November 2020

Climate Change – Technical Paper for Appointed Actuaries

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Introduction

Climate change is a material strategic risk and one of the major challenges facing financial institutions today. Investors in financial institutions acknowledged this in 2017 when the Taskforce for Climate Related Financial Disclosures ("TCFD") released a voluntary disclosure basis. Regulators have recognised that the financial risks associated with climate change have the ability to undermine financial stability and are increasing their expectations around the measurement and management of climate change risks and opportunities.

This Technical Paper provides Appointed Actuaries with an outline of how insurance operations may be impacted by climate change, and offers suggestions for how to address these issues in a Financial Condition Report. Australian Prudential Regulation Authority's ("APRA") Prudential Standard CPS320[1] outlines the requirements for the Appointed Actuary ("AA") in writing a Financial Condition Report. In this note we refer to individual sections of this prudential standard where appropriate.

This information will also be helpful in many other situations when advice is provided to financial institutions.

This Technical Paper does not constitute legal advice. Any interpretation or commentary within the Technical Paper regarding specific legislative or regulatory requirements reflects the expectations of the Institute but does not guarantee compliance under applicable legislation or regulations. Accordingly, Members should seek clarification from the relevant regulator and/or seek legal advice in the event they are unsure or require specific guidance regarding their legal or regulatory obligations.

Ongoing feedback from Members is encouraged; any feedback should be directed to the Climate Change Working Group via actuaries@actuaries.asn.au

Background

There has been increasing interest from regulators and investors over recent years in how financial institutions are managing their climate risks. APRA has made it clear that it is imprudent for entities to ignore risks just because they are long term, because the time horizon is uncertain, or because there is uncertainty about future government policy.

Climate risk has been described by APRA as "distinctly 'financial' in nature", "foreseeable, material and actionable now" and having "potential system-wide implications"[2]. APRA is concerned not only about the impact of natural disasters on insurers' capacity to pay claims, but also the affordability and availability of insurance in high risk areas, and the flow on effects of reduced financial resilience for households and businesses unable to purchase insurance. They expect to see continuous improvement in the awareness and action of regulated entities in relation to climate risk[3].

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[1] APRA, *Prudential Standard 320 Actuarial and Related Matters*, July 2019
https://www.apra.gov.au/sites/default/files/cps_320_standard_only.pdf
[2] Summerhayes, G. (2017) *Australia's new horizon: Climate change challenges and prudential risk*, Insurance Council of Australia Annual Forum, Sydney, 17 February 2017
https://www.apra.gov.au/Speeches/Pages/Australias-new-horizon.aspx
[3] APRA, *Information Paper, Climate Change: Awareness to Action*, 20 March 2019
https://www.apra.gov.au/sites/default/files/climate_change_awareness_to_action_march_2019.pdf

The International Association of Insurance Supervisors has issued a paper[4] that outlines some of APRA's activities relating to climate risk and discusses the approach and methodology of a number of international insurance supervisors, and also issued a draft paper responding to the TCFD recommendations[5].

Climate change risk and the role of the actuary

An insurer with a comprehensive Risk Management Framework may already have explicitly included climate risk within its broader risk management activities, along with other accelerating risks such as cyber risk and technology risk. This means that climate risk would be considered as any other financial and strategic risk in the FCR.

Disclosure by financial institutions

Since 2015, a voluntary disclosure statement has been established by the TCFD of the Financial Stability Board ("FSB") to develop consistent climate-related financial risk disclosure for use by financial institutions to provide more explicit information for investors and external stakeholders. The TFCD established a framework for these disclosures and reports on the effectiveness, coverage and consistency of climate-related disclosures. The TCFD seeks to develop recommendations for voluntary climate-related financial disclosures that are consistent, comparable, reliable, clear, and efficient, and provide decision-useful information to lenders, insurers, and investors[6].

Actuaries may advise insurers (and other financial institutions) on climate-related disclosures, including reporting to investors on the governance, risk management, strategy, scenario analysis, and metrics and targets deployed to manage climate-related risks and opportunities.

The TCFD recommendations have been strongly supported by insurance regulators globally. Significantly, a complete set of TCFD disclosures requires the performance of scenario analyses – that is, to consider what the financial impact would be if temperatures rise by, for example, less than 2°C or greater than 2°C by 2050.

Prudential Practice Guide

In February 2020, APRA set out a plan to develop a Prudential Practice Guide focused on climate-related financial risks, and to perform a climate risk vulnerability assessment, beginning with Australia's largest banks, but expected to extend to the remainder of APRA-regulated financial institutions. While the timetable for these actions has been delayed because of the impact of COVID-19, APRA is expected to continue with these activities once the impacts of COVID-19 have abated.

This Technical Paper is intended to complement APRA's Prudential Practice Guide on climate-related financial risk and assist an AA addressing climate change, particularly in the FCR. In the current environment and in preparation for increasing scrutiny by regulators and Boards of Directors, it would be helpful for an AA to explicitly discuss climate risk and, where appropriate, any TCFD disclosures in their FCR.

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[4] International Association of Insurance Supervisors, *Issues Paper on Climate Change Risks to the Insurance Sector*, July 2018

[5] International Association of Insurance Supervisors *Issues paper on the Implementation of the Recommendations of the Task Force on Climate-related Financial Disclosures*, February 20

[6] https://www.fsb-tcfd.org/

Assessment of climate risk

An AA can provide their assessment of whether, within the context of the broader Risk Management Framework of the company:

- The right level of governance and leader engagement exists across the business to address climate risk
- The business understands the financial, strategic and operational risk associated with climate change
  - The business has an effective plan or strategy to assess and address climate risk
  - They are satisfied that customer considerations and reputation risk have been adequately considered and addressed by the business.

TCFD disclosures

TCFD calls for companies to disclose under four pillars: Governance, Risk Management, Strategy / Scenario Analysis and Metrics & Targets.

The AA, as part of their management role, could well be involved in the development and review of the disclosures. In the context of the FCR, the AA could comment as follows:

- Governance – As part of the discussion of the risk management framework, the AA should have visibility of the governance commentary in the TCFD disclosures, to enable any inconsistencies to be identified.
- Risk Management – As part of the discussion of the risk management framework, the AA will be discussing the effectiveness of the framework in the context of climate risks.
- Strategy / Scenario Analysis – The Climate Scenario analyses in the TCFD disclosures are likely to be longer-term than those assessed in an ICAAP or FCR strict three-year horizon, but it may be appropriate for the AA to review the consistency of the TCFD strategy and scenario analysis with the work done for the FCR and the ICAAP. Similarly, commentary on Strategy in the TCFD disclosures should be consistent with commentary on business strategy in the FCR.
- Metrics and Targets might require some commentary if there are any inconsistencies with the broader risk management framework.

Climate change scenario analysis

In the context of climate change itself, "Scenarios" are defined in relation to global warming pathways to the year 2100. Each Scenario is a specific Representative Concentration Pathway (RCP) that specifies the level of greenhouse gas concentrations that have been adopted by the Intergovernmental Panel on Climate Change (IPCC). Four RCPs are used in the Fifth IPCC Assessment[7] as a basis for climate predictions and projections. Climate Change risk assessments should consider these RCPs for internal and TCFD reporting to enable comparability.

