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Time to Act:

Facing the Risks of a
Changing Climate



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CIA membership supports this statement through a robust process that identifies topics of importance to Canadians where actuarial expertise can contribute to public discourse. Actuaries with diverse backgrounds and views participate in the assembly of relevant research and in drafting the statement. CIA members not involved in drafting the statement are invited to provide input to ensure that the drafters consider all views and that the statement is supported by a reasonable degree of consensus.

Executive summary

Actuaries are risk management experts who use data modelling and statistical methods to measure and manage the financial impacts of uncertain events and scenarios.

Climate change creates uncertainty, posing a significant threat to the sustainability of our global ecosystems, health, and economies. The insured losses from severe weather events in Canada alone reached \$1.9 billion in 2018 (IBC 2018), the fourth-highest amount on record, not including uninsured costs paid by all levels of government, businesses, and individuals.

As signatories to the Paris Agreement look for ways to limit increases in global average temperature to well below 2 C above pre-industrial levels (UNFCCC 2015), organizations in the finance and insurance sectors are becoming increasingly aware of the importance of quantifying and disclosing the financial impacts of climate change in helping to achieve this target.

The Canadian Institute of Actuaries aims to ensure financial security for Canadians and the application of actuarial science for the well-being of society. In the face of a changing climate, we call on **all levels of government, business leaders, and investors** to take immediate action towards meeting the Paris Agreement target.

It is time to act:

1

Prioritize **data collection** related to the financial impacts of climate-related events

2

Implement policies that accelerate **climate-risk financial reporting** requirements

3

Account for **climate-related factors in investment decisions** and corporate risk planning

Climate change: an actuarial perspective

Actuaries use data and calculations to determine the probability of future events and their possible effects, and we draw on sound professional judgment to offer options on planning for and addressing risk.

We work in many areas, including life and health insurance, property and casualty insurance, investments, pensions, and enterprise risk management. Our work helps decision-makers in the public and private sectors ensure the long-term financial viability and sustainability of insurance systems, social protection programs, and investments.

Across these varied practice areas, we observe a range of climate risks affecting Canadians in areas such as health, mortality, property, and financial security. Indeed, climate change ranked as a top risk according to several recent actuarial surveys (JRMS 2019; CSFI 2019).

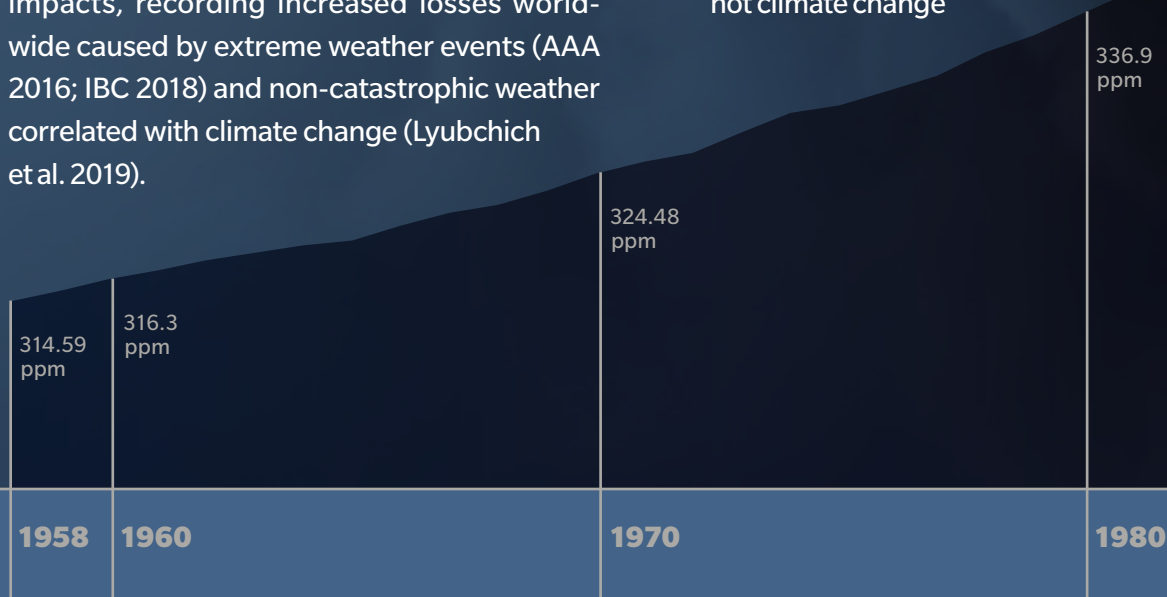
Actuaries working in **property and casualty insurance** are at the forefront of climate change impacts, recording increased losses worldwide caused by extreme weather events (AAA 2016; IBC 2018) and non-catastrophic weather correlated with climate change (Lyubchich et al. 2019).

