting on climate-related issues and, in turn, a concerted corporate response to climate change.

CPD's 2017 discussion paper *Climate Horizons* showed how scenario analysis could help Australian companies, investors and regulators manage climate-related risks and opportunities. This report updates our findings, offers new resources for organisations coming to grips with scenario analysis, and recommends next steps for regulators and policymakers to build on the progress made.

**We find encouraging support for the TCFD recommendations, but a serious deficiency in consistency and quality in disclosures — especially on scenario analysis.** More organisations are conducting scenario analysis and disclosing the results, but the outcomes are patchy, due to a combination of stretched capabilities, imperfect resources and divergent standards. Many scenario exercises have employed questionable assumptions and overlooked the physical impacts of climate change. There is also little indication that scenario analysis has influenced corporate decisions and strategy.

**Global best practice adopts more ambitious climate targets for scenario analysis.** The International Energy Agency now emphasises pathways that can keep warming to 2°C or less. These include a Sustainable Development Scenario that is aligned with Paris Agreement targets and also factors in further policy goals such as achieving universal global access to modern energy by 2030. The Intergovernmental Panel on Climate Change will soon release a report on mitigation and development pathways consistent with limiting warming to 1.5°C. Some leading companies have used 1.5°C scenarios to test their exposures and strategies, and new resources are emerging for considering more disruptive technological changes, policy transitions and physical impacts. Scenarios that assume limited policy change beyond what is already announced are losing credibility, as are corporate strategies built upon them.

**Boards that are not up to speed on contemporary climate scenarios expose themselves and their shareholders to substantial risk.** This is not an academic issue. Companies that rely on flawed scenario assumptions are likely to overlook critical risks and opportunities. If directors are to meet their lawful duties, then scenario analysis should be central to climate-related strategy and financial reporting. Rigorous scenario exercises can showcase strategies and risk-management processes geared towards long-term value and returns. Markets and investors will punish organisations whose scenario work is not up to scratch.

**Australian financial regulators should continue to support a proactive approach to climate risk reporting and sustainable finance.** Decisive leadership by the Australian Prudential Regulation Authority (APRA) in 2017 has highlighted the constructive role regulators can play. Further steps by other regulators can build this momentum. The Australian Securities and Investment Commission (ASIC) should provide updated guidance to company directors on climate-related financial reporting. The Reserve Bank Australia (RBA) should join a growing global conversation about how climate change connects to its mandate as a central bank. And the Council of Financial Regulators (CFR) should review the performance of Australian companies against the TCFD guidelines this reporting season. If the voluntary TCFD framework does not deliver more consistent and accurate climate disclosures, more rigorous mandatory reporting requirements will be necessary.

**Financial markets and regulators can't go it alone on climate: the Federal Government should follow moves in the UK and Europe by appointing an Australian Sustainable Finance Taskforce.** There is a huge opportunity for government and industry to work together to develop a policy roadmap for green and sustainable finance in Australia. This would seize on momentum for better management of climate-related risks and opportunities, and align Australia's efforts with major strategic shifts towards sustainable finance underway in our major trading partners. The Australian Sustainable Finance Taskforce (Taskforce) can be a hybrid of the British, European and Canadian examples, which are government supported but comprise a mixture of industry, academic and civil society stakeholders. The Taskforce should be assisted by a Secretariat from the Department of Prime Minister and Cabinet and include representatives from the CFR as observers. It should be asked to report back within 12 months, after the next Federal Election, and pay close attention to how the sustainable finance classification system is finalised in Europe.



# SECTION 1: INTRODUCTION

This is a critical time for climate risk management and disclosure. The physical impacts of climate change are happening before our eyes, disrupting ecosystems, communities and economies. Markets and policymakers are ramping up investment and policy ambition on emissions reduction and adaptation, clearly signalling the major adjustments and transitions to come. Businesses, investors and financial institutions must be able to manage the risks and opportunities that these transitions, and the physical impacts of climate change, will entail. Time is short: many of these impacts are “foreseeable, material and actionable right now”,<sup>1</sup> and customers, shareholders and regulators are expecting sophisticated responses.

This report focuses on a pivotal part of this picture — the use of climate scenario analysis to help businesses adapt to an uncertain future.

## The story so far

The International Taskforce on Climate-Related Financial Disclosures (TCFD) identified scenario analysis as a critical element of comprehensive climate risk disclosure (Box 1). Leading global investors and regulators have echoed the TCFD’s call, including in Australia where APRA has highlighted the value of scenario analysis and stress testing as a key planning tool.

*“Achieving consistent, robust scenario analysis will be particularly challenging while standards and capabilities are still developing and different stakeholder expectations are emerging. There is a danger that inconsistent or flawed approaches to scenario analysis will obscure more than they reveal.”*

*Climate Horizons Discussion Paper, November 2017*

Conducting scenario analysis is a difficult task. Some challenges are methodological: the models and data for analysing climate pathways, impacts and policy responses are intricate and incomplete. Others are practical: developing the capabilities takes time, and it is difficult to build consistent approaches to scenario analysis without agreed standards and expectations.

The TCFD raised expectations about climate scenario analysis, but did not — and indeed could not — offer a one-size-fits-all approach. Over time, allowing firms to develop scenarios and methodologies to suit their own circumstances may support the creative, strategic thinking that scenarios analysis is meant to encourage, resulting in more sophisticated analyses and responses. But in the interim, inconsistencies in how scenario analysis is conducted and disclosed could slow progress towards the end goal: more credible and comparable information on climate-related risks to support better business choices and investment decisions.

While rapid early take up of scenario analysis is encouraging, the analyses conducted to date by leading companies vary widely in terms of methodology, rigour and transparency. Similarly, the limitations in widely-available scenarios mean that businesses that rely on them are likely to underestimate the risks and opportunities associated with the transition to a social, environmental and economic strategy consistent with the ‘well below 2 degrees’ Paris Agreement.

Recognising these challenges, our earlier discussion paper suggested five high-level principles that could serve as hallmarks of robust scenario analysis. These recommendations formed the basis for the further research, feedback and stakeholder consultations that underpin the findings in this report (Box 2).

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<sup>1</sup> Geoff Summerhayes, ‘Australia’s new horizon: climate change challenges and prudential risk’, February 2017

## Outline of this report

This report offers a snapshot of current practice and a selection of resources and recommendations to support quality climate scenario work and a coordinated sustainable finance agenda.

**Section 2** reviews local and international progress on climate risk disclosure and scenario analysis, focussing on developments since the TCFD released its recommendations in June 2017. It also highlights examples of scenarios used by leading companies and investors (a detailed table of scenarios is included as Appendix A).

**Section 3** highlights the features, strengths and weaknesses of the most commonly-used global climate scenarios, focussing on the latest suite of scenarios published by the International Energy Agency (IEA).

**Section 4** draws on upcoming research from ClimateWorks Australia that takes a best practice approach to developing and applying scenarios for long-term strategies by including disruptive technologies, social changes and new business models that could drive decarbonisation pathways genuinely aligned with a 1.5-2°C goal.

**Section 5** emphasises the importance of considering and disclosing the physical impacts of climate change, and collates the latest Australian research and resources on physical risks.

**Section 6** recommends key steps Australian regulators and the Federal Government can take to support a rigorous Australian response to scenario analysis and climate risk disclosure, in concert with the emerging global agenda on green and sustainable finance.

Two additional resources are included as appendices to the report:

- A summary table comparing selected examples of climate scenarios to date (Appendix A)
- A checklist of questions for company directors seeking to fulfil their duties relating to climate risks in light of the TCFD recommendations (Appendix B).

## Box 1: Scenario analysis, transition risks and physical impacts

The TCFD report defines scenario analysis as a means of evaluating “a range of hypothetical outcomes by considering a variety of alternative plausible future states (scenarios) under a given set of assumptions and constraints”. Scenarios are *not* forecasts or predictions that provide a full description of a likely future, or an exhaustive description of the possible alternatives. Rather, they are internally-consistent hypotheticals that test and explore the central elements of different possible futures and highlight key forces and factors that could drive future developments, including those that challenge convention wisdom or business-as-usual.

At its core, as the TCFD report argues, scenario analysis is “a tool to enhance critical strategic thinking.” Pierre Wack, an early pioneer of corporate use of scenario analysis at Royal Dutch Shell, put it this way:

*“Scenarios must help decision makers develop their own feel for the nature of the system, the forces at work within it, the uncertainties that underlie the alternative scenarios, and the concepts useful for interpreting key data.*

*...Scenarios acknowledge uncertainty and aim at structuring and understanding it—but not by merely crisscrossing variables and producing dozens or hundreds of outcomes. Instead, they create a few alternative and internally consistent pathways into the future...*

*The point, to repeat, is not so much to have one scenario that “gets it right” as to have a set of scenarios that illuminates the major forces driving the system, their interrelationships, and the critical uncertainties.” (Wack 1986)*

This “strategic thinking process” about climate change needs to incorporate quite different types of climate-related impacts, risks and uncertainties. The TCFD distinguishes between transition risks (stemming from policy, social, technological and other changes that are part of the transition to a low-carbon economy) and physical risks (stemming from the physical consequences of climate change through adverse weather events or longer-term changes in climate patterns). These risks are related: a rapid policy-driven shift to a low-carbon economy implies greater transition risks but fewer physical impacts in the long-term (i.e. from 2035-2040 onwards), while policy inaction or business-as-usual settings imply fewer transition risks now but much greater physical impacts over time as greenhouse gas concentrations continue to accelerate. Different resources and approaches are needed to build both types of risks into a scenario analysis framework. Section 3 of this report focusses on International Energy Agency scenarios that are geared towards understanding transition risks. Section 5 discusses the important role scenario analysis can play to understand physical impacts and risks.



## Box 2: Key feedback on 5 principles for good scenario analysis in our 2017 discussion paper

CPD sought feedback from leading companies, investors, investor groups, NGOs, academics and industry experts on the 5 principles and parameters for effective scenario analysis proposed in our 2017 discussion paper (which are listed in bold below). This box summarises the key responses we received.

**First: Include a scenario that is genuinely consistent with Paris targets — that is, a high probability of limiting warming to below 2°C, and towards 1.5°C.**

*The IEA450 scenario has been relied on widely to investigate Paris-aligned pathways, but its emission trajectory is not sufficient to keep warming well below 2 degrees — a limitation that is not widely recognised. New resources like the Sustainable Development Scenario introduced by the IEA in 2017 are beginning to offer ambitious emissions reductions pathways that are linked to other sustainable development priorities. Some organisations are also making use of other more challenging 1.5°C aligned pathways like the Greenpeace Energy [r]Evolution scenario, to test risks and opportunities under a wider range of transitions and disruptions.*

**Second: Include the physical impacts of climate change, which will be significant even if warming is kept below 2°C, and will be extreme under business-as-usual settings.**

*Physical risks have received inadequate attention in scenario analysis, despite recognition that physical impacts are an important near and long-term factor under any emissions trajectory, and that they will be severe under business-as-usual scenarios. While better tools are being developed, companies and investors can draw on a number of existing resources and methodologies to better understand the financial impacts of physical risks.*

**Third: Utilise the most robust and relevant sectoral or regional scenarios and resources, and consider incorporating challenging sector-specific scenarios for technological, policy and other changes.**

*The energy-sector orientation, limited geographical and sectoral coverage and lack of more challenging decarbonisation pathways in IEA-based scenarios mean that most users will need to draw on more comprehensive and robust scenario resources. Early Australian approaches built on the Climate Change Authority's carbon budget calculations and implied emissions trajectories for the energy sector, but constructing likely scenario pathways and budgets for other sectors can be more problematic. New, Australia-focused scenario resources that highlight different trajectories and pathways towards a zero-carbon economy — including ClimateWorks Australia's upcoming Frontiers of Decarbonisation project — can make an important contribution here.*

**Fourth: Be transparent about assumptions and parameters used to develop the scenarios, in line with the TCFD disclosure framework and Fifth: Show evidence of responses to scenario analysis results through changes to strategy, governance, and risk management processes.**

*Scenarios need to be more than box ticking exercises, and even the most sophisticated scenario exercises are only useful if they help inform strategic decisions and lead to responses that are communicated to shareholders and stakeholders. Many disclosures to date have provided high information on scenario processes (including scenario parameters and assumptions) but low information on responses — that is, on how scenarios have informed strategy, governance and risk management practices.*

## SECTION 2: SNAPSHOT OF CURRENT PRACTICE

### Summary

This section provides a snapshot of current practices and highlights some important emerging trends in scenario analysis. It finds that expectations around scenario analysis and the TCFD recommendations are growing, but that capabilities are taking time to develop. Approaches also vary widely across industries and institutions. The most promising scenario practices incorporate multiple scenarios and demonstrate clear links between scenario outputs and strategy. In line with TCFD calls to use scenarios that are consistent with Paris targets, some recent scenario exercises have employed more ambitious pathways that limit warming to 1.5-2°C.

### There has been a strong response to the TCFD

The TCFD's final report in June 2017 generated significant attention and activity on climate-related risks. As of May 2018, more than 275 companies with a combined market capitalisation of over US\$7 trillion have formally supported the TCFD recommendations,<sup>2</sup> as have 300 investors representing over US\$28 trillion in assets.<sup>3</sup> In Australia, prominent early supporters of the TCFD recommendations include BHP, ANZ, Cbus, Australian Super, AGL, NAB, CBA, Westpac, Qantas and Aurizon.

Globally, early evidence suggests that disclosure of climate-related risks has improved since the TCFD's final report. In March 2018, a joint Climate Disclosure Standards Board and Carbon Disclosure Project survey found that over 90 per cent of responding companies globally disclosed at least one type of climate-related risk, while 82 per cent have board-level oversight of climate-related risks and opportunities. (It wasn't all good news – the same study showed just 12 per cent of companies provided board-level *incentives* for climate-related management, while only 52 per cent considered any climate-related risks beyond a six-year horizon.)<sup>4</sup>

Australia's response has been sluggish, despite increased awareness of climate-related risks after key interventions by regulators and leading corporates. A recent report by Market Forces found that only around half of the 73 most climate-exposed companies in the ASX 200 identified climate change as a material risk in their latest reporting.<sup>5</sup> In a recent Deloitte survey on CSR practices and priorities in Australia and New Zealand, only a quarter of more than 1000 firms surveyed said addressing the TCFD recommendations was a high or very high priority over the next 12 months.<sup>6</sup>

### Progress on scenario analysis is patchy

Progress on scenario analysis has been even slower, despite it being recognised by financial authorities as a key element of the TCFD report. Globally, most of the organisations using scenario analysis are in the energy and resources sector, where exposures are most direct and where scenario analysis has been an established tool for some time. The same is true in Australia, where mining and energy companies and large financial institutions have been prominent users of scenario analysis. The absolute number of companies using scenarios remains small: EY's 2018 Climate Risk Disclosure Barometer surveyed 144 ASX companies and found that only 12 disclosed some form of scenario analysis so far,<sup>7</sup> with a number of others having committed to doing so in upcoming

<sup>2</sup> 'TCFD and CDSB Launch Knowledge Hub', TCFD press release, 1 May 2018, available [https://www.fsb-tcfd.org/wp-content/uploads/2018/05/Press-Release-TCFD-CDSB-Knowledge-Hub-1-May-2018\\_FINAL\\_043018.pdf](https://www.fsb-tcfd.org/wp-content/uploads/2018/05/Press-Release-TCFD-CDSB-Knowledge-Hub-1-May-2018_FINAL_043018.pdf)

<sup>3</sup> UNEP Finance Initiative et.al, '2018 Global Investor Statement to Governments on Climate Change', 4 June 2018, available [https://theinvestoragenda.org/wp-content/uploads/2018/06/GISGCC-FINAL-for-G7-with-signatories\\_-update-4-June.pdf](https://theinvestoragenda.org/wp-content/uploads/2018/06/GISGCC-FINAL-for-G7-with-signatories_-update-4-June.pdf)

<sup>4</sup> CDSB and CDP, 'Ready or not: Are companies prepared for the TCFD recommendations?: A geographical analysis of CDP 2017 responses', 2018.

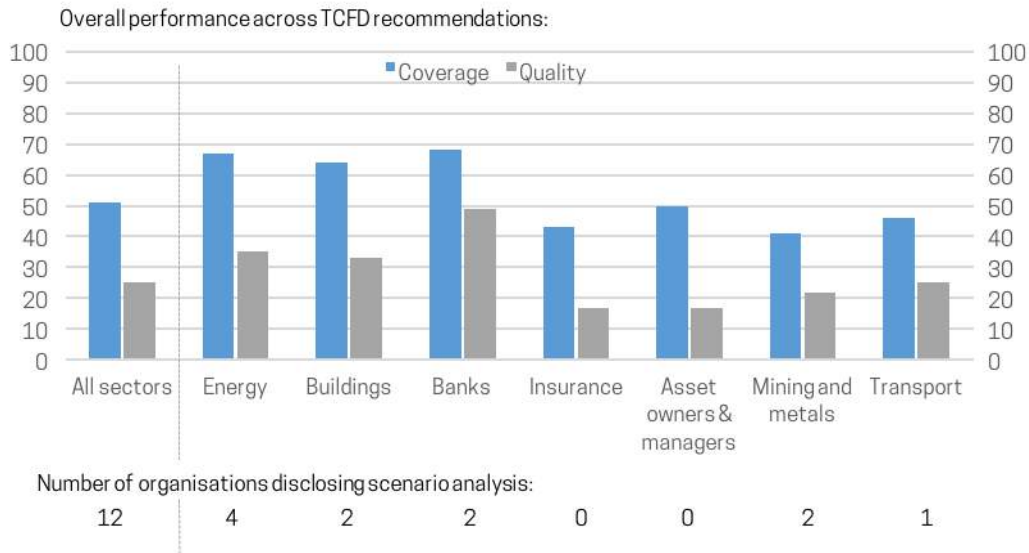
<sup>5</sup> Market Forces, 'Investing in the dark: Australian companies are failing to properly disclose climate risk', March 2018.

<sup>6</sup> Deloitte, 2018 State of CSR in Australia and New Zealand Report, April 2018.

<sup>7</sup> EY Climate Risk Disclosure Barometer 2018.

reports (Chart 1). Overall, EY found that performance on both coverage and quality of TCFD-aligned disclosures was weakest for the 'strategy' component of the TCFD framework, which includes the TCFD's central recommendation on scenario analysis.

**Chart 1: TCFD-aligned disclosures in Australia by sector (EY Climate Risk Barometer)**



Note: 'Coverage' refers to how many of the 11 TCFD recommendations are addressed by relevant disclosures. Quality refers to a rating of disclosures for each recommendation across a 1-5 scale. For full results and methodology, including on sectors omitted here, see: EY Climate Risk Disclosure Barometer 2018.

The number of scenario exercises and their use across different sectors is likely to increase now that there has been more time to understand the TCFD recommendations, review exposures, and develop processes and capabilities for conducting early scenario work. There will also be opportunities to tap into examples of domestic and international best practice, and ongoing efforts by the TCFD and other organisations to provide more guidance on what its scenario analysis recommendations require (Box 3).



### Box 3: Important global resources on scenario analysis and the TCFDs

Since the release of the TCFD, several leading international NGOs, regulators and disclosure and accounting bodies have sought to provide information, resources and guidance for organisations wanting to conduct TCFD-consistent scenario analysis. This includes:

- **Continued work by the TCFD and its partners** to discuss priorities for improving scenario resources and provide sector-specific examples of applied scenario analysis. The TCFD co-hosted a conference with the Bank of England in October 2017 to discuss early experiences with scenario analysis and priorities for refining scenario tools to allow more sophisticated financial and strategic risk analysis. In May 2018, the TCFD held a Scenario Analysis Conference in New York to highlight leading examples of scenario analysis and disclosure from the financial, energy, airline and automobile sectors. Presentations from both conferences can be viewed online: <https://www.fsb-tcf.org/events-landing/>

In May, the TCFD joined the Carbon Disclosure Standards Board to launch the TCFD knowledge hub, which includes hundreds of resources for companies seeking to understand and implement the TCFD recommendations (including on scenario analysis): <https://tcfithub.org/>

- **The Finance Initiative of the United Nations Environment Programme (UNEP)** brings together 16 global banks including ANZ and NAB and has completed a pilot project on how banks can adopt scenario analysis consistent with the TCFD requirements. The Initiative's report, *Extending Our Horizons*, outlines a methodology that can be adopted by banks to assess transition-related exposures in their corporate loan portfolios, and that can be adapted for a wide range of scenario inputs and institutional risks. <http://www.unepfi.org/banking/tcfid/>
- **The European Bank for Reconstruction and Development (EBRD) and the Global Centre of Excellence in Climate Adaptation** published guidance for advancing TCFD recommendations in relation to physical climate risk. The report includes a number of recommendations on how physical risk should be assessed and disclosed over different time horizons. <http://www.physicalclimaterisk.com>
- Leading NGOs which produce influential reporting frameworks for climate risk disclosure are working to align their approaches with the TCFD, including on scenario analysis. For example, the **Climate Disclosure Standards Board** has updated its reporting standards (currently used by companies with a market capitalization of over \$5 trillion dollars) to provide clear links between its principles and recommended disclosures and the TCFD framework. This includes a call for all organizations to consider applying a basic level of scenario analysis for strategic planning and risk management purposes. The **Sustainability Accounting Standards Board** has also highlighted the convergence between its frameworks and metrics and the recommendations of the TCFD. The **Carbon Disclosure Project** has announced significant changes to its reporting questionnaire to take a more forward-looking approach to risk disclosure, including new questions on scenario analysis, which will be a specific focus of its next reporting cycle.

