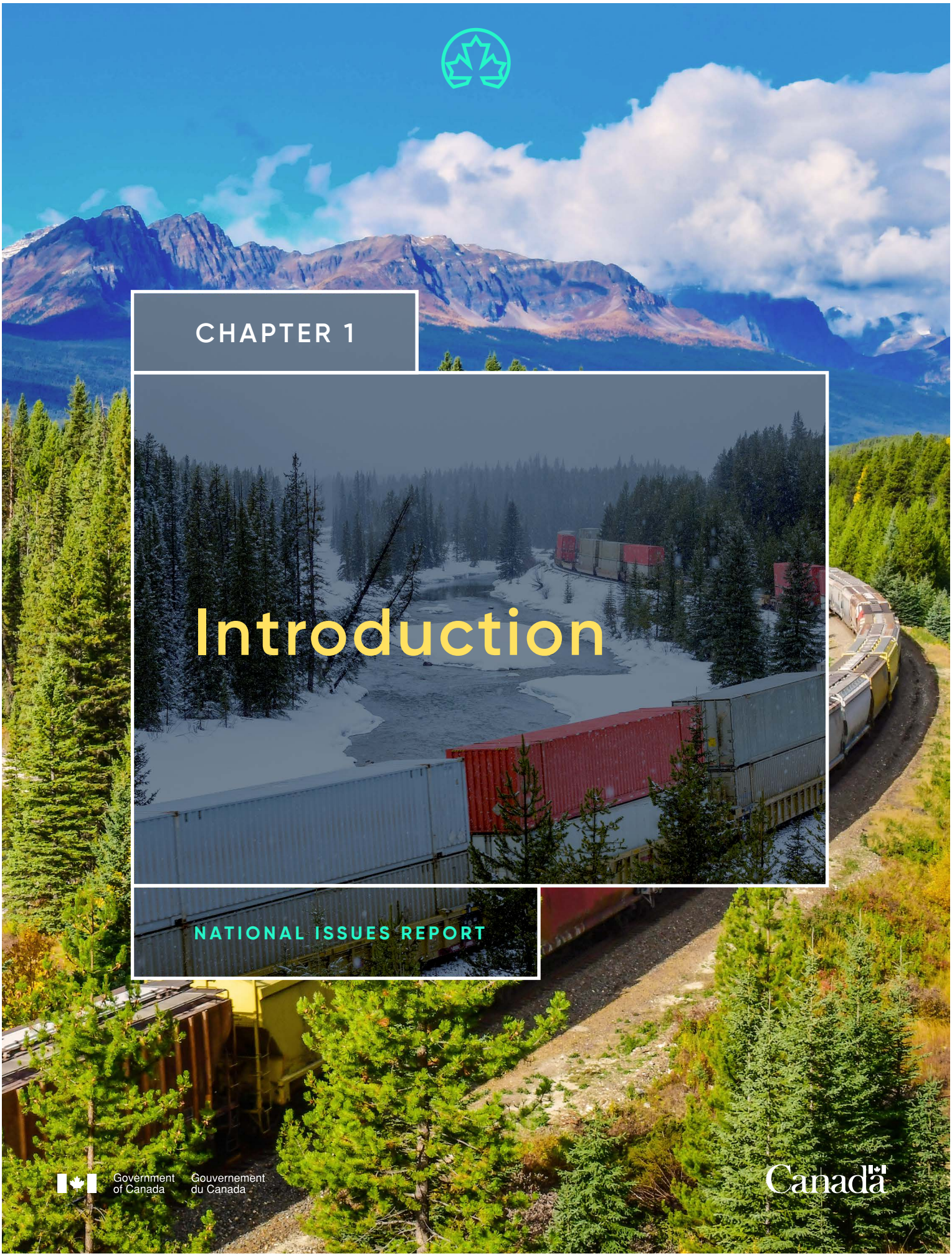

CHAPTER 1

Introduction

NATIONAL ISSUES REPORT

Government of Canada / Gouvernement du Canada

Canada

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1.1 Introduction

In 2014, the Intergovernmental Panel on Climate Change (IPCC) stated that "warming of the climate system is unequivocal" (IPCC, 2014). Since then, evidence of change has continued to build, with observed increases in temperature (over land and oceans), rising sea levels, loss of snow and ice, and shifting precipitation patterns at the global scale (e.g., IPCC, 2018; 2019; USGCRP, 2018). Many of the changes brought about by increases in temperature are unprecedented, and most are projected to persist and intensify over the current century (Bush et al., 2019; IPCC, 2014). A clearer picture of the impacts is also emerging, with recognition that climate change has the potential to affect almost every aspect of our lives—our health and well-being, economies, environment, and even our identities and sense of self. It is also increasingly clear that the impacts are not evenly distributed, and that certain regions, populations and groups are being disproportionately affected.