Actuaries in the **pension, life insurance, and health insurance** industries work to forecast the changes in mortality and morbidity (IAA-REWG 2017; Hails et al. 2017) as the effects of climate change impact the risks of people being injured, becoming ill, and when or how they die.

Actuaries in **investments and finance** are dealing with the financial impacts of climate change risks on cash flows emanating from assets. As organizations adopt the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD 2017), actuaries are incorporating these considerations into their financial reporting.

Globally, actuarial organizations are developing standards of practice and guidance for their members on how to account for climate risk in their work and build climate change scenarios (IFoA 2017; Hails et al. 2017; Rothwell 2018; IAA-REWG 2019; IAA-REWG 2018; IAA-REWG 2017).

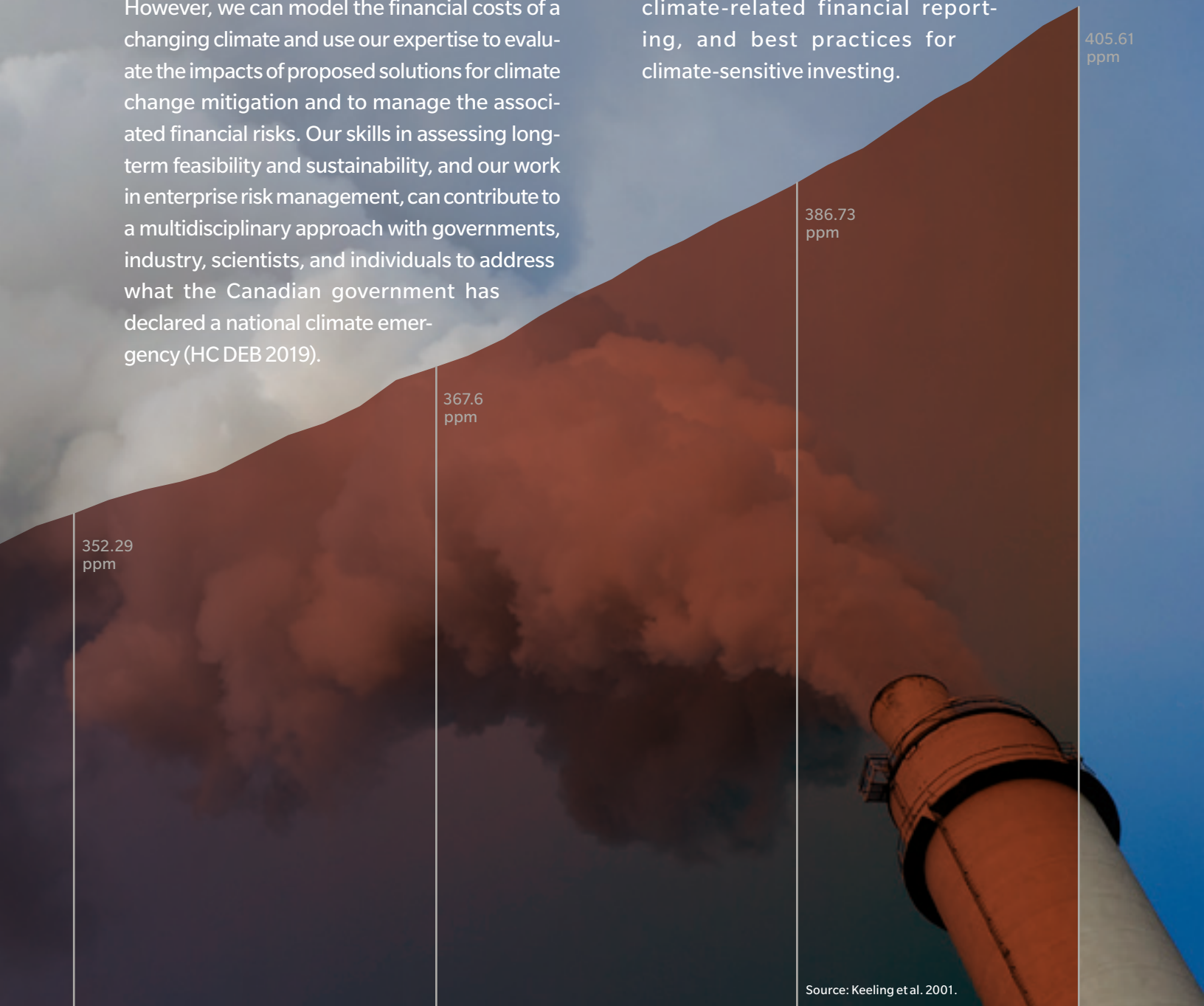
Actuaries as a profession are not climate change