**Table 1: Summary of selected company scenario exercises (full details in Appendix 1)**

Company	Horizon	Scenarios	Net zero by 2050?	Key transition parameters	Physical risks	Evidence of impact on decisions
<b>AGL</b>	2030	<u>Two</u> : Current policy, 2°C	Yes	NEM pathways derived from CCA budget	No	Company supports net zero emissions by 2050
<b>AXA</b>	Unclear	<u>One</u>	No	NDCs; IEA450	No	Limited; scenario analysis shows negligible impact on most holdings
<b>Aviva</b>	2040	Multiple	Unclear	IEA 450/2DS, Bridge	Yes (insufficient detail)	Limited; <i>Strategic Response to Climate Change</i> includes actions for 2015-20
<b>Origin Energy</b>	2030	<u>Three</u> : BAU, NDC, 2°C	Yes	NEM pathways derived from CCA budget	No	Company supports net zero emissions by 2050
<b>South32</b>	2050	<u>Three</u> : <i>Runaway climate change; Patchy progress; Global cooperation</i>	Yes	IEA CPS, NPS, 450/2DS, BNEF NEO	Yes (not all scenarios)	No greenfield coal developments linked to 2°C scenario
<b>BHP</b>	2030	<u>Four</u> : <i>A New Gear; Closed Doors; Two Giants; Global Accord (2°C)</i> plus 'shock event' for rapid decarbonisation	No	Assumes emissions targets by region to 2030	Yes (insufficient detail)	'All commodities in existing portfolio have strong future margins'.
<b>BP</b>	2040	<u>Three</u> : <i>Evolving Transition; Faster Transition; Even Faster Transition (2°C)</i> , plus alternative policy scenarios	No	BP Energy Outlook	No; limited detail in other reports.	Focusing on gas and 'advantaged oil' (low cost or high margin). Small investment in low-carbon/"digital".
<b>Shell</b>	2100	<u>Three</u> : <i>Mountains, Oceans, Sky</i> ('normative' <2°C)	No (2070)	Shell parameters;	Yes (limited detail)	Halve total emissions (inc from use of products) by 2050.
<b>Oil Search</b>	2050	<u>Three</u>	Yes	IEA NPS, 450, Greenpeace [R]Evolution	Yes (limited detail)	Analysis 'reinforced corporate strategy for globally competitive energy portfolio'
<b>Westpac</b>	2050	<u>Three</u> : <i>Strong National Action, Global Cooperation, Delayed Action</i> (all 2°C)	Yes	Net zero for Australia by 2050	No	Claims targets aligned with zero emissions pathway
<b>Glencore Xstrata</b>	2040	<u>Three</u> : <i>Delayed Action; Committed Action; Ambitious Action</i>	No	Modified IEA NPS, 450	Yes	Some. Central case is weakest mitigation scenario: delayed, haphazard transition.
<b>ANZ</b>	2040	<u>Two</u> : IEA NPS and IEA 450 (thermal coal customers only)	No	IEA NPS, 450 Thermal coal customers only	No	Scenarios will "inform strategy regarding customer engagement and risk evaluation"
<b>Chevron</b>	2040	<u>Multiple</u> : proprietary reference scenario and alternative cases	Yes (SDS)	Multiple, including IEA SDS	No	Emphasises flexibility to manage portfolio and exposures



## Scenarios are more sophisticated — but parameters, standards and disclosures vary widely

Some recent examples of scenario analysis are beginning to reflect increased capability and ambition following the TCFD report. Disclosers typically consider multiple scenarios. There has been consistent movement towards including scenarios that are more aligned with a 2°C target (although the widely-used IEA 450 scenario provides only a 50 per cent chance of keeping warming below this level). Some organisations have utilised the IEA's new Sustainable Development Scenario (e.g. Chevron), while others have used more challenging scenarios such as the Greenpeace Energy [r]Evolution scenario (e.g. Oil Search), which is aligned with a 1.5 °C climate goal. Shell's sophisticated new "Sky" transition scenario, which is also aligned with a 1.5-2°C outcome, has significantly raised the bar for transition scenarios in terms of both ambition and detailed disclosure. Overall, across what is still a relatively small sample of recent disclosers, there are signs of growing appetite for scenario exercises that can test risks and opportunities (or demonstrate business resilience) across a more ambitious range of emissions reductions pathways and policy and technological assumptions.

However, recent exercises reinforce concerns about inconsistent use and disclosure of climate scenarios. As Table 1 highlights, there has been wide variance in crucial scenario parameters, time horizons and quantitative outputs. Disclosure of key scenario assumptions varies significantly, and physical risks are rarely incorporated comprehensively into scenario exercises. More fundamentally, there is often a disconnect between rising detail and ambition on scenario analysis exercises and still scant disclosures as to how these exercises have influenced decision-making and strategy. In other cases, companies cite major strategic responses but provide little transparency on the details or outputs of scenarios themselves. These outcomes suggest that even the earliest and most enthusiastic adapters of scenario analysis have a long way to go to reach standards expected under the TCFD framework.

Generally, the most comprehensive scenario exercises have been conducted by organisations with direct exposures to transition risks (for example, changes in prices and demand for energy or carbon-intensive commodities) where parameters and trajectories can be mapped closely to strategic and operating environments. In Australia, this includes scenario analysis by major energy companies AGL and Origin, which both employ emissions pathways for the National Electricity Market (NEM) derived from projections by the Climate Change Authority (CCA) of Australia's carbon budget to 2050 under Paris targets.

Approaches have differed markedly across sectors and institutions where it is more difficult to comprehensively model potential risks and exposures. Some companies with large and complex exposures have chosen to focus initially on a subset of risks or transitions. In its first disclosed scenario exercise, for example, ANZ tested potential exposures for its Australian and international customers in thermal coal supply chains.

The variance in approaches across disclosures in similar industries, and common challenges in developing scenario related processes and capabilities, reinforce the potential value of co-ordinated sector-level initiatives to help drive best practice and underpin consistent and meaningful disclosures. One recent example is the UNEP Finance Initiative's pilot scenario methodology for the banking sector, which provides a replicable, TCFD-consistent framework that is refined to suit the particular needs, exposures and existing risk management capabilities of banks (Box 4).

While these more sophisticated approaches develop, many organisations are likely to continue to rely heavily on reference scenarios provided by the IEA and other organisations. The next section provides a snapshot of the most recent suite of IEA scenarios along with their key features and limitations.

#### Box 4: Scenario analysis and corporate loan portfolios — the UNEP Finance Initiative Pilot

In *Extending Our Horizons* (April 2018), the UNEP Finance Initiative proposed a new methodology for assessing transition-related exposures in banks’ corporate loan portfolios. It is framed as a first step towards a “comprehensive approach for evaluating transition risk at a portfolio or institutional level that describes the risk in terms of financial losses.”

The UNEP pilot is significant in two respects. First, it provides a sophisticated process for connecting insights from scenarios to climate-related exposures and opportunities at the level of borrower, market segment and sector. Second, the methodology can accommodate different types of scenarios (ranging from IEA-style scenarios through to bespoke, event-based scenarios) and multiple timeframes, and be adapted by banks with very different portfolios and exposures. In this way, it seeks to provide a repeatable, consistent framework that can be used to generate useful disclosures, but one that can also capture potentially large variances in sector risk and the particular needs of different institutions.

The methodology proposed by the pilot involves combining three modules:

- 1. Transition scenarios: Identify “risk factor pathways” that describe key scenario insights in corporate financial terms** that can be measured relative to a baseline scenario. The four factors developed by the pilot are: incremental changes in direct emissions costs; indirect emissions costs; low-carbon capital expenditure; and changes in revenue. These are used to estimate differences in risk profiles *between* sectors under different scenarios. They are also used to estimate different scenario impacts *within* sectors, by adding an estimate of how sensitive a given segment within a sector is relative to the others (for example, within electricity, coal-fired plants will have a higher potential for adverse impacts than renewables-focused companies).
- 2. Borrower-level calibration: Use expert judgement and tailored assessments to estimate how each scenario will impact individual borrowers.** This calibration draws on existing credit-rating expertise and tools to assess the impact of a scenario on specific borrowers within a segment, given their financial characteristics and qualitative considerations like adaptability.
- 3. Portfolio impact assessment: Integrating “top down” (scenario) and “bottom up” (calibration) to estimate a “climate credit quality index” across an entire portfolio.** Changes in creditworthiness for a representative set of borrowers are used to extrapolate credit impacts across the loan portfolio, estimating changes in expected losses under different scenarios.

The UNEP FI pilot also suggests separate, formal methodologies for assessing transition-related opportunities and physical risks.

#### Example bank assessment of segment sensitivities to transition scenario risk factor pathways

SEGMENTS	RISK FACTOR PATHWAYS			
	DIRECT EMISSIONS COSTS	INDIRECT EMISSIONS COSTS	LOW-CARBON CAPEX	REVENUE
Black coal mining	Moderately high	Moderately high	Moderately high	High
Copper ore mining	Moderately low	Moderate	Moderate	Moderately high
Gold ore mining	Moderately low	Moderate	Moderate	Moderate
Iron ore mining	Moderate	Moderately high	Moderate	Moderately low

Note: This extract is drawn from an analysis conducted by a single bank to pilot UNEP FI’s scenario-based assessment of transition risks and is intended as an illustration of the framework used, rather than the sensitivity of the market segments.

## Box 5: Directors' duties and scenario analysis — what is required?

The 2016 legal opinion on climate change and directors' duties by Noel Hutley SC and Sebastian Hartford-Davis concluded that duties in the *Corporations Act* require company directors to consider the foreseeable impacts of climate change on their business, and to manage and disclose those risks that are material.

With the TCFD recommendations emerging as a key benchmark for reporting on the impacts of climate change, the Centre for Policy Development, the Commonwealth Climate and Law Initiative (CCLI) and MinterEllison (whose Special Counsel Sarah Barker instructed on the Hutley opinion) have prepared a framework to assist directors when responding to the TCFD framework and discharging their obligations to properly consider climate-related risks. This guide, *The climate risk reporting journey: a corporate governance primer*, proposes key questions relevant to assuring a corporation's reporting on climate-related financial issues, and the robust processes of governance and oversight on which those disclosures must be based.

Several of the key questions directors should turn their attention to relate to scenario analysis. Whilst the framework should be considered holistically, relevant extracts include:

*Do we understand the role of stress-testing and scenario analysis in strategic governance, planning and risk management? Do we understand any relevant exposures to stranded asset risk? By whom are we being advised on these issues? How have we assured that their expertise is relevant and appropriate? What processes are in place to ensure that we remain informed of developments in this area?*

*How does our exposure differ under stress-testing against a range of plausible climate futures (including one aligned with Paris Agreement goals to keep average warming "well below" 2°C), over various time horizons relevant to our business and investment planning and useful asset life-cycles (short, medium and long-term)? On what basis do we believe these scenarios represent an adequate range of credible physical, economic transition and litigation risks (and opportunities) that could reasonably be expected to impact on our business performance or prospects?*

*Which of those risks present a material exposure to our corporate strategy or operations (in both absolute and relative terms) — and on what basis is the threshold of 'materiality' set? Over what time frames?*

*What are the implications of identified material climate risks and opportunities for our business model? What strategic responses are open to us to continue to thrive — stress-tested against a range of potential climate futures?*

*What forward-looking statements in relation to climate-related risks (and opportunities) are appropriate to disclose to the market (including in the OFR/directors' report)? Are any such statements grounded in stress-testing and scenario planning in relation to both physical and economic transition-related risks, over time-horizons consistent with our capital and financial planning cycles? Do our disclosures accurately convey the potential for materially different outcomes depending on key variables and assumptions?*

*What range of climate-related assumptions, scenarios and potential material financial impacts have been considered by management but not disclosed? On what basis has it been determined that they should not be disclosed? Are we proposing to disclose only favourable scenarios? How do reported performance and prospects vary under a range of different, albeit plausible, assumptions?*

The climate risk primer is included in full as **Appendix B** to this report, and will be separately available via the CPD, CCLI and MinterEllison websites.

# SECTION 3: GLOBAL TRANSITION SCENARIOS – RECENT TRENDS AND KEY INSIGHTS

## Summary

This section provides a high-level overview of some key features and limitations of the International Energy Agency transition scenarios that have been widely used in scenario analysis to date. It finds that global scenarios published by organisations like the IEA can be important reference points for organisations conducting scenario analysis, especially in the early stages. It is crucial though, that the key assumptions and limitations of these resources are well understood by the organisations that rely on them for their analyses and disclosures. Increasingly, global practice is likely to move towards more ambitious ‘normative’ scenarios like the IEA’s Sustainable Development Scenario, which incorporates one potential global pathway towards simultaneously achieving important climate and development goals. Scenarios that adopt or exceed this level of ambition are becoming a must-have for sophisticated companies that are serious about managing climate risks.



Global climate and energy-sector projections published by the IEA, IPCC and others are a vital input to many corporate scenario analysis exercises. As the TCFD emphasised, these “meta-scenarios” or reference scenarios provide vital context and a set of macro trends to support more finely-tuned company or sector-specific scenarios. And as the review of Australian scenario disclosures showed, early examples of scenario analysis have relied heavily on these resources. Despite their prominence, the features and limitations of these scenarios are often poorly understood.

Overcoming these limitations is a critical challenge. It will take time to develop tailored scenarios to support granular financial risks analysis for specific countries, industries and firms. But demonstrating a robust understanding of the major global scenarios, when they are employed, and providing evidence of how these have shaped strategy, are essential starting points for organisations that are serious about responding to the TCFD report.

## Summary of key IEA scenarios

While scenario analysis was one of its central recommendations, the TCFD report did not recommend a specific scenario or framework. Instead, it highlighted a range of resources relevant for climate risk analysis that fall into two broad and overlapping categories. The first is **transition scenarios**, which illustrate different policy and technology pathways in the energy and economic system and the emissions trajectories these generate. These pathways vary as widely as the complex assumptions, variables and targets that drive them, so understanding these differences and drivers is essential to choosing the right scenarios and using them in the right way. The second category is **physical climate scenarios** that connect different economic and emissions pathways and greenhouse gas concentrations to climatic impacts at different geographical scales.

The TCFD lists a wide range of scenarios and resources across each category. This section focuses on transition scenarios. (Section 5 of this report focuses on physical risks.)

The UNEP Finance Initiative's pilot study into banks' use of scenario analysis proposed four criteria for evaluating the most useful scenario sources for financial assessment of credit risk:

- (i) the availability of a range of scenarios — baseline, 2°C, and below 2°C
- (ii) the breadth of outputs across sectors and regions
- (iii) the granularity of outputs at a sector, region and country level and
- (iv) the frequency of updates to assumptions and parameters.

None of the widely-used publicly-available scenarios fully meet these criteria, but the IEA's annual World Economic Outlook scenarios and the Integrated Assessment Models that underpin IPCC assessments come closest. Here, we focus on the IEA's most recent set of scenarios, published in 2017, which are likely to be widely relied upon in the early stages of TCFD adoption.

### The IEA's 2017 scenarios included a crucial new tool — the Sustainable Development Scenario

The scenarios produced by the IEA focus primarily on energy-sector trends, technologies and policies. The pathways they provide are not intended to predict future policies or outcomes, but to “highlight the key choices, consequences and contingencies that lie ahead” for energy policy.<sup>8</sup> This focus on the energy sector means the IEA scenarios are not an ideal basis for all businesses to think about how climate change will affect them.

Traditionally, the IEA scenarios illustrated the possible impacts of current policy intentions, rather than anticipating new policies or pathways or working towards agreed goals. This has led to criticisms that IEA scenarios — especially if misconstrued as forecasts — validate or perpetuate a low-policy-change “business as usual” approach, and are slow to respond to crucial developments driven by major policy shifts (such as very rapid uptake of solar panels).

More recently, the IEA has adopted a different approach. It has developed new scenarios that assume ambitious goals around climate change mitigation and development, and worked backwards to create illustrative policy pathways for how these could be reached in a low-cost, coherent way.

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<sup>8</sup> IEA, *World Energy Outlook 2018*, p.36

## Box 6: Summary of IEA 2017 World Energy Outlook scenarios

### Current Policies Scenario (CPS)

The Current Policies Scenario only considers policies and measures enacted into law by mid-2017, assuming that where these policies target a range of outcomes, the least ambitious outcomes will be achieved. The CPS provides a point of comparison for other scenarios, and a cautious assessment of where existing policies would lead the energy sector without any further policy effort.

### New Policies Scenario (NPS)

The New Policies Scenario includes existing policies and announced policy intentions in the form of official targets or plans. In many cases these are guided by countries' Nationally Determined Contributions toward the Paris Agreement, where they have not been superseded by more recent announcements. Where targets and policies are not fully reflected in legislation, the scenario incorporates assumptions about the prospects and timing for their implementation based on an assessment of political, regulatory, market, infrastructural and financial constraints. This reading of national policy environments is also influenced by policies and targets adopted by sub-national governments. While the NPS is the IEA's "central scenario", this does not imply that the IEA does not anticipate additional policy efforts beyond those implemented or announced. Instead it is designed to provide feedback on where today's decision makers are taking the energy system, to provide feedback for further policy development.

### Sustainable Development Scenario (SDS)

The Sustainable Development Scenario examines what it would take to achieve the main energy-related components of the 2030 Sustainable Development Goals adopted by the members of the United Nations. These interrelated goals are to (1) take urgent action to combat climate change, (2) achieve universal access to modern energy by 2030, and (3) dramatically reduce pollution that causes poor air quality. The objective of the SDS is to lay out an integrated strategy for achieving these goals in the context of energy security. The scenario features (1) realisation of universal energy access in both electricity and clean cooking by 2030 (2) achieving a peak in emissions as soon as possible followed by a substantial decline, consistent with the direction needed to achieve the Paris Agreement, and (3) delivering a large reduction in other energy-related pollutants, consistent with a dramatic improvement in global air quality and reduction in premature deaths from household air pollution.

The 2017 WEO also includes a Faster Transition Scenario (plotting a pathway to net zero energy sector emissions by 2060), and an Energy for All Case (which couples the achievement of modern energy for all with the policy backdrop of the NPS). Another IEA publication, Energy Technology Perspectives, provides technology-focused analysis of pathways to limit warming to 2 degrees or less.

*Source: Adapted from IEA World Energy Outlook, 2017*

First, the IEA produced its 450 Scenario which was framed as an ambitious pathway for limiting global warming to 2°C (although it only provides a 1-in-2 chance of doing so, which is too low to be genuinely consistent with the Paris Agreement). In 2017, the IEA expanded this approach by adding its Sustainable Development Scenario (SDS), a pathway that combines action to combat climate change (aligned with the 450 scenario) with major efforts to reduce dangerous air pollution and achieve universal global access to modern energy by 2030.