[7] https://www.ipcc.ch/report/ar5/syr/ The Fifth IPCC report was released in 2014 and next revision planned for 2022.

The Paris Agreement, within the United Nations Framework Convention on Climate Change (UNFCCC)[8], is a commitment by nearly all the world's nations to undertake ambitious efforts to combat climate change and adapt to its effects, with the central aims to:

- Keep average global temperature rise this century well below 2°C above pre-industrial levels (1880); and
- Pursue efforts to limit the temperature increase even further to 1.5°C, including achieving net-zero global emissions by 2050.

Current impacts of global warming, including more extreme weather, will remain above historical levels as anthropogenic emissions remain in the earth's atmosphere for centuries. The Paris Agreement seeks to limit further damage. As shown in the below graphs[9], achieving net-zero emissions by 2050 (blue) is critical if global average temperatures are to be kept below 1.5°C. Without action, global average temperatures are on track to increase 3-4°C by the end of the century.

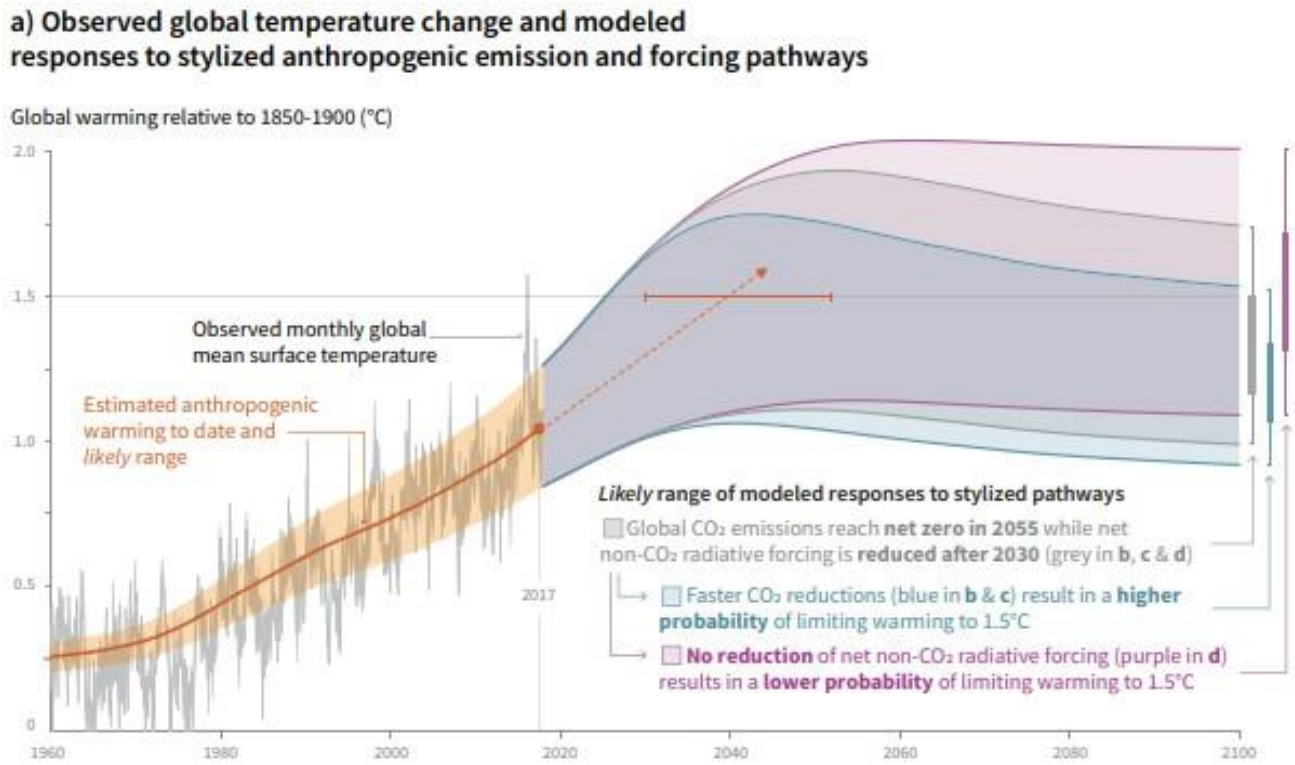
The impacts of global warming are not uniform - Australia is among the most impacted countries globally as surface temperatures increase more further away from the equator. Warming is also stronger over land than in the oceans, and strongest over the Arctic. Australia has warmed at a faster rate than the rest of the world, with the current surface temperatures increasing more than 1.1°C above pre-industrial levels (versus 1.0°C globally). The duration, frequency and intensity of extreme heat events have increased across large parts of Australia.

The financial impact of climate change will arise both from physical changes, and the associated economic impacts. Physical and transition risks (defined below) affect financial firms in distinct ways. In any single scenario there is a trade-off across both risk types given their interrelated nature. For example, continued emissions will lead to rising temperatures that increase physical risks, but limiting these impacts requires substantial emissions reductions that increase transition risks, so any scenario for physical risks will also require some consideration of how the associated transition risk will emerge. Another way of considering this trade-off is by considering both sides of the balance sheet – the assets and the liabilities. Physical and transition risks may affect assets and liabilities in opposite directions. This is outlined further in the referenced Bank of England discussion paper on scenarios for financial risks[10].

[8] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[9] *Intergovernmental Panel on Climate Change (2018), Summary for Policymakers: Global Warming of 1.5C, p.6, Available at: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf*

[10] https://www.bankofengland.co.uk/-/media/boe/files/paper/2019/the-2021-biennial-exploratory-scenario-on-the-financial-risks-from-climate-change.pdf