experts who can offer advice on how to slow down or reverse the negative effects of climate change. However, we can model the financial costs of a changing climate and use our expertise to evaluate the impacts of proposed solutions for climate change mitigation and to manage the associated financial risks. Our skills in assessing long-term feasibility and sustainability, and our work in enterprise risk management, can contribute to a multidisciplinary approach with governments, industry, scientists, and individuals to address what the Canadian government has declared a national climate emergency (HC DEB 2019).

Now more than ever, we see the urgency for increased action on data collection, climate-related financial reporting, and best practices for climate-sensitive investing.



Source: Keeling et al. 2001.

1990

2000

2010

2018

Financial impacts of climate-related events

Rising global average temperatures, linked to increased emissions of greenhouse gases (GHGs) such as carbon dioxide, methane, and nitrous oxide, are increasing the global risk and intensity of events like extreme weather, health impacts, disruptions to food and water security, and financial instability (IPCC 2014). The Actuaries Climate Index[®] measures the extent of sea level change and the frequency of extreme weather in Canada and the United States (ACI 2019). The data show a continued significant deviation from historical levels, reaching new highs or lows in recent seasons, well above or below any of the seasonal values in the 1961–1990 reference period.

More extreme weather means more financial repercussions, such as the costs of mitigation and adaptation measures, emergency services, clean-up, compensation for victims, loss of business income, disability, loss of life, and rebuilding. For example, flooding within urban centres is Canada's costliest and fastest growing extreme weather challenge (Moudrak and Feltmate 2019). And costs are increasing: the Insurance Bureau of Canada reports that insured damage for severe weather events reached \$1.9 billion in 2018, the fourth-highest ever on record (IBC 2018). Previous records were set in 2016 (\$5.1 billion), 2013 (\$3.3 billion), and 1998 (\$2.2

billion). These amounts account only for what was paid by insurers. The costs to all levels of government, businesses, and individuals are not known, but would likely significantly increase the overall costs paid.

There is urgent need for reliable information related to the financial and economic impacts of climate change. For example, national flood maps and models should be developed and made available to the public in order to educate and allow all interested parties to make informed decisions. A national database of costs from severe weather such as flooding, windstorms, and wildfire would support actuaries' ability to anticipate the costs and probabilities for insurance companies and claimants to ensure fair, accurate, and timely support in the wake of a climate-related catastrophe.

This data collection in Canada is currently done at the municipal level, but it is not consistent or comparable, nor mandatory, leading to significant data gaps. We urge the federal government to oversee the development of a national database of extreme events that includes the total costs paid by all levels of government, insurers, organizations, and individuals. This data would drive better estimates on the exposure to climate risks and help prioritize climate change mitigation and adaptation projects in Canada.

[®] Registered in the US Patent and Trademark Office







Accelerating climate-risk financial reporting

In June 2017, the Task Force on Climate-related Financial Disclosures (TCFD), created by the Financial Stability Board, released a framework for organizations to disclose in their financial reporting how they manage climate-related risks and opportunities (TCFD 2017). By helping organizations prepare and standardize their financial reports with climate-related details, the TCFD framework promotes better-informed investment, credit, and insurance underwriting decisions, and will help minimize market disruptions related to climate risks.

However, findings in the TCFD 2019 Status Report (TCFD 2019) suggest that these voluntary standards have not resulted in material changes. Climate change is still not fully accounted for in corporate planning processes by Canadian businesses nor being sufficiently disclosed to investors, such that climate risks are not properly understood, managed, or priced. Internationally, only about 30 per cent of companies assessed by the Transition Pathway Initiative “have strategies consistent with the emissions reductions pledged by the Paris Agreement signatories in the form of ‘Nationally Determined Contributions’” (TPI 2019). As actuaries, we are concerned that this means a significant accumulation of unknown climate risk exists and continues to increase in capital markets.

We support mandatory financial disclosure of climate-related risks and opportunities by 2021, as detailed in the International Institute for Sustainable Development’s three-year plan (Bak 2019). We recommend a smooth and structured implementation ensuring accurate, timely, and standardized disclosure and appropriate governance mechanisms, strategies, risk management, metrics, and targets.