Like the 450 scenario, the SDS "starts with a certain vision of where the energy sector needs to go and then works back to the present." In the SDS, global emissions peak before 2020 and decline swiftly. By 2040, emissions are at the lower range of Representative Concentration Pathways for greenhouse gas concentrations that estimate a temperature increase of around 1.7-1.8°C by 2100 (RCP 2.6).<sup>9</sup> However, as discussed on p.27, this outcome depends critically on the timing and magnitude of further emissions reductions after 2040. "For example, if emissions continued to gradually decline towards zero in 2100, this would lead to a roughly even

<sup>9</sup> See Intergovernmental Panel on Climate Change, Fifth Assessment Report (AR5), 2013

chance of holding the temperature rise to below 2°C. If emissions fell much faster, hitting zero around 2060 and then becoming significantly negative, this would be in line with a roughly even chance of limiting the ultimate global temperature rise to 1.5 °C.”<sup>10 11</sup>

The SDS and similarly ambitious scenarios are likely to become crucial reference points for scenario analyses that are aligned with the Paris targets and incorporate related sustainable development goals.<sup>12</sup>

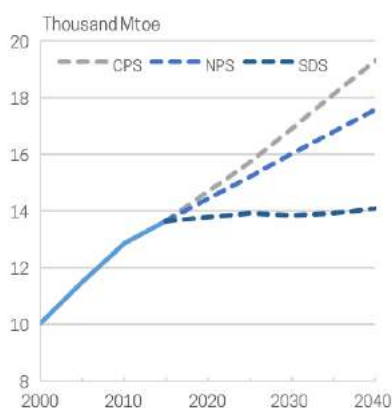
## Key differences across major scenarios

The starting point for understanding and using global scenarios is to understand the policy pathways that drive them, the trajectories and outputs they produce, and the insights that they provide.

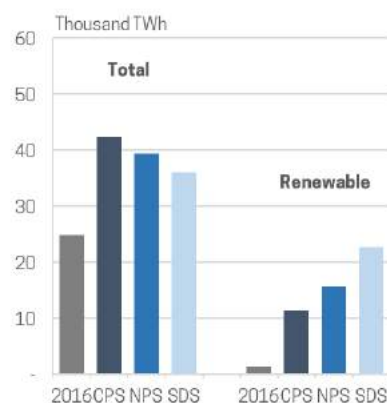
The policy assumptions in each scenario are cumulative: policies in the New Policies Scenario build on those already enacted as current policy, and are built on again to generate the more ambitious Sustainable Development Scenario. Key policy drivers include the adoption of carbon pricing (the SDS assumes staggered introduction of CO<sub>2</sub> pricing in all advanced economies), the phasing out of fossil fuel subsidies across importing and exporting countries, and a range of existing and plausible measures targeting renewable energy, and increasingly stringent energy efficiency measures or emissions limits in transport, building and industry. (The IEA provides a comprehensive list of policy assumptions for each major country/region in the WEO appendix).

The scenarios show that these policy pathways would generate vastly different futures for global energy systems and emissions. In the Sustainable Development Scenario, total global primary energy demand grows only fractionally between 2016 and 2040, to be 20 per cent lower than the level in the New Policies Scenario, and almost 30 per cent below the level implied by current policies (Chart 2). Overall electricity generation increases significantly to 2040 under all scenarios, but the renewables share of generation rises sharply in the NPS and SDS (Chart 3), contributing to a halving in global CO<sub>2</sub> emissions by 2040 under the SDS (Chart 4). With the coal share of primary energy demand dropping, global demand either flatlines under the NPS or falls sharply under the SDS pathway (Chart 5).

**Chart 2: Global primary energy demand**



**Chart 3: Global electricity generation (2040)**

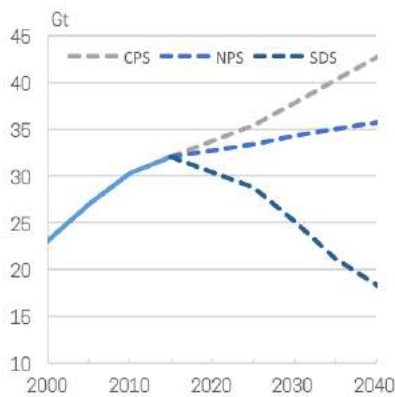


<sup>10</sup> ‘Commentary: a new approach to energy and sustainable development’, International Energy Agency, 13 November 2017. Available: <https://www.iea.org/newsroom/news/2017/november/a-new-approach-to-energy-and-sustainable-development-the-sustainable-development.html>

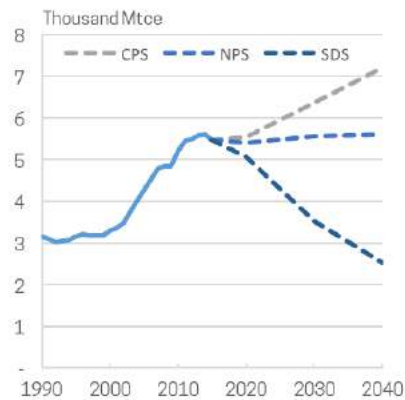
<sup>11</sup> For a discussion of carbon budgets consistent with limiting warming to 1.5 °C, see Miller et al, ‘Emissions budgets and pathways consistent with limiting warming to 1.5°C, Nature Geoscience’, 18 September 2017

<sup>12</sup> In 2018, the IPCC will release a special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways. In a similar vein to the SDS, this report will examine mitigation pathways that are compatible with a 1.5°C target in the context of sustainable development. This will include a review of technological, environmental, institutional and socio-economic opportunities and challenges related to 1.5°C pathways. See <http://www.ipcc.ch/report/sr15/>

**Chart 4: Global CO2 Emissions**



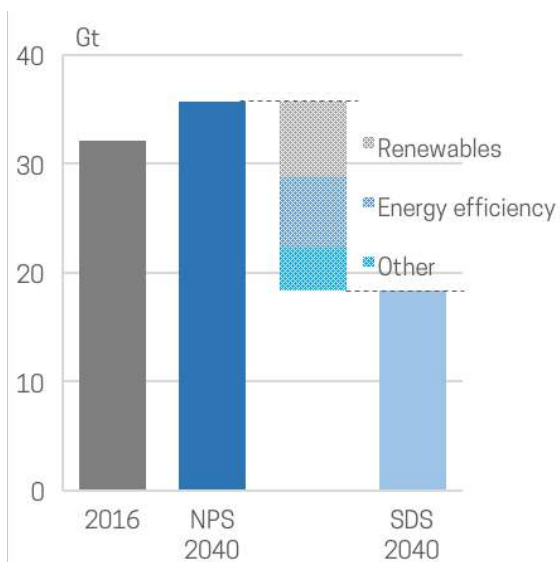
**Chart 5: Global coal demand**



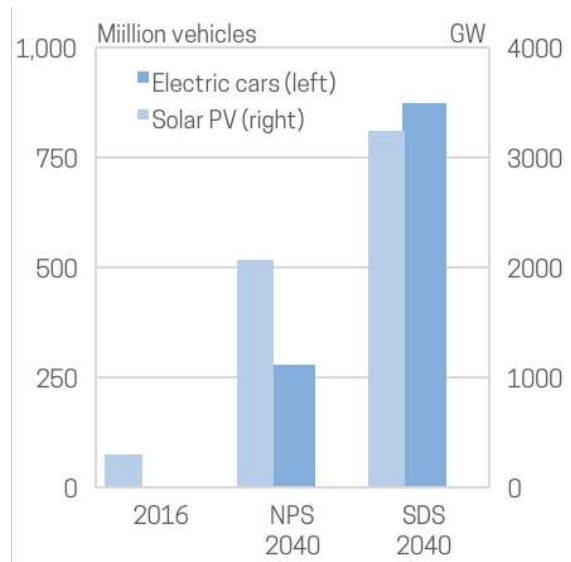
Source: International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris. Charts 2-4: WEO Annex A. Chart 5: WEO Figure 5.1.

The combination of renewable energy generation and increased energy efficiency deliver almost three-quarters of the difference in emissions between the Sustainable Development Scenario and the New Policies Scenario (Chart 6). Globally, energy intensity falls by an average of 3.2 per cent per year in the SDS, compared to 2.3 per cent in the NDS and 1.9 per cent based on current policies. Major drivers include a more efficient global vehicle fleet (including almost 900 million electrified passenger vehicles) and solar PV capacity, which increases more than 10-fold compared to today's levels and together with wind accounts for one-third of global electricity supply by 2040 (Chart 7). These changes are underpinned by major investment flows in the Sustainable Development Scenario, including an additional \$9 trillion between 2016 and 2040 in the energy sector (dominated by investment in renewables and transmission and distribution) and an additional \$12 trillion in end-use sectors (including major investments in energy efficiency and take-up of technologies like electronic vehicles) (Chart 8).

**Chart 6: Contributions to emissions reduction**

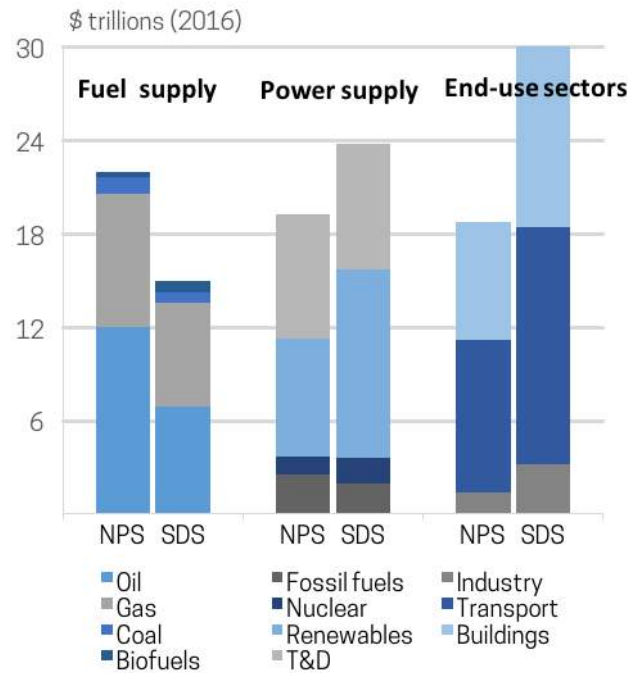


**Chart 7: Global solar and electric cars**





**Chart 8: Investment by sector (2017-2040)**



Source: International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris.  
 Chart 6: WEO Figure 2.10. Chart 7: WEO Figure 3.21. Chart 8: WEO Figure 3.20.

## High-level scenario outputs are an important resource

All IEA scenarios include quantitative outputs on fossil fuel production and demand by region, energy demand, electricity generation, carbon emissions and other indicators. In many cases these are broken down across major regions and groupings (North America, Central and South America, Europe, Africa, Middle East, Eurasia, Asia Pacific, South-East Asia and OECD) and major countries (United States, EU, China, India, Brazil, South Africa, Russia and Japan). For some sectors and companies, these headline outputs can be used directly in scenario generation and sensitivity analysis, or used as inputs for other models to produce projections for demand, production and prices for key commodities, resources and products. Given the focus on energy, this approach is likely to be especially relevant for companies in resources and energy sectors, for whom the IEA scenarios can serve as an important input or adjunct to existing methodologies for long-term scenario analysis and strategic planning.

For organisations not operating in these areas, the lack of geographic or sectoral granularity in the IEA scenarios is an important limitation. This is especially the case in Australia, which is not separately broken out in IEA projections, and where the energy-system focus of the IEA scenarios omits important drivers of emissions trajectories and climate policy such as land use changes. However, the scenarios can still be an important resource for Australian companies and investors. They provide coherent qualitative and quantitative narratives on crucial economic, technological and policy developments in our major trading partners, with a focus on the energy-related sectors that drive some of our largest trade and investment flows. This means they are useful not just for companies in these sectors, but also for the downstream sectors that are heavily exposed to them (for example, logistics and energy-intensive manufacturing), and the investors and institutions that finance them.

## Insights to sharpen strategic thinking are just as important

These direct scenario outputs are useful for many companies and investors. But understanding the key insights from the scenarios, and their limitations, can be even more valuable and important than the hard numbers — both for developing more finely-tuned scenarios and for refining strategy and risk management.

Perhaps the most valuable insight comes from the design of the Sustainable Development Scenario itself. The IEA's inclusion of this scenario underlines the likelihood, the necessity and the desirability of climate and development policies that go well beyond what is already announced and anticipated. This is not a sudden shift: earlier scenarios like the 450 scenario incorporated climate policy goals, rather than making neutral projections of current or anticipated policy. The SDS entrenches this important methodological change, and expands it by connecting temperature-focused goals with related development ambitions.

Other key insights include:

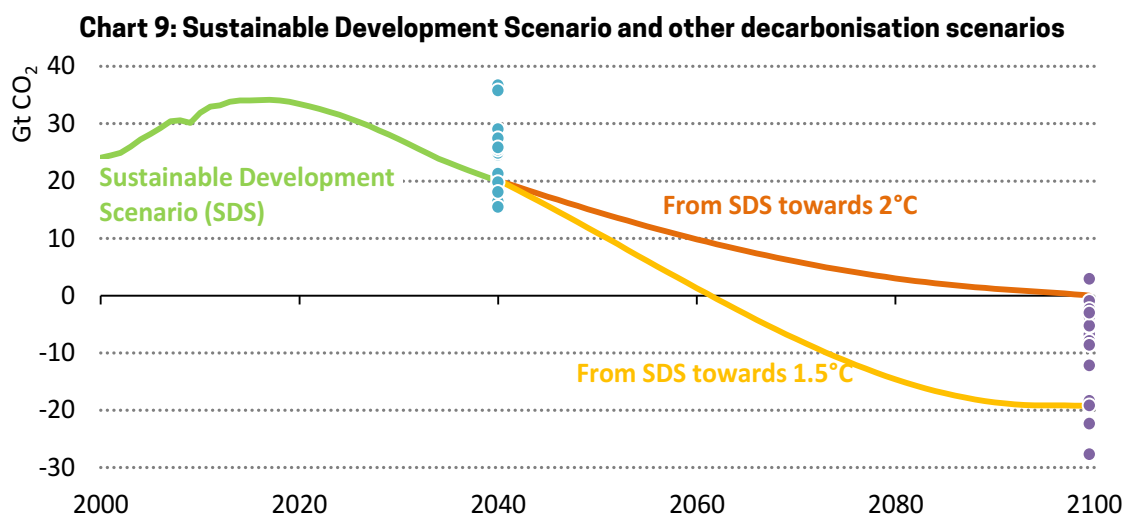
**Policy ambition and effort is likely to increase significantly.** The IEA explicitly recognizes that “the emissions trajectory in the New Policy Scenario is clearly out of step with the requirement of the Paris Agreement” and that “there will undoubtedly be additional policy shifts between now and 2040.” This means that scenarios such as the SDS, rather than being outliers or optimistic cases, will become more important baseline cases, while scenarios that envisage little or no policy change above what is currently announced will be less reliable guides to transition risks and opportunities.

**Major emissions reductions in electricity generation are critical.** Compared to existing policies, the electricity sector accounts for 62 per cent of emissions reductions to 2040 in the New Policies Scenario, and 58 per cent in the Sustainable Development Scenario. Other sectors also have a major role to play, but rapid and sustained emissions reductions in electricity generation, extending well beyond the sector's proportional share of total emissions, is the most feasible and cost-effective way to move towards a Paris-consistent emissions trajectory.

This is a particularly important signal for the direction of Australian policy. Australia's CO<sub>2</sub> intensity of electricity generation is now around twice as high as the IEA average. Yet current Government policy targets a reduction in electricity emissions to 2030 that is proportional to overall emissions reductions targets — that is, a 26 per cent reduction in electricity-related emissions, as part of a national target for a 26-28 per cent reduction in overall emissions by 2030 compared to 2005 levels. Lower emissions reductions targets or outcomes in electricity generation imply more policy effort on energy efficiency and higher emissions reductions targets in more difficult-to-decarbonise sectors. This implies greater investment needs and adjustment costs for firms in buildings, transport and agriculture sectors, amongst others.

**A low-carbon scenario is not compatible with unabated coal-fired power generation.** The SDS envisages a halving of coal-fired power generation by 2040, at which point most coal-related emissions would be mitigated by carbon capture and storage (CCS). The absence of cost-effective CCS doesn't imply that a less-than-2°C trajectory is unattainable without CCS. Rather, it suggests that coal-fired power generation will and must be curtailed even more sharply than the SDS envisages.

**Two-degree or less scenarios require rapid decarbonisation beginning now, further cuts beyond 2040, and net negative emissions in the second half of the century.** Ultimately, temperature outcomes will be a function of cumulative anthropogenic emissions at the point of total decarbonisation and any irreversible climate effects that cannot be undone through negative emissions. The SDS trajectory is aligned with carbon budgets that could keep global warming below 2°C, but the long-term temperature rise hinges on developments beyond 2040. Keeping temperature increases closer to 1.5°C would require significant net negative emissions in the later part of this century. Both options imply policy efforts on top of the SDS assumptions beyond 2040 — a time frame now firmly within the expected lifespan of assets being created now through investments in resource extraction, energy generation and infrastructure.



Emissions from scenarios projecting global temperature rise of around 1.7-1.8°C: ● 2040 ● 2100

Note: Chart shows energy- and process-related CO<sub>2</sub> emissions. Dots represent emissions in 2040 and 2100 from all Representative Concentration Pathway 2.6 (RCP 2.6) scenarios in the most recent Shared Socioeconomic Pathways (SSP) database. Source: International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris. Figure 3.12

An important, related point is that net emissions must fall to zero to stabilise temperature to stabilise at any level – be it 1.5°C, 2°C or more. Different scenarios provide different pathways or timeframes for reaching this point. But a core insight common to each is that companies need to develop long-term business models and strategies that can maintain profitability and limit supply chain risks in a net-zero economy.<sup>13</sup>

## Understanding limitations, gaps and omissions

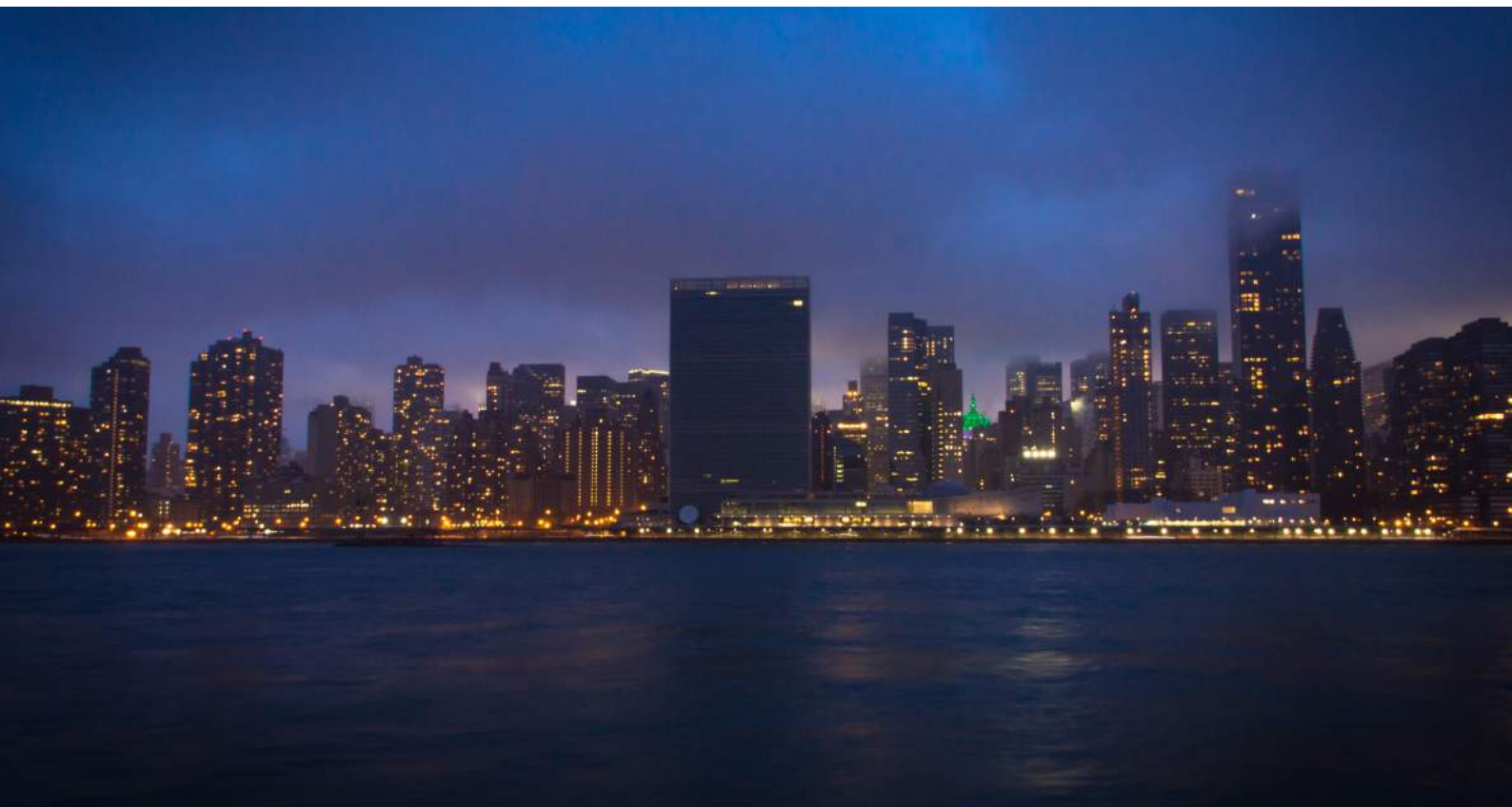
While these IEA resources can be an important starting point, sophisticated scenario analysis will need to go beyond them. Understanding the limits of what these global scenarios can offer, and demonstrating an ability and willingness to test for risks, exposures and opportunities that they are not designed to draw out, is a key hallmark of good climate risk analysis.