Types of climate risks

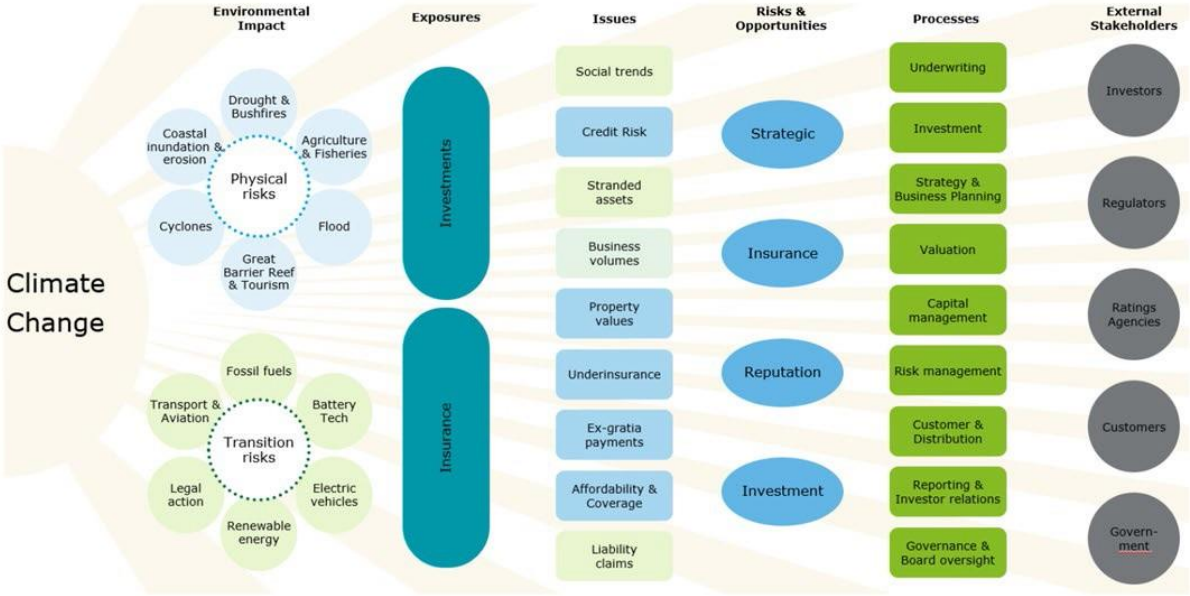
Financial Institutions are exposed to climate impacts through three main mechanisms, as identified by the Bank of England's Prudential Regulation Authority

- **Physical risks:** The first-order risks arising from weather-related events. Impacts may arise directly through damage to property and business interruption, or indirectly through subsequent events such as disruption of global supply chains and the resulting effect on commercial businesses.
- **Transition risks:** The financial risks arising from a transition to a low-carbon economy. This includes the potential impact on asset values of carbon-intensive financial assets, and impact on insurance premiums from carbon-intensive sectors of the economy.
- **Liability risks:** Directors or trustees may be held responsible for failing to mitigate against climate change physical risks, or the risks arising from the transition to a low-carbon economy, as they relate to their organisation. These risks can manifest directly from an insurers' own action/inaction, or through the activities of customers as risk is passed on to insurance firms under liability contracts such as professional indemnity and directors' and officers' insurance. Reputational risk arising from insurers' broader management of climate change is a related risk which may amplify impacts on insurers.

The following sections discuss the issues that actuaries of general insurers, life insurers, health insurers and reinsurers should consider in relation to the possible impact of climate risk. Some impacts such as investment management (common to all insurers) and health impacts (common to workers compensation, life insurance and health insurance) are discussed in the 'All Insurers' section.

All insurers

Climate change may have a wide range of impacts on insurance processes, leading to a range of risks and opportunities (see Figure below).



This Technical Paper firstly considers the processes linked to areas of actuarial practice for insurers broadly. The specific considerations for the General Insurance, Life Insurance and Health Insurance entities are detailed separately; in particular, how the physical, transition and liability risks impact the product pricing, underwriting and design, the valuation of liabilities and other areas of actuarial practice within these entities.

Capital management

The ability of an insurer to continue to attract capital will require consideration of the impacts of climate change through the capital management framework and the company's risk management strategy.

CPS320[11] states that the AA must include "general observations on the insurer's approach to capital management" and "an assessment of the insurer's current and future profitability and capital adequacy" in the FCR.

Target capital

Within the capital management framework, the methodology for determining stress margins on insurance risks may need to be tailored to allow for the uncertainties associated with climate change. This is particularly relevant to insurers with material exposure to natural hazards and the physical risks associated with climate change.

A risk-based capital model may be used to estimate the level of target capital required to achieve

[11] APRA, *Prudential Standard CPS 320 Actuarial and Related Matters*, July 2019
https://www.legislation.gov.au/Details/F2018L00746

the insurer's chosen risk appetite. It may also be used as a tool to assess and compare various risk mitigation actions or business strategies under different climate change scenarios.

In reviewing the capital modelling, actuaries may also consider whether stress margins for target capital may need to be reviewed.

Stress testing

Stress tests will also be important tools for assessing capital adequacy, and the AA should comment on whether the insurer has done appropriate stress and scenario tests to assess their risk.

Some considerations with relation to climate change include:

- Modelling outcomes in shorter and longer time horizons, as climate change impacts are longer term than the general three-year stress test.
- The extent to which existing natural hazards models capture potential climate change impacts, noting they are typically parameterised using historical datasets based on the existing climate. There is difficulty in separating climate change impacts from the range of uncertain outcomes predicted and challenges in forecasting the future climate.
- The extent to which physical climate risks which are already happening are reflected in recent historical claims costs.
- The amount of premium written by the insurer may be impacted by technological or regulatory change in some sectors of the economy, under certain climate scenarios.
- There may be dependencies/correlations across risk types or lines of business.
- The value of investments may be impacted by climate change issues (see below for further consideration of this point).
- The extent to which climate change will change the geographic distribution of natural hazards risks.

While physical climate change impacts may occur over a longer period than a 3-year time frame, the AA should note that transition and liability risks may occur more quickly, for example, due to legislative or regulatory change.

The AA may also consider whether any management actions identified as part of the scenario should be taken in advance as precautionary measures, or whether they would be relevant or desirable only if the scenario emerges.

Reinsurance

CPS 320[12] requires the AA to provide an assessment of the suitability and adequacy of the insurer's reinsurance strategy as part of the FCR.

In performing this assessment the AA should consider:

- Any climate change impacts which might be more material for the availability of reinsurance over the medium to longer term
- Forward looking risk modelling focusing on long-term climate trends - rather than wholly relying on historical loss data

Insurers should also recognise that reinsurers do or will consider climate change risk in their pricing, underwriting and product design across general, life and health coverage. In particular, reinsurers are seeking sustainable pricing in relation to natural hazards-related coverage and managing their accumulation to this risk. They are also managing their assets with consideration to transition risk and the potential for stranded assets associated with fossil fuels.

The largest global reinsurers have exposure to climate change risk through physical risk, transition risk and liability risk and have recognised climate change for some time.

Credit ratings

Credit rating targets may be incorporated in the insurer's risk appetite statement, and therefore need to be considered as part of the insurer's risk management. Credit rating agencies are increasingly considering climate risk in their credit rating determinations. They are assessing the climate change risks appropriate to the financial sector on a global basis and consider the disclosures made by each entity.

Climate change liability risk

The liability risks to an Insurer or Investment manager primarily arise through a fiduciary duty to shareholders to address financial and strategic risks, including climate change. In 2019, Noel Hutley SC and Sebastian Hartford Davis provided updated legal opinion that the need for directors to consider climate risks and opportunities continues to rise and reinforced the urgency of improved board-level governance of this issue.