We are also seeing these trends in Canada. Observed warming in Canada is, on average, approximately double the magnitude of global warming (Bush and Lemmen, 2019), with northern parts of the country experiencing the greatest rates of change (*see* Figure 1.1). We are experiencing more extreme heat, less extreme cold, longer growing seasons, shorter snow and ice cover seasons, earlier spring peak streamflow, thinning glaciers, thawing permafrost and rising sea levels (Bush and Lemmen, 2019). Losses from extreme events, such as floods and wildfires, are also increasing. In recent Canadian surveys, 87% of respondents indicated that they are already seeing the effects of climate change in their community (Natural Resources Canada, 2019), and 93% indicated that they believe climate change is either having an impact on their health now or will in the future (Environics Research Group, 2017).

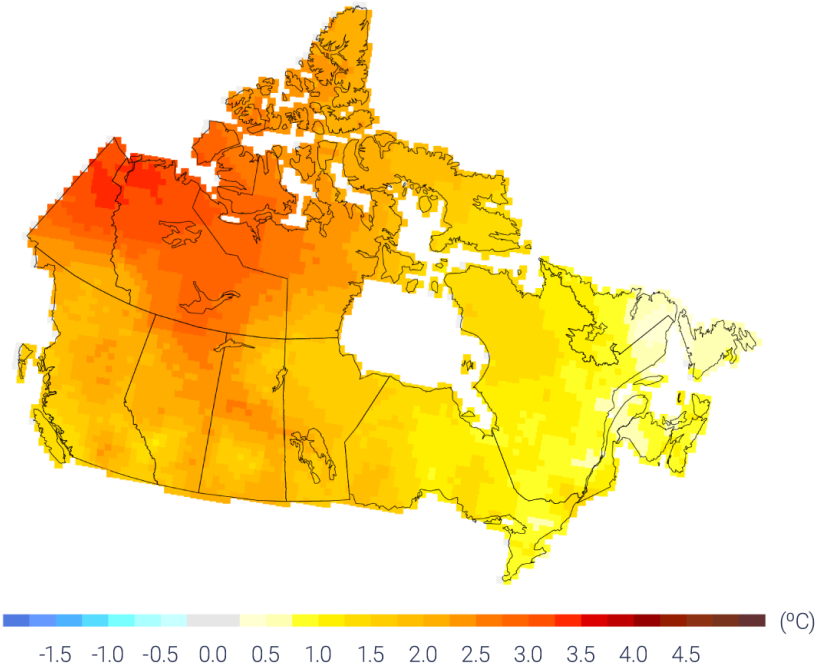

Figure 1.1: Map showing observed changes in annual temperature (°C) across Canada between 1948 and 2016. Source: Zhang et al., 2019.

These observed trends and documented impacts have firmly established the scientific basis for climate change. Debates over whether climate change is real have largely been replaced by discussions on how to respond. The need to plan for and to address climate change impacts grows daily. Decisions taken now to address climate change impacts will have important ongoing implications for Canada's society, economy and environment. However, while there is clearly an urgent need to take action on climate change (IPCC, 2018), the path forward can be complicated. Climate change is a global issue with widespread, pervasive, interacting and often complex impacts occurring at all scales. At a basic level, there are two critically important response pathways—mitigation (greenhouse gas (GHG) emissions reduction) and adaptation—which are related and co-dependent (*see* Box 1.1).

Box 1.1: Linkages between climate change adaptation and mitigation

There are important linkages between actions that reduce greenhouse gas (GHG) emissions (climate change mitigation) and actions that build resilience to deal with climate change impacts (adaptation). As *Canada's Changing Climate Report* concluded, "the rate and magnitude of climate change under high versus low emission scenarios project two very different futures for Canada" (*see* Figure 1.2).The ultimate success of adaptation in Canada will be influenced by which GHG emissions pathway the world ultimately follows.