The IEA scenarios focus primarily on energy systems, do not extend beyond 2040, do not provide granular outputs for individual sectors and countries, and are geared towards policy rather than financial analysis. Additionally, while they do incorporate some important policy shifts, they do not include more challenging assumptions around technological disruption, behavioural change and material substitution and efficiency.

<sup>13</sup> See Millar et al, 'Principles to guide investment towards a stable climate', *Nature Climate Change* 8, 2-4, 2018.

These limitations reflect theoretical challenges with scenario modelling as well as analytical choices made by the IEA. Top-down, system-wide approaches are likely to miss important variations and nuances in specific parts of the system. The assumption of effective, low-cost policy pathways overlooks the complex social, economic and technological interactions that will influence policy outcomes. (For example, most global scenarios are optimized around a global carbon price, assuming that action on climate change occurs through least-cost technologically-neutral abatement.) Conservative assumptions about new technologies that could be developed and commercialised — while justified given the difficulty of anticipating innovation and invention — means scenarios can overlook important tipping points and pathways.

As a result, conventional scenarios are likely to overlook or underestimate important factors. Companies that do not look beyond them may miss or underestimate important risks and evolutions that should greatly affect their business and investment decisions. The next section outlines some emerging approaches to scenario analysis that incorporate greater disruptions and a more granular focus on how these might play out in Australia.



# SECTION 4: UNDERSTANDING DEEP UNCERTAINTY THROUGH EXPLORATORY SCENARIO ANALYSIS

## Summary

This section highlights some existing and emerging resources with more challenging assumptions for scenario analysis and summarises important elements of an interactive scenario design process. There are “off the shelf” scenarios for considering more ambitious or disruptive transition pathways than those provided by the IEA. Organisations seeking to develop tailored scenarios can engage in an interactive scenario development process to draw out key scenario drivers and narratives.

## Climate change is characterised by deep uncertainty and many current scenarios do not go far enough

Climate change is an incredibly complex problem that is characterised by deep uncertainty. Deep uncertainty arises due to the combination of both complexity and unknowns:

- Global action on climate change will require systemic changes in economic, social, technological and environmental systems that will have complex interactions and feedbacks. That makes climate change actions and impacts very complex to model.
- The challenges of climate change are not comparable to past events, so it is impossible to draw comparison to how events have transpired in the past. Climate scenarios are uncharted pathways and low carbon technologies have either outperformed (e.g. solar, batteries) or underperformed (e.g. CCS) predictions. In addition, potential “Black Swan” events such as the Fukushima nuclear disaster can have systemic impacts that are impossible to predict.

Conventional approaches to planning are poorly suited to these situations. As outlined in the previous section, while conventional scenarios are now beginning to explore more ambitious climate trajectories and interrelated policy goals, they often include narrow or conservative assumptions that do not enable business to test their strategies against a wider range of uncertain future conditions.

## Some “off-the-shelf” scenarios are better suited for more challenging analysis

Some “off-the-shelf” scenarios are better suited to more challenging climate risk and opportunity assessment. Recently more scenarios that do not rely solely on top-down economic analysis have been addressing a range of potential outcomes that could be experienced during the climate transition. Table 2 shows some key assumptions for a selection of these next generation scenarios, which are built upon a narrative-based approach and could be used for scenario analysis. These next generation scenarios can be used verbatim or adjusted using supplementary narratives or data to suit the needs of the business.

Next generation scenario resources that incorporate more challenging assumptions and a more granular regional and/or sectoral focus could help overcome many of the limitations associated with mainstream global scenarios. ClimateWorks Australia is developing a new generation of Australian-specific decarbonisation scenarios that incorporate more exploratory pathways and disruptions. These new scenarios will be better suited to test the range of potential transition risks or to inform even more tailored scenarios (Box 7).

**Table 2: Some more challenging transition scenarios**

	World Energy Council “Modern Jazz”	Shell “Sky”	Greenpeace “energy [r]evolution”
<b>Climate ambition</b>	3°C	1.5°C	1.5°C
<b>Electric vehicles</b>	32% of global fleet by 2060	30% of new vehicle sales globally by 2030	8,100 TWh of electricity are used globally for EVs and rail by 2050
<b>CCS</b>	4.8Gt CO <sub>2</sub> /yr captured by 2050	5Gt CO <sub>2</sub> /yr captured by 2050	No information available
<b>Automation</b>	Automated, zero carbon mass transit and increased productivity	Accelerated electric vehicle uptake due to automation	29% of new vehicles sales in Asia (excluding China) are autonomous in 2050
<b>Materials efficiency</b>	Explores concepts of circular supplies, resource recover, product life extension, sharing platforms and products as a service	No information available	Implementation of best practice technology in industry and improved recycling rates
<b>Behaviour change</b>	Interactive demand management practices are widely adopted	Consumption and production patterns change mostly as a result of carbon pricing	Reduction of car dependency, incentives for sustainable transport and land use
<b>Technological innovation</b>	‘Smart cities’ characterized by new demand management technologies. 75% reduction in capital cost of solar PV by 2050	Innovations in material science for carbon supply chains, creation of products from carbon capture and biomass feedstock	Renewable technology innovation is driven by renewable energy targets across all sectors, reducing costs and increasing investment

**Box 7: Frontiers of Decarbonisation — new generation scenarios developed by ClimateWorks Australia**

ClimateWorks Australia is developing a knowledge base to support broader exploration of scenarios for Australia’s energy and carbon transition. The Frontiers of Decarbonisation project will analyse the potential of innovative technologies, along with social and economic practices, and develop scenarios to illustrate the range of possible trajectories for the Australian economy, compatible with the 2°C climate goal as well as the 1.5°C climate goal.

Mainstream climate scenarios do not include many technologies which are already expected to disrupt their respective industries. One example is the potential impact of autonomous vehicles on personal and freight transport services. Another is 3D printing, which is often ignored, even though it could significantly change the structure of the manufacturing industry and deliver step changes in energy and material efficiency. More specific technologies could also disrupt existing subsectors. Laminated timber, for example, could significantly reduce demand for steel in construction, as well as create new revenue sources for carbon forestry.

The Frontiers of Decarbonisation project will run a large set of scenarios in the newly developed Australian TIMES model (in collaboration with CSIRO and based on a tool developed by the IEA). ClimateWorks Australia will develop tools and extract a set of representative scenarios, which will be explained and analysed in a report to be published by the end of 2018.

The scenarios detailed in the report will be available for organisations to use directly for scenario analysis. The project will also develop scenario building tools to enable the design of scenarios to test risks that will be of material importance to individual organisations.

## Developing tailored scenarios to capture the range of relevant risks

If available scenarios are not relevant to a particular business, or not sufficiently distinctive and challenging, then businesses can develop their own tailored scenarios and consider a wider range of disruptions. The TCFD recommendations and its technical appendix on scenario analysis offer important guidance for companies developing their own tailored scenario analyses and narratives. This includes the following guidance on key characteristics that tailored climate scenarios should include:

**Table 3: TCFD recommendations on scenario design**

Scenario qualities	Description
<b>Plausible</b>	The narrative of each scenario must be credible: the descriptions of what happened, and why and how it happened, should be believable.
<b>Distinctive</b>	Scenarios must be sufficiently diverse, focusing on different combinations of the key factors. Given the agreed international climate change commitments, scenarios aiming to strive for a limit global warming to 2°C and 1.5°C above pre-industrial levels should be included.
<b>Consistent</b>	Each scenario must be easy to follow with consistent internal logic.
<b>Relevant</b>	Each scenario must be material to the needs of the business, testing risks and opportunities that are central to the operation of the business. Continual engagement with stakeholders is a good way to ensure that scenarios will be relevant to decision making.
<b>Challenging</b>	Scenarios should challenge the conventional thinking on a range of key assumptions that are material to the business.

Developing tailored scenarios that cover all relevant key business activities and that are challenging but widely supported by the stakeholders requires a different approach than the top-down processes largely used in the past for strategy development. A key challenge is ensuring that scenarios that are tailored for specific organisations or sectors maintain consistency and comparability with other exercises, reinforcing the importance of the consistent high-level principles and parameters outlined in CPD's 2017 discussion paper, and the potentially influential role of sector-led initiatives that can co-ordinate and develop best practice across multiple organisations.

Developing tailored scenarios can be done using an interactive exploratory thinking approach,<sup>14</sup> which involves taking key stakeholders through a participatory process to ensure the scenarios capture the range of drivers and risks that are most critical for the organisation. This approach "bridges various perspectives and various areas of expertise to identify the most material sources of risk associated with climate change transitions. It also helps to create a shared understanding and consensus about the vulnerabilities for the business, regardless of how each one of the actors characterises the likelihood of different futures."<sup>15</sup>

Box 8 presents a summary of the different steps proposed to conduct a full iterative climate strategy development, using exploratory scenarios developed through an interactive exploratory thinking process. Key stages in this process, including the identification of scenario drivers, development of scenario narratives and modelling of scenario outputs, are discussed in the section below.

<sup>14</sup> Shirin Malekpour et.al, 'A methodology to enable exploratory thinking in strategic planning', *Technological Forecasting and Social Change*, 105, p.p. 192-202, April 2016

<sup>15</sup> Enayat A. Moallemi & Shirin Malekpour, 'A participatory exploratory modelling approach for long-term planning in energy transitions', *Energy Research & Social Science*, 35, p.p.205-216, January 2018

## Box 8: Iterative climate strategy development process, using exploratory scenarios

### 1. Going through an “interactive exploratory thinking process”

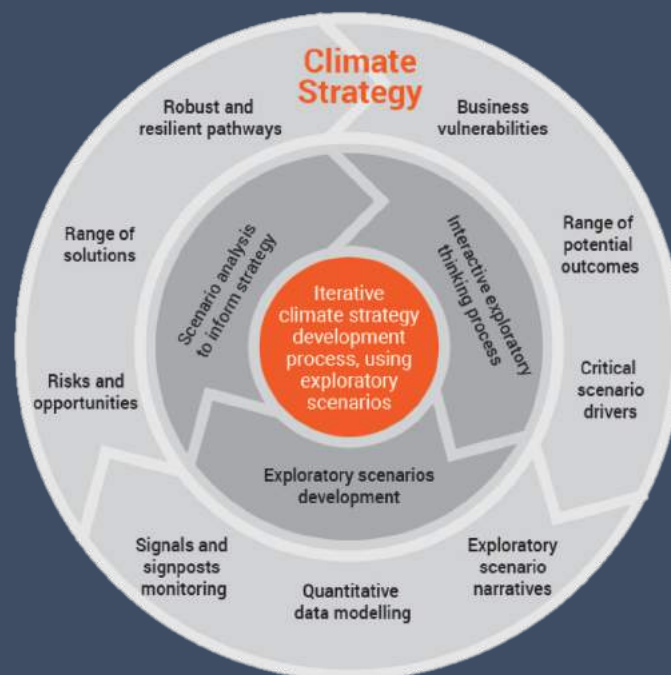
Starting the scenario analysis process with a dialogue between key internal and external stakeholders and decision makers can enable them to reach agreement on key uncertainties for the business, providing for more robust decision-making and greater buy in from relevant parts of the organisation including at executive and board level. (Board engagement in this process is both consistent with directors’ duties on climate risk, and critical if scenarios are to be well targeted and improve decision making and strategy.) Using the framework below, the ‘interactive exploratory thinking process’ includes a collective understanding of the business vulnerabilities, the identification of the range of potential outcomes and the prioritisation of critical scenario drivers.

### 2. Developing exploratory scenarios

Building upon the critical scenario drivers identified during the interactive exploratory thinking process, businesses can choose either to use new generation scenarios verbatim if they are relevant for their activities, to adapt these scenarios to suit their needs, or to embark on an exploratory scenario development process to create more tailored scenarios. The scenario should start with the development of consistent narratives, which explain different possibilities for the future and their expected outcomes. This step can be completed with a modelling phase to develop quantitative data for the most relevant scenarios. This data can then inform the elaboration of signals and signposts to add tangibility to scenario narratives while allowing the long-term monitoring of scenarios.

### 3. Using the scenario analysis to inform the climate strategy

Once a set of plausible, distinctive, consistent, relevant and challenging scenarios has been defined, these scenarios can be used to conduct a risk and opportunity assessment, by testing the current business strategy against each of the scenarios. The business will then have to think about solutions that could help the business avoid risks or exploit opportunities. Compiling compatible solutions together and considering several options for more flexibility will generate robust and resilient plans for the business to thrive in a low carbon transition.



Source: ClimateWorks Australia



This process begins by identifying the scope of the investigation that is most valuable to future planning, identifying the markets, geographies and time periods that are most relevant for the business. In the case of climate change, a long timeframe is likely to be most appropriate to ensure that a business's potential exposures to long-term transitional and physical risks are adequately addressed.

Once scope and timeframe are defined, the collective thinking process should identify the major sources of potential climate-related vulnerability for the business. The most important vulnerabilities will relate to operations or profitability that are materially impacted by systemic economic or environmental changes associated with climate change. The materiality of the vulnerabilities can then be explored by considering the range of potential outcomes for each vulnerability. (A company in the electricity sector, for example, could rely heavily on profits from large-scale fossil fuel plants and that vulnerability could be challenged by considering different outcomes, such as a distributed electricity system dominated by small scale renewables or a decrease in electricity demand due to customers going off-grid). This approach will facilitate the high-level identification of the broad range of potential risks and opportunities and assist in establishing an initial list of vulnerabilities that could be used as scenario drivers.

For scenarios to be effective, they need to be exploratory and to challenge business-as-usual assumptions that would be impacted by a transition to a low carbon economy. This means collective thinking should not be limited to mainstream or easily-modelled drivers but should incorporate both high level scenario drivers that build the global context for the scenario narrative (e.g. climate and economic factors such as population and GDP growth, climate ambition, emissions trajectories) and more specific drivers that are directly relevant to particular vulnerabilities a business might face (e.g. spread of particular technological innovations, shifts to localised economies, development of sustainable agriculture production).

Examples of scenario drivers are presented in Table 4:

**Table 4: Example scenario drivers**

Scenario component	Example of scenario drivers	Impact description
<b>Economic structure</b>	Growth in middle class of developing nations	Increase in demand for products typical of the middle class, for example, beef and construction materials
<b>Production</b>	Circular economy	Increased rates of reuse and recycling and waste streams of industries being used for production
<b>Consumption</b>	Consumer led shift to low carbon living	Increased consumer demand for low carbon products and decreased demand for carbon intensive products
<b>Transport</b>	Autonomous vehicles	Increase in the energy efficiency of transport and in kilometres travelled per person per year, reduction in freight cost
<b>Infrastructure</b>	Increase of temperatures and carbon dioxide	Increased rate of carbonation of concrete infrastructure causing an accelerated deterioration of reinforcement

It is clearly impossible to include all potentially-important drivers of future outcomes. Instead, organisations should focus on the key scenario drivers that are most material to their own planning and strategy. The severity of potential impacts on the business from the range of possible environment outcomes identified during the exploratory thinking process will give an indication of the materiality of each vulnerability. The Impact vs Uncertainty matrix presented in Figure 1 below is a useful tool to identify the drivers and assumptions that should be tested in the greatest level of detail. Less focus will be required for the less material assumptions, which could be approximated with broad estimates or excluded from scenarios altogether.

**Figure 1: Example of Impact/Uncertainty Matrix**

<i>Degree of uncertainty</i>			
Low	Medium	High	
<b>Critical planning issues</b> Highly relevant and fairly predictable (can often be based on existing projections). Should be taken into account in <i>all</i> scenarios.	<b>Important scenario drivers</b> Extremely important and fairly certain. Should be used to differentiate scenarios. Should be based on projections but potential discontinuities also should be investigated.	<b>Critical scenario drivers</b> Factors and forces essential for success and highly unpredictable. Should be used to differentiate scenario plots and trigger exit strategies.	High
<b>Important planning issues</b> Relevant and very predictable. Should be figured into most scenarios.	<b>Important planning issues</b> Relevant and somewhat predictable. Should be present in most scenarios.	<b>Important scenario drivers</b> Relevant issues that are highly uncertain. Plausible, significant shifts in these forces should be used to differentiate scenario plots.	Med
<b>Monitorable issues</b> Related to the decision focus but not critical. Should be compared to projections as scenario is implemented.	<b>Monitorable issues</b> Related but not crucial to the decision focus. Should be monitored for unexpected changes.	<b>Issues to monitor and reassess impact</b> Highly unpredictable forces that do not have an immediate impact on the decision focus. Should be closely monitored.	Low

Source: Jonathan Maack, 'Scenario analysis: a tool for managers', in Krueger et al, *Social Analysis: Selected Tools and Techniques*, 2001.

At this point of the scenario development, once the vulnerabilities and the key scenario drivers have been identified and all stakeholders are engaged in the scenario analysis process, organisations might identify existing scenarios that already include their key scenario drivers and suit their needs. In that case, they may choose to directly use these existing scenarios or to use scenario development tools such as those to be developed under the *Frontiers of Decarbonisation* project (Box 8 above).

## Developing consistent scenario narratives

Scenario narratives explain different possibilities for the future, and their expected outcomes. Scenario narratives should provide a clear and memorable shorthand to understand the main themes in the scenario, without having to go too deep into the detail. A good scenario narrative can help make very complex scenario modelling more relatable and applicable to the end user and can help users compare events that are happening in the real world to the timeline in the narrative. These narratives should use the key scenario drivers and capture the range of possibilities that have been identified in the previous exploratory process. The combinations of possibilities which form an inconsistent narrative (e.g. a scenario where there is a climate ambition of 1.5 degrees with very limited technological innovation) should be discarded.

## Illustrating potential scenario drivers and narratives at the whole of economy level: ClimateWorks Australia's scenario framework

ClimateWorks Australia has developed a scenario framework that can help identify climate scenario drivers and develop narratives, incorporating scenario drivers that are relevant for the whole economy. This framework can be adapted and refined based on the organisation's business. It is not aimed at providing an exhaustive list of drivers; rather, it gives an idea of the wide range of scenario drivers to consider in the scenario development process. That is the type of scenario framework that will be used for the *Frontiers of Decarbonisation* project (Box 7).

Two illustrative scenario narratives are proposed as an example in the Box 9. These correspond to the two sets of scenario drivers presented in ClimateWorks Australia's scenario framework.

### **Box 9: Illustrative climate scenario narratives**

Two example scenarios below highlight scenario drivers that could help a hypothetical large electricity generator and network operator on the NEM to better understand the risks and opportunities posed by climate change. This company has coal, gas and renewable assets as well as network infrastructure assets and wishes to test the profitability of each asset class in the medium and long term across two vastly different scenarios. The approach to a number of key drivers are illustrated on the scenario framework on p.36 highlighting the range of drivers and choices available in scenario design.

#### **Scenario A: "Policy Perpetuity" (Blue triangles)**

Political divisions and a lack of pressure from the citizenry delays action on climate change, with alternating governments enacting and repealing climate policies, leading to a lack of investment in, and implementation of low-carbon energy technologies.

The energy generation mix slowly moves towards a higher penetration of renewables, due to cost competitiveness, while policy interventions make the use of CCS in retrofits and new builds is commonplace after 2030.

With little incentive for electrification only the most profitable opportunities are pursued, while there is ample low-carbon fuel available due to the rates of deforestation. Electricity demand is buoyed by increasing population and the rise of electric vehicles, but is somewhat offset by energy efficiency initiatives.