This elevation of liability risk since the original 2016 Hutley opinion, arises due to:

1. The coordinated engagement by financial regulators on climate change,
2. New reporting frameworks such as the Taskforce on Climate-related Financial Disclosures (TCFD) and recommended disclosure guidance from the Australian Accounting Standards Board and the Auditing and Assurance Standards Board,
3. Investor and community pressure,

[12] APRA, *Prudential Standard 320 Actuarial and Related Matters*, July 2019
https://www.apra.gov.au/sites/default/files/cps_320_standard_only.pdf

4. Advances in scientific knowledge, and
5. Increased litigation risks.

The advice concludes that: "*In our opinion, these matters elevate the standard of care that will be expected of a reasonable director. Company directors who consider climate change risks actively, disclose them properly and respond appropriately will reduce exposure to liability. But as time passes, the benchmark is rising.*"[13]

Although the TCFD reporting is voluntary, the representations made in these reports influence investment decisions. Shareholder class actions have been filed in the US and Europe alleging a misrepresentation of climate related financial risks, and/or a breach of directors' duties for a failure to govern for those risks. There is also growing activism with cases of interest in Australia with litigation in train against REST, a large superannuation fund trustee, and more recently the Commonwealth Government, in relation to matters of that nature. While to date activists have had limited success in pursuing climate change related matters through legal channels, many of the legal building blocks that would facilitate a successful class action outcome are now in place, substantially increasing litigation risks for directors and their insurers.

Impacts of climate change on health

The health impacts of climate change have the potential to affect all types of insurers – workers compensation insurers, life insurers and health insurers will all be impacted. This section outlines the various ways in which climate change can impact on health broadly, and then each individual insurance section goes into more detail.

In recent years, work has been done to better understand the relationship between climate change and health in Australia, including the annual MJA–Lancet Countdown on health and climate change[14] which concluded that "Australia remains at significant risk of declines in health due to climate change, and that substantial and sustained national action is urgently required in order to prevent this."

There are many links between climate change and health[15] and a few key Australian examples include[16]:

- Rising temperatures and heatwaves are noted to have a high cost in lives, and also affect the health of the population through heat exhaustion and heat stroke, increasing hospital admission rates and death rates.
- Extreme weather events (e.g. the bushfires in 2019/2020 followed by flooding) can have both direct impacts on health through physical injuries, respiratory problems and psychological distress, and may also indirectly affect health through affecting food and water security and the onset of mental illness exacerbated by loss of homes and livelihoods.
- Changes in temperature, rainfall and humidity affect the optimal conditions for the spread

[13] https://cpd.org.au/2019/03/directors-duties-2019/

[14] https://www.mja.com.au/journal/2019/211/11/2019-report-mja-lancet-countdown-health-and-climate-change-turbulent-year-mixed
https://www.mja.com.au/journal/2018/209/11/mja-lancet-countdown-health-and-climate-change-australian-policy-inaction-0

[15] https://www.scientificamerican.com/article/climate-change-is-having-widespread-health-impacts/

[16] https://www.abc.net.au/news/health/2019-07-06/health-impacts-of-climate-change/11282926
https://actuaries.asn.au/Library/Opinion/2019/TheDialogue10ClimateWEBLres.pdf

of disease. For example, this affects the distribution and number of mosquitoes, leading to the spread of dengue fever and Ross River virus where there may not have previously been cases.

- Climate change may worsen air quality through increased bushfire risk and changes to ozone[17].
    - Chronic exposure to air pollution increases risk of cardiovascular disease, respiratory disease and lung cancer[18] and can affect reproductive, urological and neurological systems.
    - In Australia, the health impacts of exposure to particulate matter, particularly following bushfire and burn off events, are evidenced[19,20] and recent research shows that even relatively low exposure to particulate matter can lead to increased levels of cardiac arrest[21].
- In contrast, transitioning to a low carbon economy, such as moving from coal energy to renewables, may have a positive impact on air pollution and hence health. For those living near coal fired power stations, their cardiovascular and respiratory systems may be positively affected by transition from coal fired power stations in their local communities.
- Mental health is noted as a key issue for farmers, where reductions in crop yield and drought affect the rural communities and the mental health of farmers and their families. The flow on impacts on food prices may also lead to worsening health outcomes for low income communities via food affordability and accessibility. As an example, the MJA Lancet Countdown reports in 2018 and 2019 identified an association between mean annual maximum temperatures (driven up by climate change) and suicide rates across states and territories.

The effect of climate change on health is complex. Insurers will need to consider the impact of other trends, such as the ageing population or the rise in chronic conditions, on all types of insurance claims, noting for instance that older people and those with underlying health conditions are known to be more vulnerable to heatwaves[22].

Investment management

[17]Orru et al., 2013. Impact of climate change on ozone-related mortality and morbidity in Europe
[18]World Health Organisation (WHO) (2018). Ambient air pollution: Health impacts. Available at: https://www.who.int/airpollution/ambient/health-impacts/en/
[19] Desservettaz, M.; Phillips, F.; Naylor, T.; Price, O.; Samson, S.; Kirkwood, J.; Paton-Walsh, C. Air Quality Impacts of Smoke from Hazard Reduction Burns and Domestic Wood Heating in Western Sydney. Atmosphere 2019, 10, 557.
[20] Centre for Air pollution, energy and health Research (2019). Bushfire smoke: what are the health impacts and what can we do to minimise exposure?
[21] Zhao, B., Johnston, F. et al (2020) Short-term exposure to ambient fine particulate matter and out-of-hospital cardiac arrest: a nationwide case-crossover study in Japan. The Lancet Planetary Health. doi.org/10.1016/S2542-5196(19)30262-1
[22]https://www.actuaries.asn.au/public-policy-and-media/thought-leadership/the-dialogue/the-impact-of-climate-change-on-mortality-and-retirement-incomes-in-australia

Assessment requirements

APRA's CPS 320[23] requires "an assessment of the appropriateness of the investment strategy, having regard to the nature of the insurance liabilities."

This section provides background to the considerations of an AA in relation to climate change in making this assessment.

Climate risk impacts on investments

Climate Change will impact investment portfolios through policy and regulatory uncertainty, changing customer preferences and product substitution, disruptive technological shock and direct financial impacts as businesses models and costs change. These factors can impact the valuation of assets and the volatility of returns. The impact manifests at both a macroeconomic and portfolio level, and can lead to positive as well as negative outcomes for individual investments and portfolios.

The potential directors' liability in dealing with climate risks should also be considered in the investment strategy. Climate Change is a key risk within the Environmental, Social and Governance considerations important in considering long term investment strategies. Addressing such risks in the investment portfolio has implications beyond investment performance and capital protection, extending to liability and reputation benefits with respect to investors and customers.

Investment challenges

Challenges incorporating climate change in the assessment and construction of an investment portfolio include:

- Politics affect response paths globally and hence the timing and impact of climate change effects and the policy responses to them.
- Obtaining appropriate and consistent quality of Information on companies and securities is an ongoing work in progress.
- Climate modelling doesn't provide granular results to the level of individual customers and capability of modelling extreme events is developing.
- Economic modelling typically adopts macro approaches which do not necessarily capture climate tipping points – for example sudden changes to physical risks, and/or sudden changes in investment outlook for particular sectors due to legislative or sentiment changes.
- The risk adjusted return in a constrained portfolio is theoretically less than on an unconstrained portfolio so positioning a portfolio for transition risk requires careful consideration, as the risk adjustment is a volatility adjustment, which may not take into account the risks being considered in determining the constraints. In this regard there is a difference between integrating Climate Risk ratings in a broader investment process and actively screening out individual investments.