Investing with climate-related factors

We also call on investors and business leaders to include environmental, social, and governance (ESG) factors in their decision-making. These criteria help measure the sustainability and ethical impact of their investments beyond the obvious financial risks. The ESG market has increased significantly: estimates suggest that it reached \$30 trillion in assets under management in 2018, up 30.4 per cent from 2016, with projections of reaching \$35 trillion by 2020 (Pierron 2019). Such responsible investment allows institutions to better manage risks, invest with public interest in mind, and can lead to improved long-term returns, although some research suggests that there is a tipping point beyond which ESG score improvements reduce the investment universe and hence, can negatively impact diversification and performance (Bennani et al. 2018).

As Canada and the world move toward low-carbon energy sources, some global fossil fuel reserves may never be extracted, even though many of today's investors have counted and valued these reserves as assets. Similarly, infrastructure like pipelines and oil- or coal-powered plants may become obsolete. Coal, for example, has fallen out of favour with insurers and investors, with many cutting or eliminating insurance or holdings for companies that make money from coal (Bosshard 2017).

Such unrealized investments are called stranded assets, and can result in numerous financial impacts such as decreasing stock prices, business cash flow issues, and an increasing number of defaulted loans (Caldecott et al. 2016). Research by the University of Waterloo (Tan et al. 2018) proposes metrics and methodologies to quantify the carbon and climate change risks for stocks, and presents models and frameworks to quantify stranded asset risk in terms of impact on the stock's investment return.



Time to act

It is time to take immediate action to help limit global average temperature increase in line with the Paris Agreement. To help achieve this target, Canada's actuaries are calling on:

1

The federal government to **oversee the development of national data collection and disclosure** related to the financial impacts of climate-related events such as floods, windstorms, and wildfires.

2

All levels of government to require all entities to implement **financial disclosure of climate-related risks and opportunities** under the TCFD by 2021 and for corporate entities to adopt the TCFD framework voluntarily as soon as possible.

3

Investors and business leaders to **include environmental, social, and governance (ESG) factors** in their decision-making.

These important steps will help manage the financial impacts associated with the climate risks we face and will help ensure climate-sensitive financial security for all Canadians.

Now is the time to act.

Summary of research

The task force responsible for producing this statement accessed research papers, articles, and other studies to ensure there was a factual basis to the recommendations presented. These sources are listed below and are referred to throughout the following summary. We encourage readers who are interested in developing a deeper understanding to study these sources.

Climate risks affecting actuarial practice areas

The task force reviewed Canadian and international sources that identify climate risks affecting actuarial practice areas, and guidance and standards developed or in development to advise members on how to account for those risks.

In addition to reviewing the CIA's own past work, the task force studied the work of the Society of Actuaries (SOA), the Casualty Actuarial Society (CAS), the Institute and Faculty of Actuaries (IFoA), and the International Actuarial Association (IAA). The CIA's research paper on climate change (CIA 2015) provides actuaries with a background on climate science and finite world resources, and touches on existing solutions to mitigate and adapt to these consequences. The SOA's white paper (SOA 2018) describes some of the science behind climate change, in particular, how the increase in greenhouse gas emissions has led to warmer temperatures. It also suggests climate models that actuaries can use to project forward the Earth's climate in order to study the consequences of greenhouse gas emissions, and ways for actuaries to manage climate-related risks.

The task force notes that the IFoA has been particularly active with its work on climate change, publishing an introduction for actuaries (Storey et al. 2019) that describes how climate change is an actuarial problem through its impact on human health and mortality, the economy, the risks people and businesses face from natural disasters, and the value of assets held by financial institutions. It provides nine practical next steps for actuaries, including proactively raising climate change with clients and stakeholders and collaborating with other disciplines. The IFoA's 2017 risk alert (IFoA 2017) calls on actuaries to ensure that they understand, and are clear in communicating, the extent to which they have taken account of climate-related risks in any relevant decisions, calculations, or advice. The risk alert also raises awareness on recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), and guidance on developing a consistent approach to disclosures of material climate-related risks.



The IFoA has also created or is in the process of creating guides, guidance, and standards of practice in pensions (Hails et al. 2017), general insurance (Rothwell 2018), life insurance, and investments. These materials explain how resource and environment (R&E) issues (with climate risk being one of the most researched R&E risks) affect the work of actuaries in these areas, and ways to account for such issues.