By mid century the temperature is 3°C above pre-industrial levels and there are significantly more extreme weather events, with detrimental impacts on infrastructure resilience.

#### **Scenario B: "Prosumers Paradise" (Red triangles)**

Strong ambition drives policy support for bottom up, business led innovation towards distributed, low carbon energy generation technologies and platforms.

Profound societal change through the adoption of the principles of the shared and circular economies present new opportunities in a rapidly changing business landscape.

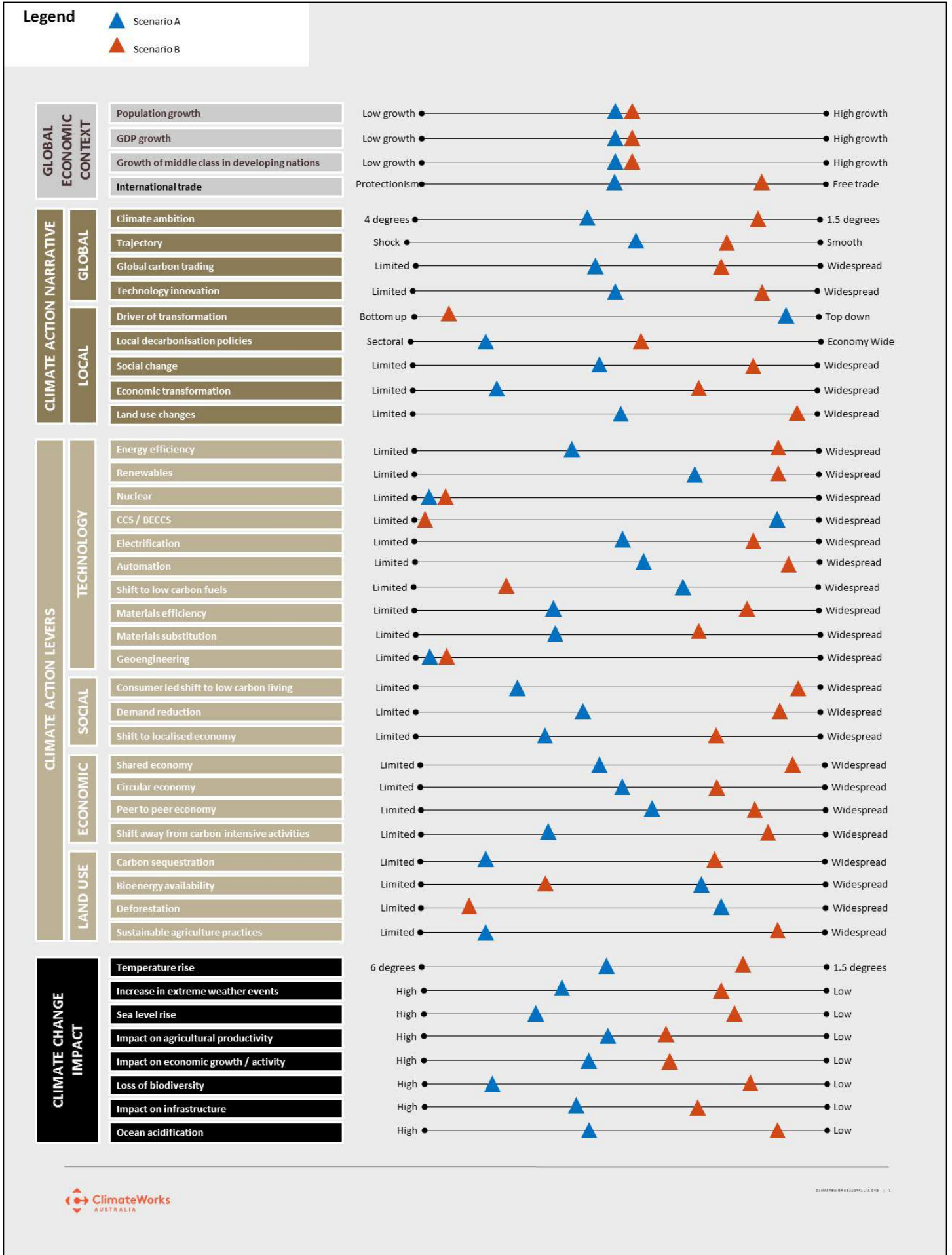
Electrification, net-zero micro grids and energy efficiency initiatives are widespread, driven by the demand for business to operate with a social license. In cases where renewable generation is not feasible on site, green power is often procured, driving demand for large scale renewables projects, while also causing the premature closure of emissions intensive energy generation infrastructure.

Natural gas turbines remain integral to grid stability in the short to medium term but quickly become redundant, following the realisation of the potential of the smart grid around 2035.

Smart appliances modulate consumption to match supply, working in tandem with platforms which facilitate localised networks of trade between energy consumers and producers with on-site generation and batteries.

By mid century the temperature is 2°C above pre industrial levels and the impacts of climate change are relatively less damaging to infrastructure.

Figure 2: ClimateWorks Australia illustrative scenario framework



## Scenario modelling and outputs

The TCFD's recommendations state that "organisations just beginning to use scenario analysis may choose to start with qualitative scenario narratives or storylines to help management explore the potential range of climate change implications for the organisation. As an organisation gains experience with qualitative scenario analysis, the scenarios and associated analysis of development paths can use quantitative information to illustrate potential pathways and outcomes". The recommendations continue by saying that "the choice of approach will depend on an organisation's needs, resources, and capabilities."

Quantitative modelling can be costly and time consuming, which is why the prioritisation of scenarios for further analysis is central to the success of the exercise. The set of scenarios selected for quantitative modelling should possess all the five characteristics listed in the TCFD's recommendations and presented earlier in Table 3.

If quantitative data is used to support scenario narratives, the data should always be consistent with other aspects of the scenario's narrative and should be sense-checked. Scenario modelling carries inherent complexity that, if not properly understood, can lead to an interpretation that does not accurately reflect the results of the scenario. When performing quantitative analysis, all data sources, key assumptions and methodology should be explicitly stated to increase transparency. Increasing the transparency of modelling increases the confidence in the process, the results and the overall utility of the outputs.

Modelling outputs can vary greatly depending on the requirements of the business. Common examples in climate scenario analysis include economic output, energy use and carbon emissions, by country, sector or supply chain depending on the granularity warranted by the modelling exercise. Many insights can be inferred from the changes in these outputs over the time frame of the modelling. These outputs can also be used to create benchmarks that can be used to understand the rate at which change is required within the business. Metrics will also provide a source of signals and signposts that can be used to provide insights into how real-world events compare to the modelling over time.

## Using scenarios to inform climate strategy

### Signals and signposts

The TCFD highlights this need for an iterative and continuous process: "*Scenario analysis can help organizations identify indicators to monitor the external environment and better recognize when the environment is moving toward a different scenario state (or to a different stage along a scenario path). This allows organizations the opportunity to reassess and adjust their strategies and financial plans accordingly.*"

Signals and signposts are essential for the long-term use of scenarios as a business planning tool and are useful indicators to support the scenario narratives and timelines. Signals are the general trends that indicate the extent to which reality relates to the scenario narrative (e.g. the sales of electric vehicles increasing by 50 per cent p.a. until 2030). Signposts are milestones, events that take place and are central to a scenario's narrative (e.g. government commitment to 100 per cent renewable energy by 2040). Identifying signals and signposts add tangibility to scenario narratives while increasing the utility of the final result, by providing a roadmap which can be compared to events in the real world to deduce which scenarios are more likely in coming to fruition.

## Developing robust and resilient plans

While scenario analysis itself can offer important insights on key risks and vulnerabilities for the organisation, its true value lies in helping to prepare for a range of outcomes that may not be considered in business as usual

planning. Ultimately, its aim is to support development of solutions and strategies to address climate-related risks and opportunities, and the building of a robust and resilient climate plan.

Scenarios should provide key metrics that can be used to test the resilience of the organisation's current and potential organisational business plans to transition risks. This should be done by assessing the business plans in the short, medium and long-term under the conditions present in each of the scenarios.

A comprehensive analysis should consider the following steps:

1. Assessment of the impact of risks and opportunities inherent in the scenarios and their impact on the performance of the business plan under scenario conditions.
2. Prioritisation of these risks and opportunities based on the materiality to the business. This prioritisation should consider a number of factors, including the impacts on the business, uncertainty of the outcome and frequency at which the risk or the opportunity is present across different scenarios.
3. For each identified risk or opportunity, a range of solutions should be developed, to either hedge against future risks or exploit opportunities.
4. To analyse the robustness of solutions, they should be tested under different time frames and scenarios, including "black-swan scenarios" (scenarios that are considered less likely to occur but would have major impacts on the business).
5. Identified solutions should then be grouped for the development of a robust strategy. The strategy should perform well across a range of scenarios and should not 'lock in' to a certain pathway.

Scenarios analysis should not be a one-off exercise, but should become integral to the organisation's regular processes of risk management and strategy development. Each iteration of the process should accommodate new risks and opportunities as they are identified. Plans developed through this process should be adaptive and metric driven to respond to changes in circumstances, as identified through signals and signposts above.

By considering these elements of planning under uncertainty, a robust and resilient plan can be developed to enable the business to perform well under a range of potential climate-related outcomes.



# SECTION 5: PHYSICAL RISK IN SCENARIO ANALYSIS

## Summary

This section reinforces the importance of considering physical risks in scenario analyses and highlights some important resources emerging for assessing physical impacts in Australia. All companies and financial institutions will likely be exposed to the impacts of climate change. Even an extremely optimistic base case scenario around emissions mitigation does not correspond to zero or negligible impacts. Yet compared to transition risks, physical risks have received inadequate attention in climate scenario analysis. Despite widespread recognition of this shortcoming, and despite growing awareness of scientific advances in anticipating climate change impacts, there has been little improvement in the disclosure of physical risks since CPD published the *Climate Horizons* discussion paper last year. Disclosers can and should be making far greater efforts to incorporate physical risks into their scenario analysis.

## The unique challenges of physical climate risk

Our previous paper outlined why physical risk must be considered by all disclosers, even if their strategy is centred on a Paris-consistent mitigation scenario. It found, however, that few early adopters of TCFD recommendations had disclosed physical risk so far.

Revisiting available disclosures found little if any improvement in physical risk scenarios, despite improvements in mitigation-related work, although the resources for disclosers and their stakeholders to draw upon have grown considerably.

This is particularly concerning as climate science research indicates that effects are outpacing IPCC trajectories.<sup>16</sup> “Climate attribution” has quickly become established in the scientific community as a way of identifying a probabilistic “fingerprint” of climate change in individual extreme events – such as Superstorm Sandy or Australia’s “Angry Summer” of 2013.<sup>17</sup> Legal experts reviewing the science concluded that “the first kind of litigation to emerge is most likely to arise from failures to adapt to, or to prepare for, our changing climate.”<sup>18</sup> Liability risk has been identified as a plausible and increasingly well-demonstrated way for climate change to lead to financial losses.

This “gap” in physical risk work should be addressed as these clearer imperatives and new resources, together with increasing awareness and clarity of expectations, make substantive scenario analysis more common. However, addressing physical risk within the TCFD framework poses some distinct challenges. Understanding these challenges can provide a useful grounding for assessing and developing physical risk scenario analysis. They include:

**Physical science expertise:** Key inputs for physical risk are “climate drivers”, derived from complex models that represent the physics of atmospheric and oceanic systems<sup>19</sup> (and in some cases also

<sup>16</sup> See for e.g. Thomas Stoerk et al, ‘Recommendations for improving the treatment of risk and uncertainty in economic estimates of climate impacts in the Sixth IPCC Assessment Report’, *Review of Environment Economics and Policy*, June 2018 and Nicholas Stern, Economics: current climate models are grossly misleading, *Nature*, 24 February 2016.

<sup>17</sup> The Bulletin of the American Meteorological Society has since 2011 published an annual special report compiling such attribution studies under the series title “Explaining Extreme Events from a Climate Perspective”. The most recent can be found at: <https://www.ametsoc.org/index.cfm/ams/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/>

<sup>18</sup> Sophie Marjanac and Lindene Patton, ‘Extreme weather event attribution science and climate change litigation: an essential step in the casual chain?’ *Journal of Energy and Natural Resources Law*, April 2018.

<sup>19</sup> See IPCC Data Distribution Centre, ‘What is a GCM?’, Available at: [http://www.ipcc-data.org/guidelines/pages/gcm\\_guide.html](http://www.ipcc-data.org/guidelines/pages/gcm_guide.html)

incorporating biological and chemical system interactions<sup>20</sup>). In a practical sense, this technical knowledge is usually very far removed from the realm of financial or corporate expertise.

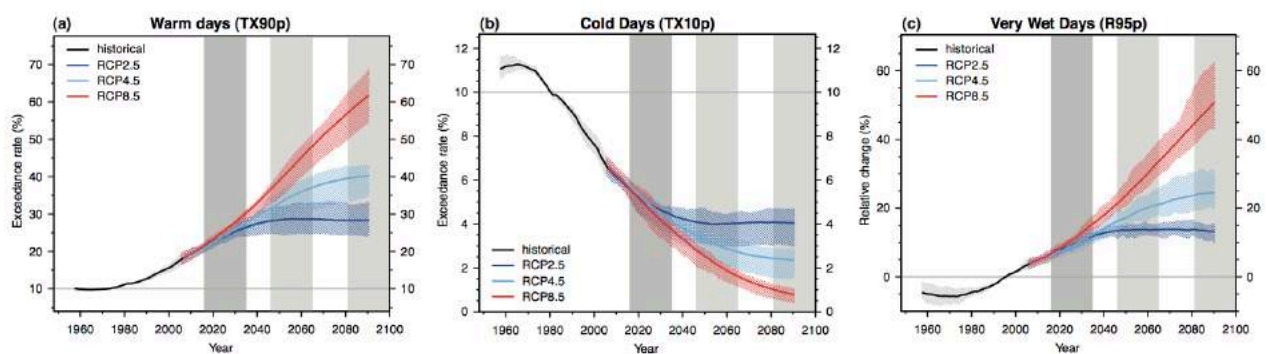
**Location and aggregation challenges:** For the purposes of TCFD-based analysis, which seeks to understand financial implications of climate change, a diverse combination of factors must be considered. These range from local geomorphology to the built environment, social structures, policy and business dependencies. These factors tend to be less scalable and less transferable than factors affecting climate transition. For portfolio companies and asset owners/managers this is particularly problematic as it limits the effectiveness of top-down or aggregated analysis.

**Financial functions:** Translating the effects of climate change itself into even high-level economic damages is a fraught and contested area (see Box 9, p.45). For more specific analysis of the financial costs that may be faced by corporate or financial institutions, there is very little in terms of established methodologies that can be applied across multiple sectors. This lack is especially problematic for sectors and asset classes which have not traditionally incorporated climate-variables or weather-related factors.

### Time horizons and certainty vary between transition risks and physical risks

While there is uncertainty over how drivers of climate transition may play out over the next few years, physical climate changes are baked in for the next few decades. IPCC studies have concluded that “mitigation actions starting now in the various RCP scenarios do not produce discernibly different climate change outcomes for the next 30 years or so...”<sup>21</sup> This means that different emissions scenarios have a high degree of overlap on significant climate impacts for at least the next two decades, which makes the choice of emissions scenario less important for assessing physical risks over this time period (Figure 3).

**Figure 3: Projected short- and long-term climate impacts under different concentration pathways**



**Figure 11.17 |** Global projections of the occurrence of (a) warm days (TX90p), (b) cold days (TX10p) and (c) precipitation amount from very wet days (R95p). Results are shown from CMIP5 for the RCP2.6, RCP4.5 and RCP8.5 scenarios. Solid lines indicate the ensemble median and shading indicates the interquartile spread between individual projections (25th and 75th percentiles). The specific definitions of the indices shown are (a) percentage of days annually with daily maximum surface air temperature ( $T_{max}$ ) exceeding the 90th percentile of  $T_{max}$  for 1961–1990, (b) percentage of days with  $T_{max}$  below the 10th percentile and (c) percentage change relative to 1986–2005 of the annual precipitation amount from daily events above the 95th percentile. (From Sillmann et al., 2013.)

Source: IPCC 2013, Climate Change 2013: The Physical Science Basis, p. 990.

<sup>20</sup> Nicholas Heavens et al, 'Studying and Projecting Climate Change with Earth System Models', *Nature Education Knowledge*, 4(5):4, 2013

<sup>21</sup> See IPCC 2013, *Technical Summary*, in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Available at: <http://www.climatechange2013.org/>



How does physical risk fit into scenario analysis?

The distinctions between transition and physical risk have prompted questions about whether the two should be treated in the same way within scenario analysis, and even whether scenario analysis is really appropriate for physical risk. There is a shift towards “scenario neutral” approaches in climate impact research community. Cicero, a Norwegian research institute, argues that elaborate scenario analysis is not necessary for physical risks because the effect of greenhouse gas emissions to date will continue to play out over the next two decades and should therefore be treated as a straightforward risk.<sup>22</sup>

While Cicero makes an important point about the way businesses should *consider and respond* to the inevitability of continuing climate impacts, we disagree with their recommendation that it be excluded from scenario analysis, for three reasons.

The first is largely pragmatic: TCFD-related scenario analysis exercises are likely to be the first time many companies and financial institutions engage with climate impacts, making them an important opportunity to incorporate previously overlooked climate factors. The second is temporal: while physical impacts and risks are important under all scenarios in the near-to-medium term, they diverge considerably over longer-term horizons which are nonetheless critical for strategy and planning – especially in sectors where assets and investments made today have an operating lifetime of several decades. The third is technical: scenarios are an important way to explore plausible extremes and compound events that are not fully addressed in climate models or traditional risk analysis, and to explore different ways that certain physical impacts might impact business activities.

## Reconciling these challenges and how to proceed

How should disclosers proceed, given the characteristics and challenges described above? We suggest four important steps.

### 1. Understand the multiple factors that drive climate risks

The challenges outlined above highlight that physical risk analysis cannot always be adequately understood by a top-down, quantitative, aggregated approach. However, this type of approach has broad appeal for many systematic, scalable financial analysis techniques. Reconciling the benefits and shortcomings of “bottom-up” and “top-down” approaches, and merging the two, is an overarching theme in developing and responding to climate scenarios.

A new paper by an international multidisciplinary group of experts identifies why both approaches are needed:

*For instance, understanding the possible meteorological drivers of a power outage in a city might require identification of the climate-sensitive elements of the energy system, such as the combination of renewable resources (solar, wind and hydroelectricity), together with the physical assets such as poles and power lines that could be affected by heavy winds, lightning and flooding. This in turn forms the basis for understanding the weather and/or climate drivers and hazards that could influence that system....*

*However, local-scale events are often embedded within larger-scale systems, which in turn are affected by planetary-scale features such as shifts in the radiation balance and associated changes in mean*

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<sup>22</sup> CICERO Climate Finance, ‘Climate scenarios demystified: A climate scenario guide for investors’, 31 January 2018.

temperature, mean sea level, the location of the jet stream and others. Modelling approaches that represent these ranges of space and time scales are therefore needed.”<sup>23</sup>

## 2. Build capability: become familiar with available sources of climate impact information

While there is still limited information on climate impacts that is deeply tailored to TCFD-style purposes, it would be a mistake to be too sweeping about the lack of information overall. For entities wanting to begin to assess exposures and vulnerabilities, a great deal of research exists, much of which is publicly owned and open source. IPCC reports draw upon a coordinated set of climate models and scenarios to provide authoritative updates of climate research roughly every seven years. Many national and sub-national resources also exist. For example, the Climate Change in Australia website is a vast resource.<sup>24</sup>

## 3. Understand climate models and other climate impact data

The cause of climate change — the atmospheric concentration of greenhouse gases increasing temperatures — operates according to the laws of physics. Global climate models (GCMs) are powerful simulations developed by teams of scientists around the world to project how climate “forcing”, including greenhouse gases released by human activity, will impact weather in the future.

These models can produce detailed, probabilistic expressions of future climate variables along different emissions pathways. Regional climate models cover smaller areas and can generate finer spatial resolution.