- Focusing on carbon intensity in a portfolio is not in and of itself an adequate indicator of the risks to returns implicit in an investment strategy as returns are also driven by industry

[23] APRA, *Prudential Standard 320 Actuarial and Related Matters*, July 2019 https://www.apra.gov.au/sites/default/files/cps_320_standard_only.pdf

structures, product constraints and the ability to adapt in different policy environments over different timeframes.

Asset modelling

Traditional asset modelling approaches do not explicitly capture the impacts of climate risk. Climate change and related policy responses (both preventive and adaptive) together form a known pending exogenous shock, and in fact an accumulating shock, to such models.

The uncertainty that needs to be captured in interpreting asset modelling results should increasingly encompass consideration of the potential timing and impacts of such exogenous shocks.

While challenging, there is a need to question whether macroeconomic assumptions about growth, interest rates and inflation are appropriate given the systemic impacts of climate change upon industries and higher risks of climate tipping points.

Stress testing

As noted in the capital section, stress testing can be a valuable tool. In investment management too, depending on the sophistication of the investment strategy, the investment manager may be testing overall business assumptions through drawing out the implications of different climate change scenarios and associated government action in responses on the portfolio.

The AA may regularly assess the appropriateness of the stress testing of the investment portfolio specifically, as well as capital more generally, against the sophistication and risk management framework adopted, including how that relates to the business' investment horizon.

The scientific literature gives some guidance to the investment manager and the AA in understanding the likelihood of physical risks in the investment portfolio. In addition, attention to the policy responses is also needed to consider the transition risks in the portfolio. While government policy responses, technological and behavioural change make it difficult to predict the distribution of outcomes for a given time horizon, it would be possible for the AA to review the appropriateness of the investment strategy's consideration of climate change against the time horizon of the investment strategy.

For example, the IPCC's 1.5 Degree Report (2019)[24] assesses what action is required to limit global warming to 1.5 degrees by 2100 – namely global greenhouse gas emissions should be reduced to net zero by approximately 2040-2055. The Report's assumption is that such reductions start immediately and that any delay brings forward the target date. Scenarios could also consider the timing of such reductions, and their implications for the investment portfolio.

This 20-30 year horizon to achieve net zero emissions is now crossing over some key investment and projection horizons. For example:

- The investment horizons for many industries, particularly infrastructure and capital intensive industries, materially heightening the risk of stranded assets.
- The projection horizon for meeting customer promises. For example, net zero emissions would need to be achieved within the lifespan of anyone currently under 65 and the success or

[24] https://www.ipcc.ch/sr15/

otherwise of the transition will directly affect their superannuation balances.

Further, the Report notes that even if net-zero emissions are achieved in these time frames in many pathways, emissions would still increase before reducing later in the century to 1.5 degrees. Notwithstanding this, there is still a 50% chance of emissions exceeding 1.5 degrees by 2100.

Questions for the investment manager

The questions below are broadly in increasing order of sophistication for the AA to consider as part of the review of the investment strategy for the FCR.

- How might a portfolio be stress tested?
- What is the portfolio's exposure to potentially stranded assets?
- What is the portfolio's exposure to assets that may benefit from transition policy?
- How might portfolio risks differ according to time horizon?
- For longer term investment horizons has there been any consideration of possible tipping points?
- How would the investment portfolio perform if a "shadow" carbon price were applied to reflect either potential policy responses or the effective cost of transition due to changes in technology and behaviour?
- Is the assessment of Climate Change impacts upon economic growth and the investment portfolio consistent with the assessment of the impacts upon the business as a whole and its customers?
- How might one establish a decision making framework to reposition the portfolio in response to different policy outcomes and emerging physical shocks?
- What requirements with respect to Climate Change risks have been established as part of criteria for selecting fund managers? For example, what is the fund manager's proxy voting policy with respect to influencing investee companies to report under the TCFD?

In regard to the interaction with the impact of climate change on liabilities, consider that:

- The duration profile of liabilities will be impacted by reserving decisions
- Liabilities will have greater volatility and uncertainty, which may impact liability driven investment
- There is a risk to long term government bonds and their credit ratings under both physical and transition risk exposures

General insurance

Types of risk for general insurers

Physical risk

General insurers may be exposed to physical risk through claims on insurable events, or through their asset portfolios. Examples of physical risk impacts include:

- Drought and bushfire risk may increase in certain locations as a result of higher temperatures, changing the frequency and severity of events at a rate that is very uncertain.
- Flood risk is likely to increase in some areas as rainfall intensity increases. Urban drainage systems in built-up areas are typically constructed to withstand only relatively low return period rainfall at short durations (for example 10 years) and commonly become ineffective in major events as they are blocked up by organic debris contained in surface water runoff.
- Cyclones may deliver greater rainfall totals, increasing the impacts of water ingression and flooding. Although highly uncertain, cyclones may also be able to form and decay further south in latitude towards more built-up coastal areas (particularly southern Queensland). This potential increase in the cyclone hazard may occur in regions without sufficient cyclone resilient building codes (Region B).
- Coastal inundation and erosion risk increase as sea levels rise. While these are not generally covered by domestic property policies, they may be a source of reputational risk for insurers if claims are denied, or unanticipated cost if ex-gratia payments are made (for example recent coastal inundation caused by East Coast Lows in 2016 and 2020).
- Agriculture and fisheries are likely to change as the appropriate conditions for crops or fish species move southwards and rainfall patterns change, making historical data less relevant.
- Great Barrier Reef and tourism may be affected by increasing coral bleaching, impacting some commercial insurance. The degradation of the Reef may also reduce the resilience of coastal properties to storm surge.

Physical risk impacts are likely to differ greatly by region, with some communities much more severely impacted than others.

Physical risks may also impact the value of investment asset portfolios and the assessment of credit risk.

Climate impacts on mortality and morbidity risks, such as heat stress from working outdoors during heat waves, or sickness from working outdoors during high pollution days, are also relevant to workers compensation claims. Impacts on health are discussed in further detail in the Life Insurance and Health Insurance sections.

Transition risk

A range of policy, legal, technological and market changes are likely to occur during the transition to a low carbon economy. Some examples of how these might impact a general insurer (excluding investments, which are considered separately) include:

- Fossil fuels – the transition to low carbon will result in a divestment of industries based on fossil fuels. This can lead to poorer maintenance or higher risk practices, producing higher claim costs in property and liability products.
- New technologies, such as batteries, electric vehicles and renewable energy, have greater uncertainty associated with performance increasing the risk of selecting inappropriate pricing and reserving assumptions.
- Transport and aviation - shifts in consumption of carbon-intensive products may require strategies for rebalancing of the product mix of a general insurer.
- Growth or contraction of certain sectors as a result of the transition to a low carbon economy may affect the amount of premium revenue the insurer writes.

Liability risk

Liability risks may arise through Directors and Officers or Professional Indemnity insurance contracts, where the insurer is held liable for failure to mitigate, adapt, or disclose climate change risks.