The IAA has prepared discussion papers on flood risk (IAA-REWG 2019), decarbonization (IAA-REWG 2018), and climate change and mortality (IAA-REWG 2017), all of which describe ways in which actuaries should assess and manage these risks. The task force notes that the climate change and mortality paper describes adverse and favourable effects of climate change on both general population mortality and the mortality of participants in financial programs advised by actuaries. It indicates that regardless of the effects on mortality, the uncertainty associated with climate change creates forecast risk for actuaries involved in assessing the financial sustainability of long-duration pension and life insurance programs, and that stakeholders should be kept informed of the possible effects of this uncertainty. The paper calls for further multi-disciplinary work in modelling the effects of climate change and sensitivities to a range of warming outcomes.

As mentioned in this public statement, actuaries in the property and casualty area are already seeing the impact of climate change risk on their business. The task force examined numerous papers and articles that describe the impact of climate change on insurance risk (Curry et al. 2012) and why financial institutions should take note of climate change (Coleman and LaPlante 2016).

In addition to actuarial organizations, the task force also examined material from insurance and finance organizations including the CRO Forum, the International Association of Insurance Supervisors (IAIS), the World Economic Forum, and the Inter-American Development Bank.

The CRO Forum, whose member companies are large multinational insurance companies, promotes risk management practice in the insurance industry. Its work includes a position paper (CRO Forum 2019) produced by a working group comprised of Allianz, AXA, Generali, Hannover Re, Munich Re, NN Group, Prudential, Swiss Re, SCOR, Uniqa, and Zurich Insurance. The paper aims to provide insurance sector chief risk officers (CROs), their colleagues, and wider stakeholders with a clear understanding of what climate change implies for the insurance industry, from an underwriting and

investment perspective, and to equip them to challenge their businesses and clients in their responses to climate change. Figure 1, from the paper, very efficiently summarizes and compares the risks under key scenarios.

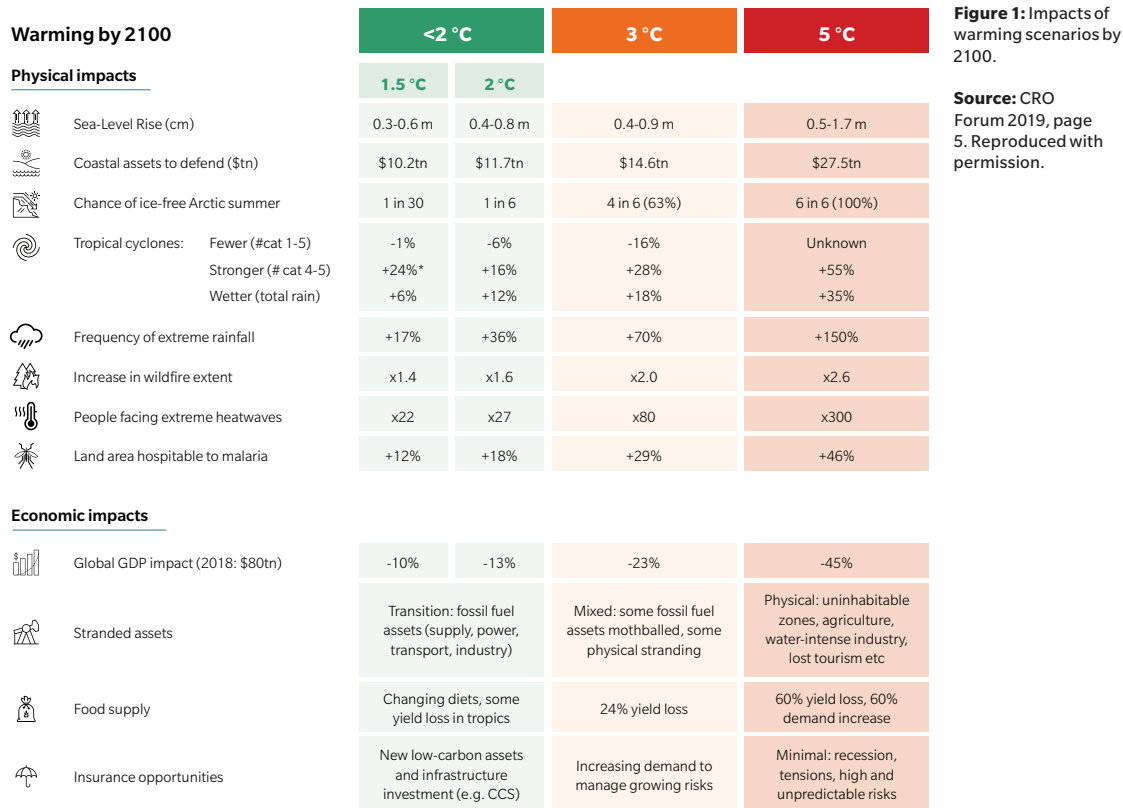


Figure 1: Impacts of warming scenarios by 2100.