While climate models can very confidently predict some climate impacts (such as temperature) at varying levels of coarseness, entities conducting TCFD disclosures may seek a level of specificity that is difficult to meet. For example, while average global temperature changes over the next few decades can be projected with high confidence, other climate impacts are predicted by climate models with varying confidence levels.<sup>25</sup> The ability to model *extremes* is still evolving, and it is important to be aware that extremes are often the most important factor from a financial risk perspective. Earlier climate modelling and IPCC reports tended to focus on climate averages, but there is now increasing focus on extremes, which has grown since the IPCC published a Special Report on Climate Extremes in 2012.<sup>26</sup> For example, the IPCC found some evidence that representation of extreme rainfall events improved between the generations of models used in IPCC Assessment Report 4 and those used in the most recent report, IPCC AR5.<sup>27</sup>

Multiple types of information can and should be used to compare different time frames. For Australian entities, an indicative comparison of time frames from various information sources are represented in Figure 4:

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<sup>23</sup> Jakob Zschleischler et.al, 'Future risks from compound events', *Nature Climate Change*, 8, p.p. 469-477, 2018

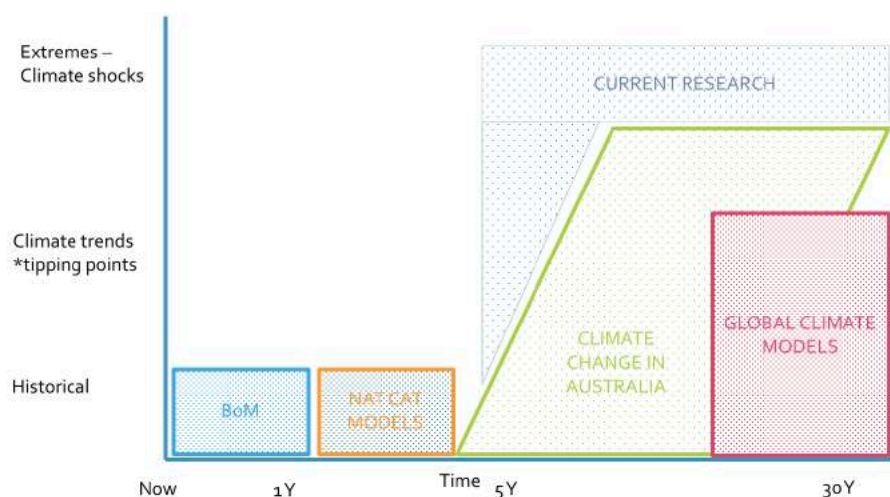
<sup>24</sup> Climate Change in Australia <https://www.climatechangeinaustralia.gov.au>

<sup>25</sup> For an overview of IPCC definitions of “high confidence” and other levels of terms relating to confidence, certainty and agreement, see Sophie Lewis and Ailie Gallant, 'Lost in translation: confidence and certainty in climate science', *The Conversation*, 23 August 2013, <http://theconversation.com/lost-in-translation-confidence-and-certainty-in-climate-science-17181>

<sup>26</sup> See IPCC, 'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaption (SREX)', Summary for Policymakers' 2012

<sup>27</sup> Flato et.al, 'Evaluation of Climate Models' in: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment report of the IPCC*.

**Figure 4: Approximate representation of time frames and impact coverage of various publicly-available physical information sources in Australia**



Source: LUCSAN Capital, Climate Policy Research Centre Pty Ltd. Jamie Hodgkinson and Dr Nick Wood, from presentation a National Center for Atmospheric Research’s Engineering for Climate Extremes Partnership (ECEP) symposium in February 2018 (used with permission).

#### 4. Draw on new guidance for physical risk in the TCFD context

An important recent paper published by the European Bank for Reconstruction & Development (EBRD) and Global Centre of Excellence in Climate Adaptation (GCECA) has some of the most detailed guidance to date.

It recommends that scenario analysis is critical role for understanding the second-order impacts of physical risks in the short and medium term, as well as the direct impacts of physical risks over longer horizons (Table 5). While first order physical risk impacts might arise directly from hazards and extremes (such as flood damage to buildings), second-order impacts include a wider array of impacts including the availability of resources, disruption of transport, migration and productivity. “Second-order impacts are much harder to model and predict, as they follow diffuse pathways from the initial hazard or trigger to the final impacts. They are well suited to scenario analysis because they are impossible to predict with precision, but must be considered due to their wide-ranging and potentially catastrophic effects.”<sup>28</sup>

**Table 5: EBRD and GCECA guidance on physical impacts and scenario analysis**

	Recommended timeframe	Approach to first-order impacts	Approach to second-order impacts
<b>Short term</b>	3-5 years	Probabilistic	Scenario analysis
<b>Medium term</b>	5-20 years	Probabilistic	Scenario analysis
<b>Long term</b>	20+ years	Scenario analysis	Scenario analysis

Source: European Bank for Reconstruction & Development and Global Centre of Excellence in Climate Adaptation, *Advancing TCFD guidance on physical climate risks and opportunities*, May 2018.

<sup>28</sup> EBRD and GCECA, *Advancing TCFD guidance on physical climate risks and opportunities*, May 2018

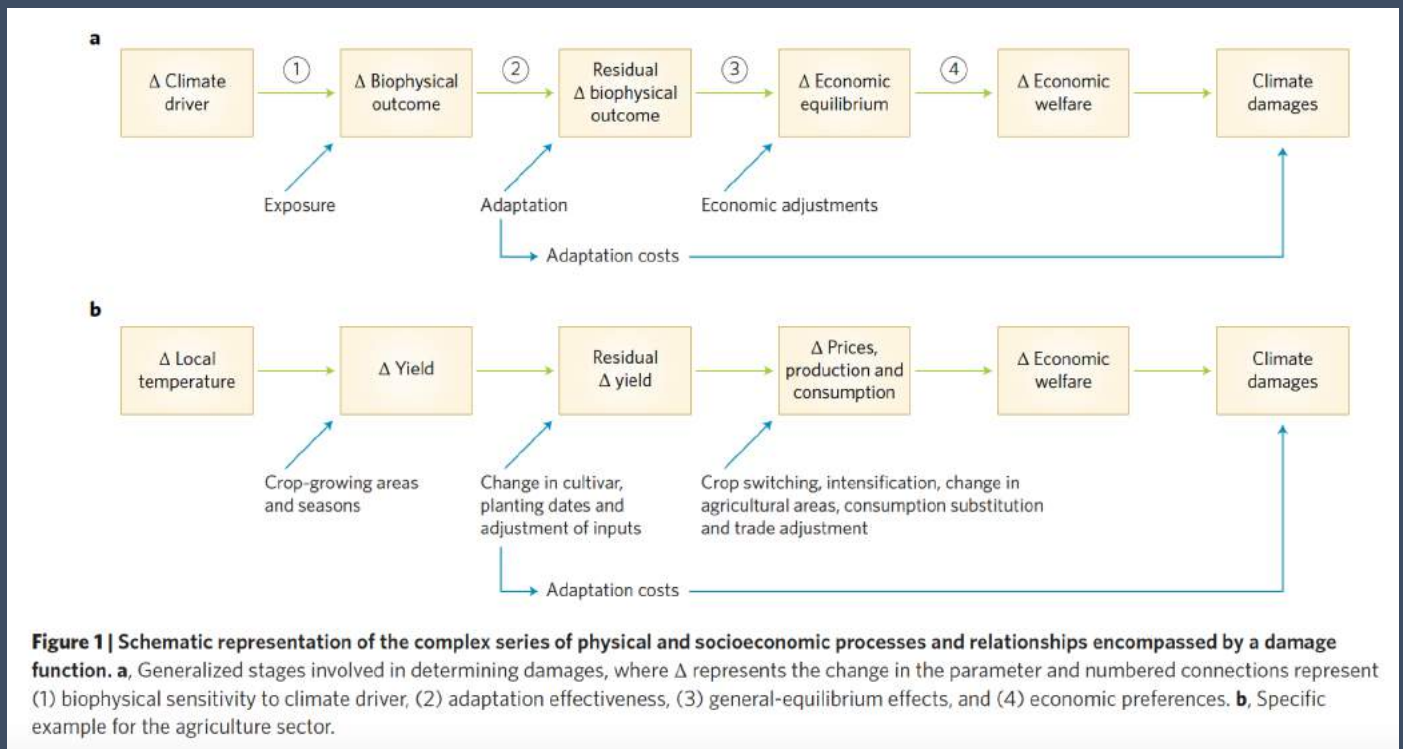
### Box 10: Boiling climate change down to costs (or revenue)

Early attempts to understand the effects of climate change on financial assets derived from cost-benefit integrated assessment models. However, these models are the subject of sustained criticism from within the economics field (e.g. Pindyk 2013, Wagner and Weitzman 2015). They are also not designed for estimating the financial impacts of climate change for a single organisation, as they were designed to answer a policymaking question (particularly relating to optimal pricing of carbon).

In academia there are several emerging ways of estimating the economic costs of climate impacts, from researchers in fields spanning economics, physical sciences, and other disciplines such as politics and engineering. Some of these may prove useful for TCFD disclosers.

Translating climate impacts into business impacts requires a number of steps. At each step, information, judgments and assumptions are required to estimate the exposure and sensitivity of the business operation or asset, the capacity for adaptation to minimise the impact, and the economic capability and propensity to implement such adaptations. (Figure 5 below, from Diaz and Moore (2017), is a general schematic of these steps, followed by one demonstrating a sector-specific example for agriculture).

**Figure 5: Assessing physical impacts and adaptation costs**



Source; Diaz and Moore, 2017

## Summary and recommendations on physical risk

While the following is not an exhaustive list, there are a number of steps that organisations can take to begin assessing physical impacts and risks under different scenarios.

### **Developing physical risk scenario analysis:**

Identify locations of assets, markets, logistics and supply chains. Geographical location is only one determinant of physical risk exposure, but information may not be available in an accessible format, or at all. Identification even at country or regional level for external factors such as markets may be useful, but more precise locations may be necessary depending on the level of financial exposure. For example, elevation may make one location far less susceptible to flooding than a similar asset located nearby but downhill.

Source sufficiently detailed information on the best science of climate impacts. This requires working out which climate modelling sources are most appropriate; differentiating between uncertainty quantification for different models types, scenario runs, and between the impacts themselves; and understanding fineness/coarseness of resolution of model and downscaling.

Understand sector-specific vulnerabilities. Focusing on sectors can be a way to develop broad estimates of vulnerability within an entity or group of assets, and it is one that will hold obvious appeal for portfolio companies and asset owners and managers with less ability to conduct more detailed and geographically-based assessments. The EBRD/GCECA paper has a useful “sensitivity matrix” for the Global Industry Classification Standard sectors; the authors stress, however, that it is “indicative only and should not be used as a substitute for a corporate materiality assessment”.

Understand the characteristics and vulnerabilities of key assets. Even with high resolution climate models and comprehensive tools and resources, disclosers still need to understand how their asset will fare in weather extremes. For example, what is a particular facility’s resilience to extreme heat, flood levels, or windspeeds? Have transportation links, communications, and other dependencies been assessed for vulnerability?

### **Disclosure of physical impacts and risk:**

Scenario analysis often serves to develop internal strategy around risks and opportunities, but the goal of the TCFD is to provide good information to market participants about climate-related factors. Organisations seeking to demonstrate a robust approach to TCFD-aligned scenario analysis and disclosure should consider making the following information available:

- Disclose locations of key assets, markets, supply chains and other important business operations.
- Identify the tools and resources that were used, including the underlying climate models and pathways or scenarios.
- Identify which climate impacts were considered relevant to the discloser (for example, “sea level rise, storm surge, extreme heat” and ideally more specific variables such as “days exceeding threshold”<sup>29</sup>)
- Where possible, use asset-level information both for exposure (precise geo-location) and for vulnerability elevation; characteristics such as materials and temperature sensitivity).
- Provide information on how “damage functions” are calculated or estimated. For example, does the discloser have historical information about weather extremes or natural disasters to use as a basis for estimating costs of extremes in the future?
- Provide information on possible adaptive measures that have been identified or evaluated.

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<sup>29</sup> A list of climate variable can be found at: <https://www.climatechangeinaustralia.gov.au/en/climate-campus/modelling-and-projections/climate-models/variables/>

## SECTION 6: POLICY RECOMMENDATIONS

### Summary

This section suggests next steps on climate-related risks and opportunities in Australia, beginning with how each of our financial regulators can build on recent progress. It calls for close monitoring of climate-related financial disclosures over the next 12 months to assess the case for mandatory reporting. A systematic review of sustainable finance in Australia is also recommended. To achieve this, the Federal Government should appoint a Sustainable Finance Taskforce to work with industry and civil society to develop a policy roadmap for green and sustainable finance. This would align Australia's efforts with major strategic shifts around the world.

### The role of financial regulators

Keeping climate change as close as possible to 1.5°C will require major policy, technological and societal innovations to drive historically unprecedented rates of emissions reductions.<sup>30</sup> This requires concerted and sustained policy response at all levels of government, using all the levers policymakers have at their disposal.

Financial regulators are only one piece of this much broader puzzle, but an important one. Achieving rapid decarbonisation requires replacing existing capital with new investments at massive scales and overcoming the economic and policy inertia that is a major constraint on mitigation pathways.<sup>31</sup> Leadership from objective and independent financial regulators can focus attention and effort on long term risks and issues that have become highly politicised or controversial. Their mandates intersect substantively with the investments that must be made and risks that will need to be managed in the transition to a zero-carbon economy.

Collectively, financial regulators have already played a key role increasing awareness of the TCFD framework, and raising expectations on business to comply. Regulatory approaches have not been uniform, however, which has been one factor in the wide geographical variance in implementing the TCFD's recommendations and the large gap between leaders and laggards on disclosure.<sup>32</sup> As the evidence on the uptake and effectiveness of the TCFD framework grows, policymakers and regulators need to weigh up the case for more direct interventions. This might include giving greater regulatory or legal force to climate-related disclosures or mandating practices that go beyond the TCFD recommendations.

### Playing catch up on climate risks and opportunities

Until recently, Australia has been badly out of step with international developments on these issues. At the start of 2017, when global business and policy leaders came together around the TCFD process, Australian regulators were yet to acknowledge publicly the potential financial and systemic impacts of climate change. In February 2017, APRA made a decisive intervention, clearly framing climate-related risks as a material and financial consideration for Australian entities. This increased awareness and built regulatory momentum, but as we recommended in November 2017 (Box 10), greater regulatory guidance and co-ordination is necessary.

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<sup>30</sup> Millar et al, 'Emissions budgets and pathways consistent with limiting warming to 1.5°C', Nature Geoscience, 18 September 2017.

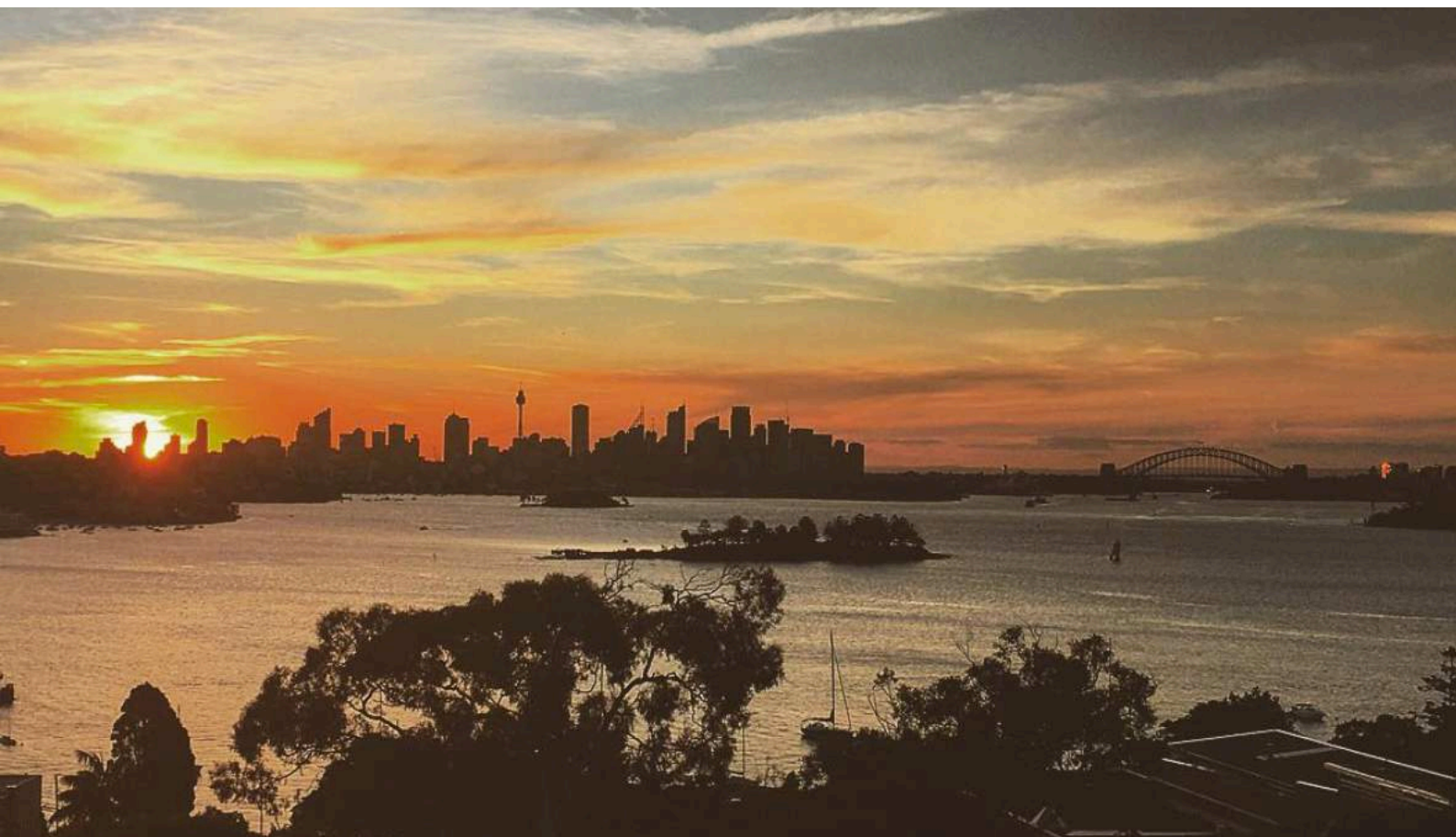
<sup>31</sup> Ibid

<sup>32</sup> Climate Disclosure Standards Board and Carbon Disclosure Project, 'Ready or not: are companies prepared for the TCFD recommendations?' March 2018.


### **Box 11: Key recommendations for regulators and policymakers from our 2017 *Climate Horizons* discussion paper**

1. Provide unambiguous support for the widespread adoption of the TCFD recommendations in Australia, including on scenario analysis.
2. Enhance climate-related guidance, supervision, and internal capabilities to better understand the systemic implications of climate risk.
3. Formally consider the case for more stringent climate-related disclosure requirements, including in light of Australian responses to the TCFD.
4. Improve co-ordination and information sharing by creating a Council of Financial Regulators working group with a specific mandate to focus on climate-related risks.

Significant regulatory developments and related announcements over the past six months have partly addressed our recommendations (see Figure 6 below). Milestones have included a second major statement by APRA on climate risks and opportunities (November 2017), an endorsement by the RBA of the TCFD's approach (February 2018), the Australian Government's response to the Senate report on Carbon Risk Disclosure (March 2018) and the release of draft updated Governance Principles and Recommendations by the ASX Corporate Governance Council, which expanded guidance on climate-related risk reporting (May 2018). Perhaps most significantly, regulators formed a working group within the Council of Financial Regulators, which brings together the Reserve Bank, APRA, ASIC and Treasury to share information, discuss regulatory issues and co-ordinate responses to financial stability threats. This group will play a vital co-ordination role and will focus initially on climate-related disclosures.



**Figure 6: Summary of climate risk responses by key organisations**

Public statements on climate risk	External co-ordination & engagement	Updated guidance to market	Internal climate risk capability	Actions and responses
				
Two major speeches on financial implications of climate risk in 2017	CFR working group (Aus) Sustainable Insurance Forum (global)	Specific guidance in speeches, such as encouraging entities to use scenario analysis	Internal climate risk working group established to co-ordinate responses	Climate risk included as part of APRA supervision Survey on best practice for climate risk disclosure
				
Climate risk mentioned several speeches and reports	CFR working group (Aus)	Encouraged companies to proactively consider reporting on climate risk under existing frameworks		
				
Governor supported TCFD report in testimony to Parliament	CFR working group (Aus)	Framed TCFD as 'exactly right direction to be heading' for disclosures		
				
Responded to Senate report	CFR working group (Aus) (Treasury) G20 Sustainable Finance study group (global) (treasury)	Endorsed recommendation for ASIC, ASX to update guidance on climate risk		
				
Climate risks discussed in ASX Corporate Governance Council consultation paper on revised guidelines	ASX Corporate Governance Council	Draft amended guidelines on climate risk disclosures for listed entities, including on TCFD use.		