Pricing, underwriting and product design

CPS320[25] states that an FCR must include "an assessment of pricing, including the adequacy of premiums". This includes the AA's assessment of whether the premiums being charged adequately price for climate change risk.

General insurance products are commonly sold as annually renewable contracts. This means premiums only need to be adequate to cover claims over the next year until the next contract renewal. However, risk-based pricing may drive high annual premium increases as models for natural hazards risk changes and models are recalibrated. Growing affordability pressure and continuity of coverage beyond the annual policy cycle should be considered. There are regulatory and reputational risks to be considered alongside material increases in premiums or withdrawal of coverage over time.

Monitoring leading indicators may help guide when pricing and underwriting need to change to reflect climate change impacts. One example of such an indicator is the Australian Actuaries Climate Index[26]. The AA should comment on monitoring of premium rates charged within the FCR (PS102).

Transition and liability risks may occur over short time frames due to regulatory and legal change.

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[25] APRA, *Prudential Standard 320 Actuarial and Related Matters*, July 2019 https://www.apra.gov.au/sites/default/files/cps_320_standard_only.pdf

[26] Australian Actuaries Climate Index https://actuaries.asn.au/microsites/climate-index

Climate change brings opportunities for insurers to develop new products. The AA should be aware of new products being developed and offered by the insurer, and comment on their design and pricing if appropriate.

Reserving

General Insurance AAs are required to determine values for central estimates and risk margins of the outstanding claims liabilities and premiums liabilities. All of these values may be affected by climate change.

Most of the considerations discussed previously apply to Reserving, particularly for premium liabilities. In addition, climate change may increase the uncertainty around assumptions, which may require increases in risk margins.

Other considerations relevant to the valuation of outstanding claims liabilities include that:

- Most physical risks will be known to have occurred or not occurred at the time of valuation. This may decrease the uncertainty due to climate risk. For example, once a hailstorm has occurred, it will be evident fairly quickly how severe the event has been.
- Some physical risks, such as workers compensation claims relating to exposure to air pollution from bushfires, may take longer to be reported.
- Some reserving methods may be significantly affected by shifts in the payment pattern, which may be more difficult to detect from historical data than changes in frequency and severity. For example:
    - Very widespread bushfires may take much longer to assess than historical ones with more limited extent, and require different demand surge assumptions.
    - Changes in underwriting and claims practices and investment in resilience may also affect payment patterns.
    - New technologies emerging during transition to a low carbon economy may have little historical data but exposure may increase rapidly as investment preferences shift.
- The timing for new transition and liability risks to emerge may be very uncertain.

Scenarios and sensitivities may be useful to inform the selection of best estimates and to quantify uncertainty.

Natural hazards catastrophe modelling

The most established catastrophe models focus on assessing physical risks with the highest historical losses, such as earthquakes, cyclones, bushfire and floods. Some of the natural hazard models may also be useful in quantifying transition and liability risk. Recently, there has been rapid development in some areas, partly driven by the TCFD recommendations, for example:

- Incorporating the effect of climate change in these models under various climate scenarios
- Consideration of the changes in correlations between different natural hazards
- Assessing perils expected to increase in importance in some areas, such as hail and bushfires
- Refining the scale of models to understand different geographic impacts as climates change

Some issues that should be considered when using a natural hazards catastrophe model include:

- How much of the current climate risk is captured by the model? In modelling infrequent events, it is likely that long-term averages are being used to estimate frequency and size. If there is an underlying trend due to climate change, it may be difficult to detect due to the cyclical weather patterns and high variability and exposure changes over time. It is particularly complex to capture the interaction of our cyclical weather patterns considering the El Niño–Southern Oscillation (ENSO), Indian Ocean Dipole (IOD) and the Southern Annular Mode (SAM).
- Are the effects of climate change likely to be different in different geographical areas? Leading indicators, such as changes in rainfall or temperatures, may be found in the Australian Actuaries Climate Index or Bureau of Meteorology historical data. Bear in mind that some changes may be subtle, for example, there may be more intense episodes of rain but no change in the average rainfall measure.
- The uncertainty associated with modelled climate impacts, especially at more granular levels, may need to be considered and communicated.
- Do exposures in the model correspond to the current state? For example, are the building regulations associated with each property understood along with the changing vulnerability as flood or bushfire risk changes?
- Is there sufficient allowance for factors other than direct damage, for example, demand surge, business interruption?
- Are there features that suggest the possibility of non-linearity or step changes? For example, the combination of urban spread, drought and higher extreme temperatures might produce a shift in bushfire risk.

Climate transition and liability risks could be understood through developing scenarios and estimating frequency and severities for these. This could involve consideration of social, political, growing and declining industries and economic drivers under different RCP Scenarios.

Different applications within insurance have different time horizons and so may need different approaches:

- Short term, such as annual pricing and valuation. Consider whether the natural hazard catastrophe model adequately captures the current climate risk or small annual increments.
- Medium term, such as portfolio steering over 5-10 years. Consider sensitivity testing with a trend or step change in natural hazard catastrophe model parameters.
- Long term, such as the impact on capital position, and designing business strategies for rebalancing business by geographical area or line of business. Sensitivity testing under different climate scenarios may be useful.

Life insurance

Types of risk for life insurers

Physical risk

The section titled "Impacts of climate change on health" details the impacts of climate change on health. This section should be read in conjunction with that overall description.

Life insurers may be exposed to physical risk through:

- Claims arising from the health and/or mortality impacts of climate change,
- The impacts that the physical risks of climate change have on their asset portfolios and/or
- The impacts that physical risks may have on their customers' ability to pay premiums, and relatedly lapse, retention and new business sales.

Examples of how the physical risks of climate change may impact life insurers include:

- Major flood or bushfire events can lead to large numbers of customers experiencing financial hardship. This may lead to material numbers of customers needing to access premium relief and/or making changes to their policies that assist with affordability.
- For mortality protection, insurers could face the risk of increasing claims costs as changes in weather patterns drive additional deaths. For example:
  - Extreme weather events may result in loss of life[27]. Historically heatwaves have killed more Australians than any other natural hazard[28].
  - Broader shifts in climate patterns (e.g. ambient temperature[29,30]) may drive changes to the overall shape of the mortality curve.
- Insurers who bear morbidity risks (through Total and Permanent Disability, Income Protection and to some extent Trauma product offerings) are also exposed to the impacts that climate change may have on health. Some examples include:
  - Heat-related stressors and impacts on respiratory and cardio-vascular health from the impact of climate change on air quality (as noted in the section titled "Impacts of climate change on health").
  - Mental health impacts, for example the psychological impacts of bushfires can continue for at least ten years following a major event[31].
- Insurers with exposure to longevity risk may benefit from lifetime income streams ending earlier than expected if mortality deteriorates due to climate change.