Source: CRO Forum 2019, page 5. Reproduced with permission.

In 2018, the IAIS produced an issues paper (IAIS 2018) that provides examples of how climate risks may manifest themselves in the underwriting and investment activities of general insurers, life and health insurers, and reinsurers, and highlights the relevance of climate change for the core objectives of insurance supervisors. The paper also demonstrates how the Insurance Core Principles (ICP), which provide the basis for supervisors to identify and respond to new and emerging risks facing the insurance sector, apply in the context of climate change.

Both the World Economic Forum (WEF 2019) and Inter-American Development Bank (Caldecott et al. 2016) explore approaches actuaries should take in accounting for the effects of climate change, in the areas of extreme weather events and stranded assets, respectively.

Gaps in information, and tools in the context of actuarial work

Most of the materials listed in the previous section indicate a need to develop new tools, methods, and approaches to evaluate the risks from climate change in actuarial work; some propose solutions. Also as noted in the previous section, international actuarial organizations, in particular the IFOA and IAA, have either developed or are developing standards of practice and guidance relating to climate change for their members.

Many tools exist or are being developed to help actuaries account for climate risk in their work, including the Actuaries Climate Index (ACI 2019). Jointly developed by the American Academy of Actuaries, the CIA, the CAS, and the SOA, the ACI provides historical climate data focusing on the frequency (rather than average) of severe weather to quantify the true incidence and impact of weather extremes.

The ACI measures changes in extremes of high and low temperatures, high winds, heavy precipitation, and drought, as well as changes in sea level, expressed in units of standard deviations from the mean for the reference period of 1961 to 1990. Figure 2 presents this information for the combined US and Canada. The black line represents the five-year moving average, while the bars represent specific seasons. By definition, the ACI averages zero over the 1961–1990 reference period. A positive value in the ACI represents an increase in climate-related extremes relative to the reference period.

The effects of climate change, in particular extreme weather events and their repercussions, have had and continue to have an impact on the work of property and casualty actuaries. *Property and Casualty Insurance Re-imagined: 2025* (Deloitte 2015) notes that insurers will have to consider how they cover risks from extreme weather events and use

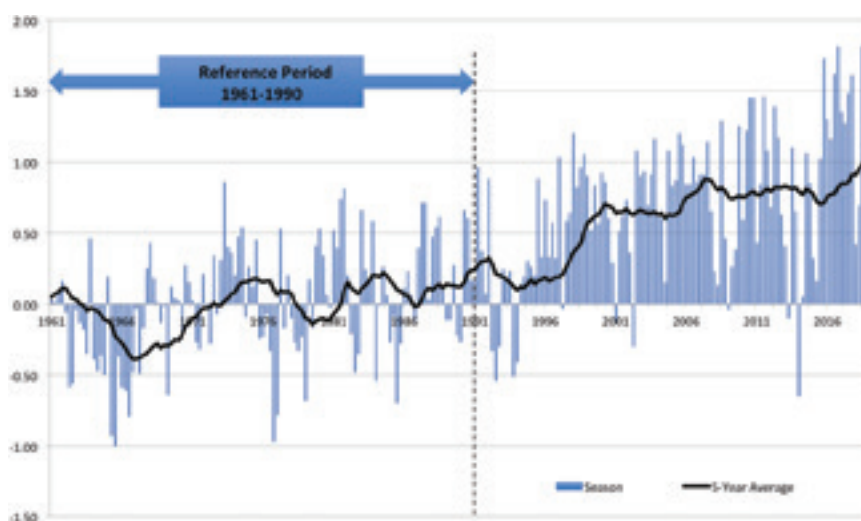


Figure 2: Actuaries Climate Index for US and Canada, winter 2018–2019.

Source: ACI 2019, August 29, 2019.

better models and data. One example of such an approach is a paper presenting a statistical analysis and projection of the possible effects of home insurance losses from the risk of climate change on future loss dynamics (Lyubchich et al. 2019). The studies' projections show conclusively that there is a substantial variation in the amount of claims from non-catastrophic weather events. Actuaries are using this information in their modelling and pricing activities for home insurance; wider use is expected in the coming years.