Collectively, these responses mean Australia is in a far stronger position than it was at the beginning of 2017. A May 2018 study by the University of Cambridge Institute for Sustainability Leadership reflected this, ranking Australia in the middle of the pack among G20 countries when it comes to implementing the recommendations of the TCFD report (Table 6).

**Table 6: G20 approaches and progress for implementing TCFD recommendations**

No formal engagement with TCFD	Political and regulatory engagement	Formal engagement with private sector	Publication of action plans and guidelines	Encoded into law
Korea Argentina Saudi Arabia Russia Indonesia India	United States Mexico China Germany Brazil	Turkey Italy <b>Australia</b> South Africa United Kingdom Canada	Japan European Union	France

Source: Cambridge Institute for Sustainability Leadership, "Sailing from different harbours: G20 approaches to implementing the recommendations of the TCFD", May 2018.

## Assessing the case for mandatory disclosures

While recent developments are encouraging, Australia has much to do to bridge the gap with global leaders. International best practice on climate risk for regulators, companies and investors has accelerated rapidly since the TCFD recommendations were released. Adoption of TCFD-aligned practices in Australia, meanwhile, remains slow and inconsistent, particularly in more complex areas like scenario analysis. Without concerted and co-ordinated action by Australian regulators and policymakers, the gap with the rest of the world will only widen.

The TCFD framework is relatively new, but climate risks and their relevance to financial performance and financial stability are not. Despite long-standing evidence of Australia's particular climate exposures, the collective response of Australian corporates and investors has been underwhelming. The take-up of pre-existing voluntary frameworks for reporting carbon and climate exposure was patchy. These failings have been exacerbated by a long and damaging period of policy uncertainty. Despite growing legal evidence that companies and directors may be held to account for failing to report on climate risks, Australia's existing soft and hard law governing corporate responsibility has been insufficient to drive widespread or consistent disclosure.

Strong stakeholder support for the TCFD recommendations reflects a broader consensus that getting consistent, accurate information on climate risk exposures into the marketplace is necessary to limit dangerous global warming and promote financial system stability. Regulatory and shareholder pressure to adopt the TCFD framework will drive better practice. Yet the need for better information is urgent, because time to respond to critical climate risks is short. Tougher responses must be considered, including more rigorous mandatory reporting requirements, if the TCFD approach fails to deliver quickly.

## Next steps for Australian regulators

Against this background, we recommend several steps Australian regulators can take in the near and medium term to build on progress so far:

**ASIC should immediately update its guidance on company directors' responsibilities to consider climate risk and set clear expectations in light of recent regulatory and market developments.** The Paris Agreement, the TCFD report, the Hutley SC opinion and recent statements by APRA and other regulators have raised expectations around climate risk management and disclosure by company directors. Yet many directors remain unclear about what is required of them. While ASIC has noted where climate risk may fit into existing reporting requirements, it has not comprehensively set out its position following recent developments, or formally responded to the Government's encouragement to update its guidance to company directors. There is an important opportunity to do so now, especially to ensure consistency with proposed updates to ASX Corporate Governance Council Principles and Recommendations.<sup>33</sup>

A medium-term priority for ASIC should be monitoring standards and transparency for green or sustainability-badged investment products, and ensuring that investment managers and advisers properly incorporate the sustainability-related preferences of retail investors. This could be as simple as requiring investment managers and financial advisers to request information about customers' sustainability preferences, and to disclose their frameworks and metrics for assessing the sustainability performance of financial products. To this end, ASIC should engage with new standards and processes being developed in other markets, including work towards a comprehensive European taxonomy to define sustainable investments and activities.<sup>34</sup>

**The Reserve Bank should set out its views on how climate-related risks impact its mandate to promote macroeconomic and financial system stability and economic prosperity.** While the RBA has conducted research on the economic and financial impacts of energy and commodity-related trends and natural disasters, it has not connected these to climate change and related policy transitions. Many of its leading international counterparts have made these links explicit in speeches and statements that assess how climate change impacts central bank mandates to promote price stability and financial stability,<sup>35</sup> or through research that looks at empirical and theoretical approaches to modelling the macroeconomic impacts of climate change.<sup>36</sup> A similar approach by the RBA would provide another crucial signal about the importance of properly understanding climate-related risks. This would also give the RBA a platform to more actively engage on climate change issues both domestically (with its partners in the Council of Financial Regulators) and internationally (through the Financial Stability Board, the G20, and potentially through the new central bank-led Network for Greening the Financial System).

In the medium term, the RBA could work with experts inside or outside government to provide research and resources on the sectoral and structural impacts of climate risk. A key impediment to more effective risk management and long-term planning is the difficulty of mapping the granular financial and economic impacts of physical impacts and transition risks for specific industries, sectors and regions. In tandem with organisations like the CSIRO, focused research that draws on the RBA's economy-wide expertise and modelling capabilities would provide greater understanding of the implications of climate change for monetary policy. It would also make a key contribution to the evidence base for other analysts and regulators.

<sup>33</sup> See 'Review of the ASX Corporate Governance Councils Principles and Recommendations', Public Consultation, May 2018

<sup>34</sup> See European Commission legislative proposals on sustainable finance, 24 May 2018.

<sup>35</sup> For example, See Bank of Canada Deputy Governor Timothy Lane, "Thermometer rising: climate change and Canada's economic future", March 2017.

<sup>36</sup> Sandra Batten, *Climate change and the macroeconomy: a critical review*, Bank of England Staff Working Paper No. 706, January 2018.

**The Council of Financial Regulators should conduct and publish a review of TCFD-aligned reporting in Australia in 2018.** The Government has so far resisted calls to nominate a single government body to coordinate responses to the TCFD. In its absence, the CFR is uniquely placed to offer an authoritative review of the adequacy of climate-related disclosures, drawing on the insights and activities of each of the major Australian regulators. This review could compare the coverage and consistency of Australian disclosures across market segments and sectors and benchmark these against best practice, with a focus on scenario analysis as one of the priority TCFD recommendations. It could also highlight disclosures, or gaps in disclosures, that are particularly relevant from a supervisory or financial stability perspective, and draw on regulators' engagements with international counterparts. By providing a public report on climate-related disclosures during the first full TCFD-reporting cycle, the CFR could support the work of its member regulators, provide information to the market on current practices, and provide an authoritative evidence base for further policy development.

## Shaping a strategic response: an Australian sustainable finance roadmap

**It is time for a holistic review of sustainable finance in Australia.** The special and urgent case for action on climate-related risks is part of a broader challenge: driving better corporate performance and investor decision-making for long-term sustainability. This includes environmental, social and economic challenges directly linked to climate change, and other distinct problems that share the common feature that, over time, inaction will have a severe detrimental impact on financial performance and stakeholder value. There are three potential negative consequences: a narrow focus on short-term financial outcomes that undermines longer-term performance; the build-up of systemic vulnerabilities because governance is not sufficiently attuned to important risks; and underinvestment in sustainable development projects, markets and strategies that can create new commercial opportunities.

**The Federal Government can turbocharge a sustainable finance agenda by appointing a taskforce to review risks and opportunities associated with sustainable finance and investment, and to recommend regulatory and policy changes.** This review could build a roadmap to sustainability via changes in policy, regulation and financial supervision. Without a systematic approach, responses will be piecemeal at best, targeting single issues rather than taking a comprehensive approach. Existing legislative and regulatory frameworks are not fit for purpose, making it hard for Australia to align our financial sector with growing global markets in clean, green finance and investment.

International efforts suggest an Australian Sustainable Finance Taskforce (Taskforce) could be structured as follows:

- A panel of up to ten government-appointed members, including former financial regulators, senior representatives from financial institutions and superannuation funds, and civil society and academic experts. Current financial regulators could have observer status.
- A chair with extensive public and private sector experience, including in international trade and investment.
- Secretariat services provided by the Department of Prime Minister and Cabinet.

The Taskforce would draw on significant international inquiries and action plans on green and sustainable finance. Prominent recent examples include the European Commission's Action Plan for Financing Sustainable Growth (informed by a High-Level Expert Group on Sustainable Finance),<sup>37</sup> the United Kingdom's Green Finance Initiative (developed by a Green Finance Taskforce), and Canada's recently-announced Expert Panel on Sustainable

<sup>37</sup> Elements of the EC plan are now being adopted into legislation: see [https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance\\_en#implementing-the-action-plan-commission-legislative-proposals](https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance_en#implementing-the-action-plan-commission-legislative-proposals)

Finance. Multilaterally, such a review would be in keeping with the UNEP's Finance Initiative and the G20 Sustainable Finance Study Group (which under Argentina's G20 presidency broadened the earlier work of the former G20 Green Finance Study Group).

The taskforce should be charged with reporting back within 12 months on terms of reference that could include:

- Developing standards and taxonomies to guide the design of sustainability-linked financial products and investments
- Clarifying the duties of company directors and fiduciaries to think beyond near-term shareholder returns and consider a wider set of stakeholders and long-term issues
- Suggesting governance reforms to support a longer-term focus within existing legislative frameworks.
- Imposing stricter mandatory requirements for disclosing climate and other sustainability-related financial risks to support rapid progress towards TCFD-aligned best practice
- Boosting financial regulators' mandates to supervise the governance and disclosure of emerging financial and non-financial risks
- Assessing the case for differential prudential treatment of "brown" assets and investments, based on the latest evidence of different risk profiles.

A review and roadmap will not diminish the pressing need for a consistent and effective national climate policy, including ambitious emissions reduction targets and policies to achieve them. It could though, help to accelerate urgent investments and governance changes needed for Australia to meet its Paris commitments, respond to crucial international frameworks like the TCFD, and deliver on its pledges to support sustainable development at home and abroad as part of the UN's 2030 Agenda.

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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS	TRANSPARENCY	PHYSICAL RISK	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
<b>AGL<sup>1</sup></b>	Yes	2030, aligned with 2050 decarbonisation	<p>Budgeted response, using the Climate Change Authority's (CCA) 10.1Gt budget for 2030 – 2050.</p> <p>The National Electricity Market (NEM) budget is 3,026Mt (derived from national budget).</p> <p>PLEXOS modelling for NEM reduction pathways (three pathways: 1. no carbon reduction; 2. 26-28% reduction from 2005 levels by 2030; and 3. 2°C budget based on CCA analysis).</p> <p>Discusses marginal abatement cost of carbon at AUD\$40/t for a new coal power plant, and &gt;AUD\$100/t for an existing coal plant.</p>	<ul style="list-style-type: none"> <li>Discloses carbon budget</li> <li>Discloses trajectory</li> <li>Discloses own sectoral budget allocation</li> <li>Includes 2030 and 2050 horizon</li> </ul>	No	Unclear, but company has supported net zero emissions for electricity generation by 2050.	Not explicitly, but indicates “significant emissions reductions” are a reasonable assumption.
<b>AXA<sup>2</sup></b>	No	Unclear	<p>Uses current Nationally Determined Contributions fielded by countries as part of the Paris Agreement. These commitments vary considerably between countries and in aggregate equate to warming of about 2.7C<sup>3</sup>.</p> <p>An earlier report, from 2016, evaluates investment portfolio against to “IEA 2° scenario”, which suggests the IEA450 scenario.<sup>4</sup></p>	Few underlying assumptions and parameters are disclosed beyond NDCs. AXA provides some information on a “Climate VaR”, applied across significant portions of its equities and fixed income holdings.	No. Physical risk is only considered in relation to real estate, and using Natcat models which do not include climate change.	AXA’s “Value at Risk” calculations show a negligible impact on most of its equities and fixed income holdings.	NDCs for transition; appear to not be incorporating climate change into physical risk at all.

<sup>1</sup> AGL, [http://agl2016.sustainability-report.com.au/files/carbon\\_constrained\\_future.pdf](http://agl2016.sustainability-report.com.au/files/carbon_constrained_future.pdf)

<sup>2</sup> AXA [https://www-axa-com.cdn.axa-contento-118412.eu/www-axa-com%2Fcf61ff6c-ee1d-4dcb-92ba-ed243ae7f2fb\\_2018+tcfd+full+report+-+final+-+b.pdf](https://www-axa-com.cdn.axa-contento-118412.eu/www-axa-com%2Fcf61ff6c-ee1d-4dcb-92ba-ed243ae7f2fb_2018+tcfd+full+report+-+final+-+b.pdf)

<sup>3</sup> <https://climateactiontracker.org/publications/climate-pledges-will-bring-27c-of-warming-potential-for-more-action/>

<sup>4</sup> [https://cdn.axa.com/www-axa-com%2Fcb46e9f7-8b1d-4418-a8a7-a68fba088db8\\_axa\\_investor\\_climate\\_report.pdf](https://cdn.axa.com/www-axa-com%2Fcb46e9f7-8b1d-4418-a8a7-a68fba088db8_axa_investor_climate_report.pdf)



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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS	TRANSPARENCY	PHYSICAL RISK	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
<b>Aviva</b> <sup>5</sup>	Unclear	2040 (emissions) 2100 (impacts)	IEA 450, IEA 2DS and IEA Bridge Scenario	<p>For physical risk, Aviva relies upon work conducted by the Economist Intelligence Unit with Vivid Economics, which in turn uses the DICE Integrated Assessment Model to produce estimates of losses to losses to future dividends; present value loss on manageable assets.</p> <p>It is not clear how this highly aggregated approach has been translated to specific sectors identified by Aviva.</p>	<p>Yes, but unclear how. (See previous column).</p> <p>Aviva does identify three key risks from climate change to its insurance business which are significantly more advanced than its peers.</p> <p>“Adverse impact to validity of actuarial pricing assumptions and projections</p> <p>Potential need to restrict coverage levels to make products insurable given increased severity and frequency of weather related losses</p>	Unclear but the company identifies a number of detailed actions broadly in response to climate change in its “Strategic Response to Climate Change” which sets out actions over 2015 – 2020 on climate.	No

<sup>5</sup> Aviva: [https://www.aviva.com/content/dam/aviva-corporate/documents/socialpurpose/pdfs/Avivas\\_strategic\\_response\\_to\\_climate\\_change\\_-\\_2016\\_update\\_ysSf6TN.pdf](https://www.aviva.com/content/dam/aviva-corporate/documents/socialpurpose/pdfs/Avivas_strategic_response_to_climate_change_-_2016_update_ysSf6TN.pdf)

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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS	TRANSPARENCY	PHYSICAL RISK	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
					Managing volatility of financial results emanating from increased severity and frequency of weather related losses .		
<b>Origin Energy<sup>6</sup></b>	Yes	2030, aligned with 2050 decarbonisation	Budgeted response applied to the wholesale generation portfolio, using the Climate Change Authority's (CCA) 10.1Gt budget for 2013 – 2050.  PLEXOS modelling for NEM reduction based on three pathways: (1) Business as usual which assumes no more measures once LRET and VRET are met. (2) A GHG reduction of -27% from 2005 levels by 2030; and (3). A 2°C budget based on CCA analysis with -45% GHG by 2030.	<ul style="list-style-type: none"> <li>• Discloses carbon budget</li> <li>• Discloses trajectory</li> <li>• Discloses own sectoral budget allocation</li> <li>• Includes 2030 and 2050 horizon</li> <li>• Limited to wholesale generation business</li> </ul>	No	Unclear, but company has supported net zero emissions for electricity generation by 2050.	Unclear, but states that wholesale generation is better off under 2°C scenario than either BAU or NDC.
<b>South32<sup>7</sup></b>	Yes	2050	Three scenarios. In highest mitigation “Global cooperation”, CO2 emissions peak 2025  Net zero emissions in 2050  Global carbon market by 2030  Solar + wind make up 41% of “energy mix” by	<ul style="list-style-type: none"> <li>• Discloses emissions peak and end-point</li> <li>• Discloses reference scenarios</li> <li>• Discloses renewables level in 2040</li> </ul>	Yes; but primarily in Runaway scenario, which states demand for South32 products may increase through 2035, beyond which	Says decision on no greenfield coal developments linked to 2°C scenario.	Unclear

<sup>6</sup> Origin Energy - <https://www.originenergy.com.au/content/dam/origin/about/investors-media/AGM%202017/Scenario%20Analysis%20FY2017.pdf>

<sup>7</sup> South32: [https://www.south32.net/docs/default-source/all-financial-results/2017-annual-reporting-suite/our-approach-to-climate-change.pdf?sfvrsn=87ac4576\\_9](https://www.south32.net/docs/default-source/all-financial-results/2017-annual-reporting-suite/our-approach-to-climate-change.pdf?sfvrsn=87ac4576_9)

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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS	TRANSPARENCY	PHYSICAL RISK	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
			<p>2040.</p> <p>Limited CCS deployment.</p> <p>Commodity recycling “to its technical limits”</p> <p>Least mitigation scenario (Runaway climate change) is RCP6 to RCP8.5</p>	<ul style="list-style-type: none"> <li>• Discloses CCS assumptions</li> <li>• Carbon price assumptions</li> <li>• Carbon market assumptions</li> </ul>	global growth, law and security may begin to breakdown.	Lays out plan for five-yearly emissions reductions plans towards zero in 2050; but for Scope 1 only.	
<b>BHP Billiton<sup>8</sup></b>	No	2030	<p>Four scenarios, plus ‘signals’ which show that the world is moving towards or away from each scenario.</p> <p>In the ‘Global accord’ 2°C scenario, a carbon price of US\$50 in 2030 is identified.</p>	<ul style="list-style-type: none"> <li>• Discloses assumptions on government emissions targets to 2030 by region (or peak emissions date where applicable)</li> <li>• Does not disclose global budget or trajectory; states “in line with levels indicated by the IPCC” after 2030 (in case of the Global accord) and by 2030 (in case of the shock event)</li> <li>• Discloses carbon prices</li> <li>• Does not disclose 2050 point</li> </ul>	Yes, although detail is extremely limited.	BHP states scenario analysis informs its approach to portfolio management; “all commodities in existing portfolio, including oil, gas and thermal, have strong future margins.”	Central case is informed by NDCs, equivalent to warming of 3°C

<sup>8</sup> BHP <http://www.bhp.com/-/media/bhp/documents/investors/reports/2015/bhpbillitonclimatechangeportfolioanalysis2015.pdf?la=en> and <http://www.bhp.com/-/media/bhp/documents/investors/reports/2016/bhpbillitonclimatechangeportfolioanalysis2016.pdf?la=en>

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	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
<b>BP<sup>9</sup></b>	No	2040	<p>'Evolving Transition' which is the "reference scenario", sees CO2 emissions rising 0.4% p/a through 2040, to 37tn tonnes from 33tn in 2015.</p> <p>'Faster transition' sees emissions falling from 33tn in 2015 to 25tn tonnes in 2040.</p> <p>"Even Faster Transition" sees emissions falling from 33tn in 2015 to 18tn tonnes in 2040.</p> <p>Three new supplementary scenarios were published in 2018, including a ban on internal combustion vehicles by 2040.</p>	<ul style="list-style-type: none"> <li>• Draws on BP's Energy Outlook, a detailed set of historical data and projections. Downloadable spreadsheets are available that allow for analysis and comparison with most key parameters of other climate and energy scenarios.</li> </ul>	<p>None in Energy Outlook.</p> <p>Sustainability Report<sup>10</sup> says adaptation is incorporated into planning of all new projects" using unspecified "specialized climate models".</p>	<p>"BP considers the scenarios...together with a range of other analysis and information, when forming its long-term strategy."</p> <p>Strategy focused on gas and "advantaged oil". BP expects about \$500m p/a in "low carbon &amp; digital" investments; and \$13-14bn p/a on upstream oil and gas capital expenditure.</p>	<p>Yes: emissions increase by more than 10% by 2040</p>

<sup>9</sup> BP: <https://www.bp.com/content/dam/bp/en/corporate/pdf/sustainability-report/group-reports/bp-sustainability-report-2016.pdf>

<sup>10</sup> <https://www.bp.com/content/dam/bp/pdf/about-bp/energy-challenge-climate-change.pdf>

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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS  Key transition parameters	TRANSPARENCY  Level of transparency/disclosure	PHYSICAL RISK  Physical impacts included?	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis				Impact on decisions?	Identifies base case?
<b>Royal Dutch Shell<sup>11</sup></b>	No; by 2070	2100; detailed disclosures of energy production and consumption at decadal intervals to 2060.	<p>Three independent scenarios and International Energy Agency's 450 Scenario, all scenarios out to 2100; expectation of net zero emissions in 2100 apart from Sky scenario, which has net zero emissions in 2070.</p> <p>Sky parameters are broadly within the range of the 2C scenarios in the Shared Socioeconomic Pathways, the emerging scenario framework for the next IPCC report. Detailed comparison by Cicero<sup>12</sup> shows that only some of Shell's choices favour its own business model (in particular, it assumes high primary energy consumption); while several others (such as on coal and CCS) are actually less favourable to Shell than the majority of SSP scenario pathways. Interestingly, Shell sees solar's contribution as higher than any of the SSPs or the IEA or Statoil, from 2035 through to 2100.</p>	<ul style="list-style-type: none"> <li>• Sky discloses assumptions of all key transition parameters and make downloadable data available in sufficient detail that its own scenarios can be compared with other mitigation scenarios such as those in the IPCC's 5th Assessment Report.</li> <li>•</li> </ul>	Food and water stress are referenced; but little detail.	Shell states that decisions are based on scenarios but no specifics are provided.	