[27] Åström et al., 2013. Attributing mortality from extreme temperatures to climate change in Stockholm, Sweden

[28] https://actuaries.asn.au/Library/Opinion/2019/TheDialogue10ClimateWEBLres.pdf

[29] Gasparrini et al. 2017, Projections of temperature-related excess mortality under climate change scenarios

[30] Gasparrini et al. 2016, Mortality risk attributable to high and low ambient temperature: a multicountry observational study

[31] https://mspgh.unimelb.edu.au/centres-institutes/centre-for-health-equity/research-group/beyond-bushfires

People with existing health conditions, comorbidities, very young and older people and socio-economically vulnerable people are more vulnerable to the health and mortality risks of climate change. Consequently, Australian life insurers with exposure mainly at the working ages have been minimally impacted by climate change to date, however impacts could be material over the long term.

Transition risk

Shifting towards a lower carbon economy may drive widespread change in the economy, particularly in sectors highly reliant on fossil fuels. These changes may lead to impacts on claims costs, asset values or risk exposure. For example:

- A disorderly transition may cause disruptions to job stability in some sectors and could have impacts on claims incidence arising from mental health. Retrenchment of people employed in industries transitioning from carbon[32]. There is much evidence that becoming unemployed has a negative impact on mental health[33].
- Consumer preferences shifting away from carbon intensive products and processes may exacerbate any changes in industry and unemployment rates.
- New technologies could lead to growth in other renewable industries, bringing about potential offsetting impacts to shrinking industries and short-term uncertainty to current occupation ratings.

Given the long term nature of the majority of life insurance products (due to their guaranteed renewability), and the sensitivity of claims rates to unemployment and mental health levels, transition risk impacts are likely to have more material impacts on a life insurer's risk portfolio than physical risks in the short term.

Liability risk

Liability risks may arise for insurers, for example in cases where they are held liable for losses due to climate change, or for inadequate assessment and/or disclosure of climate risks to shareholders. More detail is included in the section titled "Climate Change Liability Risk".

Pricing, underwriting and product design

Life insurance in Australia can typically cover mortality, morbidity, and longevity risks through retail and group markets. Products can range from short term yearly-renewable, or longer term with benefits to age 65. The introduction of products or features to meet the changing needs of Australians for long term products should consider the climate change risks in pricing and in the reviewability of pricing.

In the short term there are:

- Uncertainties in quantifying and attributing climate risks, and understanding how adaptation may change climate risks
- Limitations of data availability and monitoring

[32] Although any such effect is likely to be dwarfed by the economic consequences of COVID-19.

[33] http://iwh.on.ca/summaries/issue-briefing/unemployment-and-mental-health

Despite these limitations, over the long-term insurers should develop a better understanding of climate risks through improvements to data availability and accessibility, as well as modelling improvements to enhance and support pricing.

Other pricing considerations include the impact of any regulatory changes specific to climate risks, and whether changes in underwriting relating to climate risks can be captured in pricing.

Reviewability as a risk mitigation strategy

Life insurers can use repricing mechanisms to manage some of the emerging risks that climate change brings. Whilst this may be a potential reactive strategy for most active life portfolios, some key considerations for repricing in light of emerging climate risks include:

- Limitations to Disabled Life Reserve portfolios – climate impacts for people already on claim, particularly long-term benefits
- Commercial and operational feasibility of repricing, and whether revised premiums are affordable for the target market
- Shock lapses and anti-selection in light of premium changes

Reserving

The uncertain nature of climate change will have wide ranging impacts on the reserving process. Considerations that AAs may take into account when assessing the reserving process (in the context of climate change) include the data and modelling techniques used, and the assumption setting process. It is advised that when considering these areas that an assessment of viability, reasonableness and appropriateness be applied.

There is recognised complexity in setting best estimate assumptions in accordance with the effects of climate change that will emerge over time, particularly as extrapolating historical trends will not provide a reliable guide to future developments. As part of regular reviews of assumptions, AAs may wish to give some considerations to the impact of climate change on best estimate assumptions. Some examples that may arise include:

- Adjusting industry tables due to specific characteristics of the company's insured lives; or
- Adjusting current best estimate assumptions due to the existence of a new risk factor.

In deciding whether it is appropriate to make these adjustments, an assessment of the data's credibility, the materiality of the assumptions and whether it is viable to implement are also key considerations.

At present, due to the uncertainty around the long-term nature and level of climate change impacts, a practical approach is to recognise that climate change represents an additional source of uncertainty in future mortality and morbidity rates, and to consider its implications for reserving assumptions. The process could also include communication of how this uncertainty has been managed to the Board.

Stress testing and scenario analysis can provide insight into the breadth of outcomes that climate change may produce. This is consistent with the approach recommended by the Taskforce on Climate-Related Financial Disclosures[34].

[34] https://www.fsb-tcfd.org/about/

Health insurance

Types of risk for health insurers

Physical risk

The section titled "Impacts of climate change on health" details the impacts of climate change on health. This section should be read in conjunction with that overall description.

The effect of climate change on health is complex. Health insurers will need to consider physical risk in the context of the impact of other trends on health insurance claims, such as the ageing population or the rise in chronic conditions. Notwithstanding the complexity, examples of how the physical risks of climate change may impact health insurers include direct impacts from the health of the population, and indirect costs from the impact of the need to change the health system:

- The associations between increased extreme heat, bushfires, drought and mental health.
- Worsening health outcomes because of increased exposure to heatwaves and other natural disasters will require our health system to adapt[35]. As the community's health needs change because of climate change, the health system will similarly need to adapt. In particular, there may be a need for the system to be able to more frequently satisfy surges in demand due to, for example, heatwaves or extreme bushfire events, increased tropical diseases in areas where they have not previously been seen, increased prevalence of chronic conditions compounded by adverse weather events, and deteriorating quality of air due to bushfires and warmer temperatures.
- Population health changes may not occur slowly enough for health systems to adapt in a planned and orderly manner. Less well-managed changes to the system potentially put upward pressure on costs to the health system as a whole, and therefore potentially health insurance premiums, in the long term.

Health insurers will need to consider the implications of the transitioning health system to design products that ensure changing health needs continue to be satisfied. Any increased volatility in health insurance claims will also have implications for insurers' reserves and the capital they hold.

Transition risk

As with general and life insurance, the transition to a low carbon economy will have an economic cost with consequences for health insurers' investment portfolios. However, other transition risks weigh on health insurance differently and may impact claims costs or risk exposure. For example:

- A disorderly transition may cause disruptions to job stability in some sectors which could have impacts on claims incidence arising from mental health. There is much evidence that becoming unemployed has a negative impact on mental health.
- Transition risks affect economic activity, supply chains, business practices and consumer behaviour. This may affect the underlying exposures of customers by new and emerging technologies and industries altering the risks faced by customers on a day to day basis.

[35] Already, we have seen that with the COVID-19 pandemic, the health policy response has been to rapidly re-organise the way the public and private health systems in Australia deliver care. This has resulted in material disruption to the finances of health insurers, quite aside from COVID-19's economic impact.