The TCFD, developed under the Financial Stability Board (FSB), recommends 11 clear, comparable, and consistent financial disclosures about how organizations manage climate-related risks and opportunities in terms of governance, strategy, risk management, and metrics and targets. This enhanced transparency in financial reporting requirements will greatly facilitate informed investment, capital allocation, and underwriting decision-making. Widespread adoption of TCFD recommendations could contribute significantly to minimize market disruptions related to the transition toward a lower carbon economy. The Ontario Teachers' Pension Plan *2018 Climate Change Report* (OTPP 2018) is a good example of an implementation of TCFD recommendations.

The Institutional Investors Group on Climate Change (IIGCC), has created a guide for institutional investors (Bakhshi 2018) who are beginning to construct and conduct scenario analysis, in accordance with the TCFD framework. The guide explains the concept behind scenario testing, and establishes a framework for scenario analysis, including the setting of objectives in the testing understanding, and selecting of climate scenarios, applying climate scenarios to develop appropriate investment parameters and inputs, and the review and disclosure of results. While the guide does not prescribe or recommend scenarios for use, it provides a number of reference scenarios, and cites several useful case studies.

As a member of the Central Banks and Supervisors Network for Greening the Financial System (NGFS), the Bank of Canada has committed to follow the six recommendations of the NGFS, the first four of which are aimed at central banks and financial supervisors while the last two are aimed at financial institutions. Recommendation 5 on achieving robust and internationally consistent climate- and environment-related disclosure, as well as recommendation 6 on supporting the development of a taxonomy of economic activities, would enhance transparency and convergence as required for an orderly transition to a green and low-carbon economy. The Bank of Canada's *Financial System Review – 2019* (Bank of Canada 2019) identifies the main vulnerabilities and risks to financial stability in Canada, and notes that the Bank is undertaking a multi-year research effort to integrate climate-related risks into financial stability analysis.



A Bank of England report (Bank of England 2019) presents a framework for the general insurance industry to manage climate change risk on the liability side of a firm's balance sheet, assesses the current tools used for measuring this risk, and sets out recommendations for how the catastrophe analytics industry can contribute further by providing accessible tools and helping consolidate, distil, and highlight the most compelling research on the impact of climate change on natural disasters.

In a 2015 address to Lloyd's of London, Mark Carney, Governor of the Bank of England and Chairman of the Financial Stability Board (FSB), described the risks of climate change on financial markets, and acknowledged the work being done by the insurance industry and regulations like Solvency II to avert the impact of climate risk to that point (Carney 2015). He also made an ominous prediction that if the insurance industry did not plan for the long term, including a world that passes the 2 C target, some geographies and sectors may become uninsurable and society may respond by nationalizing risk altogether.

The 15 recommendations in the final report of the Expert Panel on Sustainable Finance (EPSF 2019) include promoting efficiency in achieving transparency and removing impediments to factoring in longer-term sustainability within Canada's asset management community.

Consulting firms such as Mercer (Mercer 2019), and Moody's Analytics (Lafakis et al. 2019) have created climate scenario research and modelling aimed at institutional investors with diversified portfolios, to assist them in assessing the climate impact on investment return. The Moody's report will be a key tool in enabling institutional investors with long-dated liabilities, such as insurance companies and pension funds, to assess the risks in their asset portfolio, and in doing so, provide appropriate disclosure to their stakeholders consistent with the TCFD recommendations.

Other organizations that have identified actions or tools that can help take climate change into account in business strategies include the International Centre for Pension Management (ICPM) and the Insurance Bureau of Canada (IBC). The ICPM (ICPM 2018) identifies 10 potential actions to help asset owners such as pension plans and insurance companies integrate climate change into the investment process. The IBC has numerous resources on severe weather and flood insurance (IBC 2019a), options for managing flood costs (IBC 2019b), and the economic impacts (Team Green Analytics 2015) of the weather effects of climate change on communities.

Research done by the University of Waterloo (Tan et al. 2018) identifies the shortcomings in recognizing and pricing climate change risks, proposes metrics and methodologies to quantify the carbon and climate change risks for stocks, and presents models and frameworks to address these shortcomings.

A 2018 research paper by Amundi Asset Management (Bennani et al. 2018), analyzes how environmental, social, and governance (ESG) investing has impacted asset pricing in the equity market and provides recommendations on implementing ESG-induced performance improvements, arguing that there is a tipping point beyond which ESG score improvements reduce the investment universe and hence, can negatively impact diversification and performance.