<sup>11</sup> Royal Dutch Shell <https://www.shell.com/energy-and-innovation/the-energy-future/scenarios/new-lenses-on-the-future.html> and <https://www.shell.com/energy-and-innovation/the-energy-future/scenarios/shell-scenario-sky.html>

<sup>12</sup> <http://cicero.oslo.no/no/posts/ciceroblogs/shell-in-a-low-carbon-world>

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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS  Key transition parameters	TRANSPARENCY  Level of transparency/disclosure	PHYSICAL RISK  Physical impacts included?	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis				Impact on decisions?	Identifies base case?
<b>Oil Search</b>	Yes – Greenpeace scenario is 100% renewable energy scenario and near zero emissions by 2050.	2040 (IEA) and 2050 (Greenpeace [R]Evolution)	IEA New Policies Scenario IEA 450 Scenario Greenpeace [R]Evolution scenario Wood Mackenzie’s LNG New Project cost curve for IEA 450S	Discloses key assumptions and characteristics across each scenario. Discloses high-level net present value impacts under each scenario for key Oil Search projects: <ul style="list-style-type: none"> <li>• positive impact</li> <li>• impact within Oil Search baseline and low case</li> <li>• returns less than planned by project still economic</li> </ul> significant negative impact	Yes, but very little detail. Says OSL-operated Kumul Marine Terminal is unaffected by changes in waves in an RCP8.5 scenario, but doesn’t disclose eg dates, sources, or how waves run-up was estimated (eg whether storm surge and cyclones were considered).	States that climate policy trends and scenario analysis have ‘reinforced corporate strategy of focussing on a globally competitive energy portfolio that is sustainable over the long term.’	Scenario outcomes compared against separate baseline projections

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Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS	TRANSPARENCY	PHYSICAL RISK	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
<b>Westpac</b> <sup>13</sup>	Yes	2050	<p>Three 2°C scenarios which all achieve net zero emissions by 2050:</p> <ul style="list-style-type: none"> <li>• Strong national action where countries act on their own and there is rapid domestic action on climate change;</li> <li>• Combined global action where coordinated global action results in a smooth transition to a low carbon economy; and</li> <li>• Delayed action where initial delays in action lead to a rapid mitigation post-2030.</li> </ul> <p>Although implied, there is no explicit mention of the level of a carbon price in any scenario.</p>	<ul style="list-style-type: none"> <li>• Discloses net zero endpoint by 2050 for Australia; a necessary achievement for &lt;2°C</li> <li>• Doesn't disclose budget or midpoint/trajectory</li> <li>• Discloses broad assumptions around existence or lack of a global coordinated carbon market across different scenarios</li> </ul>	No	Westpac says it has set targets, including energy generation financing, coal mining financing, and lending to climate change solutions, "to remain on a credible pathway" to net zero emissions by 2050.	No; but all three scenarios are <2°C
<b>Glencore Xstrata</b> <sup>14</sup>	No	2040	<p>Three scenarios:</p> <ul style="list-style-type: none"> <li>• "Delayed Action" is a weak and uncoordinated implementation of current NDCs and carbon prices of \$US10-40 by 2040;</li> <li>• "Committed Action" based on the IEA's New Policies Scenario (full implementation of current NDC and</li> </ul>	<p>Limited disclosure of parameters ("Ambitious Action" based on IEA 450 Scenario).</p> <p>Discloses high-level results of portfolio resilience analysis under each scenario (positive, neutral or negative outlook</p>	Lists many climate impacts including rainfall changes, drought, storm surge. Briefly describes a process of surveying assets and amending risk register.	Sceptical of ambitious emissions reductions pathways. Supports 'pragmatic' and 'technology neutral' energy	Yes; "Delayed Action", based on weak implementation of current NDCs, is the central scenario.

<sup>13</sup> Westpac: Scenario: [https://2016annualreport.westpacgroup.com.au/assets/Westpac\\_Sustainability\\_Report\\_2016.pdf](https://2016annualreport.westpacgroup.com.au/assets/Westpac_Sustainability_Report_2016.pdf) Response <https://www.westpac.com.au/content/dam/public/wbc/documents/pdf/aw/sustainability/WestpacCCEActionPlan.pdf>

<sup>14</sup> Glencore [http://www.glencore.com/assets/sustainability/doc/sd\\_reports/2017-Climate-change-considerations-for-our-business.pdf](http://www.glencore.com/assets/sustainability/doc/sd_reports/2017-Climate-change-considerations-for-our-business.pdf)

## APPENDIX A

Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS	TRANSPARENCY	PHYSICAL RISK	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis	Key transition parameters	Level of transparency/disclosure	Physical impacts included?	Impact on decisions?	Identifies base case?
			carbon prices of \$US20-50 by 2040); and <ul style="list-style-type: none"> <li>“Ambitious Action” based on IEA 450 scenario with carbon prices of \$US125-140 by 2040.</li> </ul>	across key commodities)		policy including role for HELE and CCS technologies.	
<b>ANZ<sup>15</sup></b>	No	2040	Two scenarios <ul style="list-style-type: none"> <li>IEA New Policy Scenario</li> <li>IEA 450 scenario</li> </ul> Exercise focusses on bank customers in thermal coal supply chains. Under each scenario, considers seven key indicators for each customer, including whether they were conducting stress testing, whether they factored a future carbon price into future expenditure decisions, and ability to diversify businesses to invest in more efficient resource use. These were combined into a rating of each customer’s awareness of climate change and resilience to climate change risks.	Discloses high level findings only (higher risks for companies with higher revenue reliance on coal and strategies less prepared to an early shift to a low carbon economy).	No, but indicates expanding scenario analyses in future years to consider other sectors exposed to “physical and transition risks”.	Not specified, but says scenario work will “inform our strategy regarding customer engagement and risk evaluation.”	No;
<b>Chevron</b>	No	2040	Multiple scenarios for energy and commodity demand, including a base case and alternative scenarios.  Analysts generate carbon price forecasts	Proprietary parameters and outputs not disclosed.  Discusses impact under SDS upstream and downstream	Not featured in its climate scenarios. Chevron notes established	Scenario results “demonstrate that our portfolio...is	Yes; indicates this is aligned with IEA NPS trajectory and

<sup>15</sup> ANZ [http://shareholder.anz.com/sites/default/files/anz8486\\_carbon\\_disclosure\\_document.pdf](http://shareholder.anz.com/sites/default/files/anz8486_carbon_disclosure_document.pdf)



APPENDIX A

Organisation	HIGH LEVEL PARAMETERS		SENSITIVE PARAMETERS  Key transition parameters	TRANSPARENCY  Level of transparency/disclosure	PHYSICAL RISK  Physical impacts included?	EFFECT ON DECISIONS	
	Net zero emissions by 2050?	Horizon of analysis				Impact on decisions?	Identifies base case?
			<p>which feed into proprietary outlooks on energy mix and commodity supply and demand, which are “generally aligned with prominent 3<sup>rd</sup> party projections” including the IEA New Policies Scenario.</p> <p>This reference case is assessed and stress tested against alternative scenarios, including the IEA Sustainable Development Scenario.</p>	<p>portfolio over short term (0-10 years) and long term (10 years plus), noting likely emphasis on brownfield investment opportunities under lower SDS price assumptions.</p> <p>Concludes that “given the long-term, gradual nature of a potential transition to a lower-demand scenario... and our processes for tracking leading indicators and managing these risks, our ability to adjust is our best preparation to limit our assets being exposed.</p>	<p>practices and examples of resilience measures, but no further information.</p>	<p>resilient in many scenarios, and our asset mix enables us to be flexible in response to potential changes.”</p> <p>Planning for an overly restrictive emissions scenario “could result in missed opportunities.”</p>	<p>energy mix.</p>

## The climate risk reporting journey A corporate governance primer

### A step-change in financial disclosure expectations

In late 2015, in the shadow of the Paris Agreement and amid increasing concerns of investors, regulators and other stakeholders about the financial implications of climate change, the G20 tasked its Financial Stability Board (FSB) to review how the financial sector could take account of climate-related issues. The FSB commissioned an industry-led taskforce: the *Taskforce on Climate-related Financial Disclosures (TCFD)*, chaired by Michael Bloomberg. The TCFD was charged with developing a voluntary framework for companies to disclose the material impacts of climate change on their financial performance and prospects, in a consistent form, that would be decision-useful for investors, lenders and insurance underwriters. The TCFD released its final Recommendations in June 2017. Whilst 'voluntary', the TCFD Recommendations are emerging as the key benchmark against which to assess a company's strategic approach to the climate change mega-trend. However, many directors (and the executives on which they rely) are ill-prepared to navigate this step-change in governance and disclosure expectations.

### Reporting and assurance

The board's approval of financial statements, and the accompanying narrative directors' report, is a primary source of assurance to shareholders. In turn, directors must exercise due care and diligence in assuring that the company's disclosures present a true, fair and balanced view of financial performance and prospects, and that they have been prepared on the basis of a robust process. This requires the board to both understand key risk areas, and to satisfy themselves that effective controls are in place.

**This primer is intended to assist boards and their committees embarking on the climate-related financial risk reporting journey. It proposes key questions relevant to the assurance of a corporation's reporting on climate-related financial issues – and to the robust processes of governance and oversight on which those disclosures must be based.** Whilst recognising that the TCFD provides a framework for *reporting* rather than board governance *per se*, the primer seeks to place each query in context by indicating the category(s) of TCFD Recommendation to which they relate.



The journey is broken down into a number of steps:



Of course, the actions required to discharge a director's obligations to govern climate-related risks (and opportunities) with due care and diligence, and to ensure that corporate reports present a true and fair view of financial performance and prospects, will be unique in each case. In particular, additional interrogation and assurance may be warranted in sectors with significant climate-related exposures (such as financial services, resources, energy, infrastructure, materials & manufacturing, transportation, agribusiness and real estate, among others). *Accordingly, this guide is high-level and general in nature only, and is not intended to provide or replace legal advice tailored to your specific jurisdiction and circumstances.*

Contact a member of the MinterEllison climate governance team (at the end of this primer) for assistance with climate risk assurance that is specific to your needs.



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## Where do we need to go?

Governance foundations (developing board understanding of climate-related risks and opportunities, and mechanisms for evaluation and oversight)

### TCFD RECOMMENDATION CATEGORY

Governance	Strategy	Risk Management	Metrics & Targets
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Have the board and senior management (including legal, governance, finance and risk teams) been briefed on climate-related risks (and opportunities) to enable us to discharge our obligations in relation to governance, strategy and risk management oversight? In particular, do we understand the different drivers (and consequences) of physical climate impacts (increase in both acute catastrophic and gradual onset) and economic transition-related risks (policy/regulatory (including under the Paris Agreement), technological, stakeholder) for our business? Do we understand the difference between climate change mitigation and adaptation? Do we understand the role of stress-testing and scenario analysis in strategic governance, planning and risk management? Do we understand any relevant exposures to stranded asset risk?



By whom are we being advised on these issues? How have we assured that their expertise is relevant and appropriate? What processes are in place to ensure that we remain informed of developments in this area?

How are issues associated with climate change integrated into our board governance (strategic and oversight) responsibilities? Is this issue receiving adequate time and focus within the board / committee agenda?



In what part(s) of the business does operational responsibility for climate-related issues (identification, assessment, management and monitoring) reside? Who is responsible and accountable for this issue within management? Are we satisfied that relevant staff (or the experts that they consult) have the appropriate competence and resources? How is climate change integrated into our strategic reviews, capital and business planning, performance objectives and 'standard' risk management framework? How are relevant exposures, and progress against strategies and targets, monitored and assessed by management, and reported to the board or its committees (on both a regular and exceptions basis)? (See further under *Dynamic Navigation - Risk Management Oversight, below*)



Have directors updated their standing declarations to identify extraneous interests that may compromise their ability to exercise independent judgment on climate-related governance issues in the best interests of the corporation?



Do climate change-related matters impact on our Directors' & Officers' insurances – from coverage exclusions and 'occurrences', to disclosure and notification considerations?





# 2 Route selection

Strategy, financial planning, capex and material risk management

## TCFD RECOMMENDATION CATEGORY

Governance	Strategy	Risk Management	Metrics & Targets
	■	■	■
	■	■	■
	■	■	■
	■	■	■
	■		
	■	■	■
	■	■	■
	■	■	■

What foreseeable climate-related risks (and opportunities) are relevant to our sector(s) and geographic location(s) – not only within our business fence-lines, but upstream in our supply chain and downstream in our distribution chains? Are there any factors that compound (or mitigate) our enterprise risk exposures vis-à-vis other companies in our sector(s)?

How does our exposure differ under stress-testing against a range of plausible climate futures (including one aligned with Paris Agreement goals to keep average warming *well below* 2C), over various time horizons relevant to our business and investment planning and useful asset life-cycles (short, medium and long-term)? On what basis do we believe these scenarios represent an adequate range of credible physical, economic transition and litigation risks (and opportunities) that could reasonably be expected to impact on our business performance or prospects?

Which of those risks present a *material* exposure to our corporate strategy or operations (in both absolute and relative terms) – and on what basis is the threshold of 'materiality' set? Over what time frames?

What are the key climate-related scenarios, variables and assumptions in this strategic analysis (including forward-looking stress testing)? On what basis have these input parameters been selected as appropriate? How do the outcomes vary under a range of different, albeit plausible, assumptions?

What are the implications of identified material climate risks and opportunities for our business model? What strategic responses are open to us to continue to thrive – stress-tested against a range of potential climate futures (*as above*)? This should include both a strategic response to potential market shifts (external impacts), and an operational response to lower our own exposure to climate-related risks (including, but not limited to, emissions mitigation strategies as against science-based targets) (internal responses). What does it mean for our product/services offering, R&D investment, M&A, capital allocation and cost of finance? Is our strategy clearly articulated, and has it been reviewed/approved by the board and/or its committees (as appropriate)?

What corporate policy(s) do, and should, we have in place in relation to climate change and its impacts? Does this policy align with Paris Agreement goals and/or science-based emissions reduction targets? Why/why not? How is this policy reflected in our procurement and other contracting practices?

What are the metrics and targets against which we measure our exposure to (and assess our progress in managing) climate-related risks, including (but not limited to) absolute and intensity-based emissions reduction targets? Over what time frames, and against which base year? Why are these parameters relevant and appropriate? What are our key performance indicators against those targets?

What events or developments should trigger our reassessment of such risks and/or a shift in strategic trajectory? What signposts do we monitor to gauge whether our central (and other) case assumptions require revision? What are the trigger points for our re-assessment of these issues? How, and how often, do we re-calibrate relevant signals?



### 3 Dynamic navigation

Risk management oversight

&



### 4 When will we get there?

Metrics and targets

#### TCFD RECOMMENDATION CATEGORY

Governance	Strategy	Risk Management	Metrics & Targets
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What are the key climate-related variables and assumptions, and metrics and targets, that we apply? Why are these the appropriate parameters/benchmarks? How do the outcomes vary under a range of different, albeit plausible, assumptions?



Have our variables, assumptions, parameters, benchmarks and methodologies been updated to reflect scientific, economic and financial developments (although recognising that these may be held constant for the purposes of meaningful trend analysis)? What impact do these developments have for our strategy, risk management and disclosure?



How does management determine the order of priority to be given to each relevant climate-related risk/opportunity?



What assessments of remuneration structures have been conducted to ensure that no perverse incentives exist that may undermine our policies or progress (eg. that may favour capex/investment in assets at risk of being stranded)? Conversely, have we considered revision of our remuneration policies to reflect progress against climate-related business objectives?



How do we engage with, or otherwise seek to influence, stakeholders (employees, government, suppliers, customers) on climate-related issues? Have we considered whether our external associations, activities and engagements (such as membership of industry groups and/or government lobbying activities) may be perceived as inconsistent with our corporate climate change policy and/or disclosures?





# 5 Communicating our path

Are annual report disclosures complete, accurate and reliable?



### TCFD RECOMMENDATION CATEGORY

Is our industry identified as one at 'high risk' in the TCFD Recommendations? Have our annual reports been prepared with regard to the TCFD (or other recognised frameworks such as SASB, GRI/IIR, CDSB etc)? *If not, why not – particularly if we are in a high-risk industry?* If so, what is the process by which our reports have been reconciled or assured against the relevant framework(s)?

Governance	Strategy	Risk Management	Metrics & Targets
■	■	■	■

Can management provide a brief overview of the process for preparing the financial statements, explanatory notes, directors' report (eg. the Operating & Financial Review (OFR)) and corporate governance statements, including the review processes? What has made management (and, independent of management, our external auditors) confident about the accuracy and integrity of the information reported as it relates to the impact of climate change on our performance and prospects? What are the key assumptions made, and metrics or statements requiring the most judgment? In what areas did our external auditor disagree with or challenge positions taken by management? Were any climate risks issues raised as key audit matters? What steps have been taken with regards the auditor's responsibility relating to other information to ensure consistency between financial and narrative disclosures?

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How have any material impacts of climate change on our financial position been assessed (eg. asset valuation or impairment, liability provisions, revenues, expenditures, and cash flows)? In particular, what methodology has been applied in impairment testing of material assets? Are these reasonable and supportable? Are particular disclosures of key assumptions and uncertainties warranted? Do we need to adjust asset recognition, reported valuation or relevant liability provisions to account for our assessment of stranded asset risks? Should we be disclosing our Scope 1, 2 and/or 3 emissions (in line with GHG Protocol Methodology), on an absolute and/or intensity basis (eg. emissions efficiency by unit of output)? Why/why not?

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What range of climate-related assumptions, scenarios and potential material financial impacts have been considered by management but not disclosed? On what basis has it been determined that they should not be disclosed? Are we proposing to disclose only favourable scenarios? How do reported performance and prospects vary under a range of different, albeit plausible, assumptions? Is it appropriate to disclose the nature of the material variables that may impact on the relevant outcome ('modifying factors'), and a description of our methodologies? *Directors may ask management and/or investigating accountants to provide a due diligence report that outlines the procedures followed, inquiries undertaken, supporting/verification information and conclusions reached.*

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What forward-looking statements in relation to the risk (and opportunities) associated with climate change for our financial prospects are appropriate to disclose to the market (including in the directors' report/OFR)? Are any such statements reasonable and supportable, and grounded in stress-testing and scenario planning in relation to both physical and economic transition-related risks, over time-horizons consistent with our capital and financial planning cycles? Does that disclosure accurately convey the potential for materially different outcomes depending on key variables and assumptions? Is it consistent with our internal assessment of strategic direction and long-term value drivers? Have those forward-looking statements, and any explanatory text that accompanies them, been subject to legal review?

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How should our disclosures evolve in response to recent developments in regulatory, institutional and shareholder expectations, and relevant litigation?

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Do we make any other 'voluntary' disclosures in relation to climate change-related risks – including (for example) a separate sustainability report or response to CDP (formerly the Carbon Disclosure Project) questionnaire? If so, how does management ensure that statements in our annual reports and continuous disclosures are consistent with any voluntary disclosures? What steps have been taken in consultation with external auditors to address the challenges of assurance over these forms of emerging forms of external reporting?

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On the basis of the above, are we satisfied that there are reasonable grounds to base our view that all potential material climate-related risks to our performance and prospects have either been appropriately disclosed, or resolved as not material?

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