Liability risk

Liability risks may arise for listed health insurers, for example in cases where they are held liable for losses due to climate change, or for inadequate assessment and/or disclosure of climate risks to shareholders. More detail is included in the section titled "Climate Change Liability Risk"

Product design, underwriting and pricing

Health insurance contracts are similar to general insurance products, being repriced annually, albeit being community rated or priced based on the benefits offered rather than the risk exposure of individuals. Practitioners could consider:

- Potential worsening trends (e.g. spread of disease enabled by hotter or wetter conditions, or mental health impacts on farmers and rural communities due to materially changed economic circumstances)
- Potential beneficial trends (e.g. Potentially less pollution related diseases due to energy transition)
- The time horizon these trends may reasonably be expected to evolve
- The risk and potential impacts of extreme events, as frequency of extreme climate related events might be expected to change (e.g. heat waves causing heat stress impacts, particularly in light of age profile of fund membership).
    - The immediate impact of such events may even have temporarily offsetting benefits for health Insurers (e.g. If an event impacts ability to access health services). However, this can lead to the emergence of longer term impacts.
    - If there is an existing allowance for extreme events in pricing, adjustments should be considered to allow for the bias implicit in past data that may underestimate the severity or frequency of future extreme events.

These trends may affect future premium adequacy. If the worsening trends outweigh the beneficial trends, then premiums may need to increase at a higher rate in order to remain at sustainable levels. Regulatory and reputational risk issues can then arise where increasing premium trends persist.

Reserving

Health insurance reserving is typically short tail and valued similarly to general insurance liabilities, although it incorporates an allowance for the Risk Equalisation Special Account to share risk between health insurers. This is dependent on the risk profile of policyholders as well as overall industry experience.

Considerations for the impact of climate change on the expected value of claims costs include:

- Transition risks may affect the underlying exposures of customers by new and emerging technologies and industries altering the risks faced by customers on a day to day basis.

- The level of engagement of the Australian government with health risks from climate change could affect issues such as:
  - The level of vulnerability to heatwaves (and heatwave mitigation plans)
  - The associations between increased extreme heat, drought and mental health.
- More frequent extreme weather events affect concentration risk and require potentially greater consideration of the distribution of policyholders, as well as the potential impact of demand surge affecting access and cost of health care. This may more immediately affect public health services, which could then have flow-on effects on the private health system funded by private health insurance.

Appendix

Climate related initiatives and resources

There are a number of initiatives with respect to climate, severe weather, natural peril and/or natural disaster risk in Australia to which the Actuaries Institute or membership are contributing, including:

- Climate Measurement Standards Initiative (CMSI)[36] is an industry-led collaboration between Australian banks, general insurers and asset owners to develop guidance on scenario analysis for TCFD reporting on the impact of climate on natural disasters (climate-related physical risk). The CMSI has produced financial disclosure guidelines and climate science guidance for Australian banks, general insurers and asset owners:
    - To provide guidance on interpretation of the TCFD in the context of the banking, general insurance and asset owner sectors in Australia
    - To obtain scientific advice in addressing the challenges around assessing changes in hazards due to climate change, including the development of scenarios to be used in TCFD scenario analyses.
- The Australian Sustainable Finance Initiative (ASFI)[37] is a collaboration of industry participants working towards a roadmap for sustainable finance in Australia. The roadmap, to be launched in 2020, will recommend pathways, policies and frameworks to enable the financial services sector to contribute more systematically to the transition to a more resilient and sustainable economy, consistent with global goals such as the UN Sustainable Development Goals and the Paris Agreement on climate change and the Sendai Framework. A progress report and summary was issued in December 2019, where access to tools, standards and data were recognised as a challenge to be addressed by the recommendations. ASFI is also considering how the private sector can mobilise capital to invest in resilience measures.
- The National Resilience Taskforce (NRTF) reported[38] on climate and disaster risk, including information on Australia's National Vulnerability and a strategic approach to managing vulnerability[39].
- Insurance Council of Australia's Climate Change Action Committee (CCAC)[40] is a multidisciplinary collaboration of insurance experts with a mandate to complete industry studies and information to:
    - Support the insurance industry to embed climate change issues and insights into decision making;
    - Work with stakeholders to raise awareness of climate change and the impacts of climate change, manage risk and develop solutions including awareness of disaster

[36] https://www.cmsi.org.au/reports
[37] https://www.sustainablefinance.org.au/
[38] https://www.aidr.org.au/media/6682/national-resilience-taskforce-profiling-australias-vulnerability.pdf
[39] https://knowledge.aidr.org.au/media/7710/03-vulnerability-guidance-strategic-decisions-climate-disaster-risk-2020.pdf
[40] https://climaterisk.insure/

preparedness in communities, and improve disaster response and recovery;

- Work with governments, regulators and other key stakeholders to promote action on climate change and other environmental issues; and
- Support industry disclosure of climate risks and opportunities.

Disclosures for investors

To enable climate change impacts to be understood and acted upon there has been movement in recent years to evolve a framework to support investors in making informed decisions. Most notably:

Task Force on Climate-related Financial Disclosures (TCFD)

This is a global industry led initiative for companies to provide voluntary, consistent climate-related financial risk disclosures for investors, lenders, insurers, and other stakeholders. The Task Force considers the physical, liability and transition risks associated with climate change and what constitutes effective financial disclosures across industries.

The objective is that better access to data will enhance how climate-related risks are assessed, priced, and managed and the TCFD aims to enable companies to more effectively measure and evaluate their own risks and those of their suppliers and competitors.

AASB/IASB

The AASB/IASB issued Practice Statement 2 (Dec 2018/April 2019). It noted that "even though the guidance is not mandatory, it represents the IASB's best practice interpretation of materiality and entities in Australia are already being subject to lawsuits regarding lack of disclosure."

The significant implication of this is that climate risk impacts on financial statements are within the scope of the Auditor's purview. The Practice Statement observes:

> *"Entities preparing financial statements in accordance with Australian Accounting Standards should consider:*
>
> - *whether investors could reasonably expect that emerging risks, including climate-related risks, could affect the amounts and disclosures reported in the financial statements and have indicated the importance of such information to their decision making; and*
> - *what disclosures about the impact of climate-related risks and other emerging risks on the assumptions made in preparing the financial statements are material to the financial statements…*
>
> *Auditors of the financial statements may consider:*
>
> - *climate-related risk and other emerging risks as part of their risk assessment applying ASA 315 Identifying and Assessing Risks of Material Misstatement through Understanding the Entity and its Environment. If there is an assessed risk of material misstatement in the financial statements, the auditor responds appropriately to the risks of material misstatement applying ASA 330 The Auditor's Responses to Assessed Risks;*

- *whether climate-related risk and other emerging risks are relevant for accounting estimates including assumptions used to arrive at a fair value estimate and potential impairment…"*

Resources on trends in Australia's climate

Useful information on trends in Australia's climate is provided by organisations such as:

- The Bureau of Meteorology[41], and
- CSIRO[42].

November 2020

[41] http://www.bom.gov.au/state-of-the-climate/State-of-the-Climate-2018.pdf
[42] https://www.csiro.au/en/Showcase/state-of-the-climate