An article in the *National Observer* (Saxfige 2019a) concludes that Canada's failure to reduce greenhouse gas emissions under consecutive climate agreements since 1988 means that reaching objectives agreed to under the Paris Agreement are even more difficult. Another article (Saxfige 2019b) compares Canada's failure with the UK's relative success, as Canada emits greenhouse gas at 119 per cent of 1990 levels, while the UK has achieved a reduction of 41 per cent, and its current policies should achieve cumulative reductions of 52 per cent by 2030. A key factor that helps explain the difference is the adoption by the UK of five-year carbon budgets that are legally enforceable.

Climate science

In addition to climate science information contained in many of the sources listed in the previous sections of this summary, the task force examined other sources of climate science.

The *AR5 Synthesis Report* from the Intergovernmental Panel on Climate Change (IPCC 2014) provided the scientific input into the Paris Agreement. The report draws on extensive scientific literature to inform the public and policy-makers on the reality of climate change, illustrating how adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change.

A follow-up document, *Special Report: Global Warming of 1.5 °C* (IPCC 2018), focuses on global emission pathways that lead to 1.5 C to 2.0 C global warming and how to achieve them in the context of sustainable development. There are significant differences to risk levels on natural and human systems between a 1.5 C and 2.0 C pathway of global warming. Heavy precipitation, extreme drought, and the probability of an ice-free Arctic Ocean are more likely in a 2.0 C global warming scenario than under a 1.5 C global warming scenario. Human activities are estimated to have caused approximately 1.0 C of global warming above pre-industrial levels, with a likely range of 0.8 C to 1.2 C. Global warming is likely to reach 1.5 C between 2030 and 2052 if it continues to increase at the current rate (high confidence). The report further describes how adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change.

The Keeling Curve (Figure 3) is a measurement of the daily concentration of carbon dioxide in the atmosphere made atop Hawaii's Mauna Loa since 1958. The values are not the result of a model but measurements made using infrared gas analyzers.

Results are updated daily and graphs are available for various periods. The curve has been extended backward on the basis of ice core data. Pre-industrial levels are estimated at 278 ppm and had never exceeded 300 ppm over the 10,000 year period since the ice age. The 400 level was reached for the first time in 2014 while a new record was established at 415 ppm in May 2019, a level never before observed in 3 million years of data. Previous records were set in May 2017 and 2018 at 409.91 ppm and 411.31 ppm, respectively, indicating a rapid upwards trend (Keeling et al. 2001). If these trends continue, we will overtake the 450 ppm threshold in 15 years or less. At a level of less than 450 ppm of CO₂, climate scientists tell us that the earth has a 50 per cent chance of stabilizing the average global temperature to below a 2 C increase over the pre-industrial period. Note that there is a seasonal fluctuation in the curve as vegetation grows and absorbs some CO₂ during the Northern Hemisphere's spring and summer.

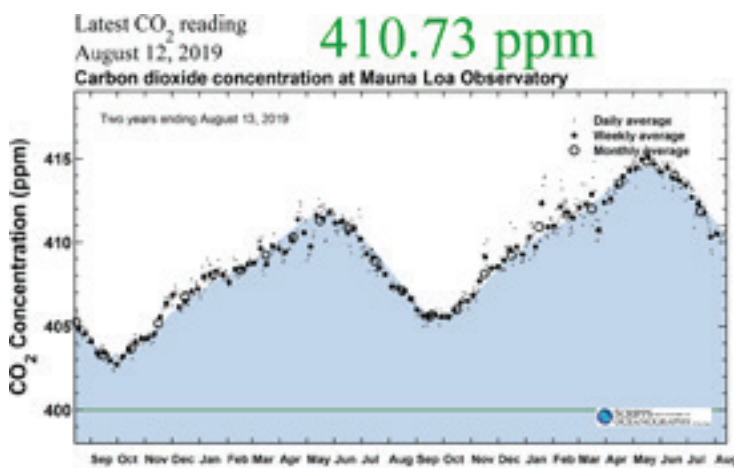


Figure 3: Carbon dioxide concentration at Mauna Loa Observatory, August 2017 to August 2019.

Source: Keeling et al. 2001, accessed August 20, 2019.

The task force also examined climate science on the contribution of non-anthropogenic causes of climate change (Climate Atlas of Canada n.d.) and non-greenhouse gas causes. Some of these sources include the National Oceanic and Atmospheric Administration's (NOAA) trends in atmospheric methane (NOAA 2019), the Royal Society and the US National Academy of Sciences' *Climate Change: Evidence and Causes* ebook (Wolff et al. 2014), and "Interpreting contemporary trends in atmospheric methane" (Turner et al. 2019) in the *Proceedings of the National Academy of Sciences of the United States of America*.

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