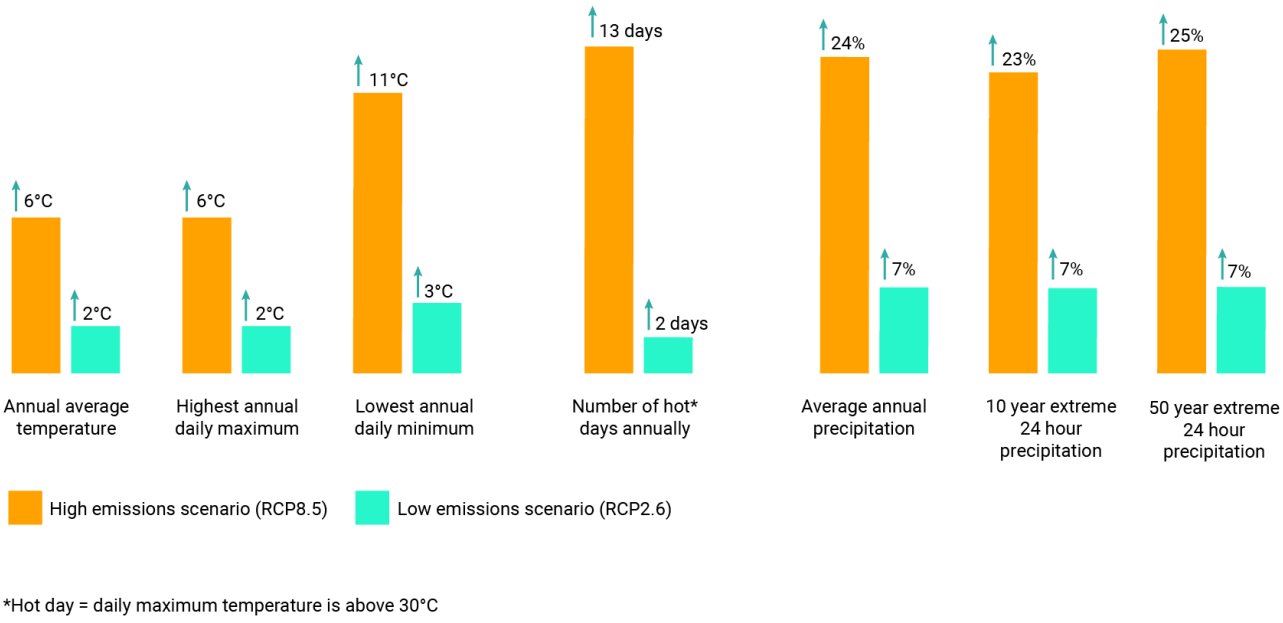

Figure 1.2: The differences between projections for climate variables under high and low emissions scenarios reveal two different potential futures for Canada. The high emissions scenario (RCP8.5) is associated with an

increase in global average temperature of about 3.7 °C by the late century, relative to the 1986–2005 reference period, whereas the low emissions scenario (RCP2.6) is associated with a global average temperature of about 1.0 °C for that same time period. Source: Adapted from Government of Canada, 2019.

As warming increases, climate-related risks and impacts also increase (IPCC, 2018). Higher rates and amounts of warming make it more difficult for adaptation actions to offer sufficient protection against these impacts. This means that significant impacts would remain even after adaptation measures are implemented, and that the chances of reaching limits to adaptation are more likely (Klein et al., 2014). Adaptation limits are reached when there are no longer any practical or feasible adaptation options available, meaning that intolerable risks must be accepted, adaptation objectives must be abandoned and/or transformation and last-resort measures, such as relocation or retreat, must take place (Dow et al., 2013).

Interactions between adaptation and mitigation decisions are illustrated in Figure 1.3. Co-benefits and synergies can be obtained for actions that have both adaptation and mitigation objectives (top right panel)—these are referred to as sustainable "win-win" approaches. For example, the use of nature-based approaches to adaptation in cities creates urban environments that are more resilient to heat waves (reducing associated health impacts) and to intense rainfall (reducing associated flooding), while also sequestering carbon and reducing energy demand (*see* Cities and Towns chapter). The top-left and bottom-right panels identify risk trade-offs that can emerge from particular actions that are designed to meet only one objective (adaptation or mitigation), but that can adversely affect the other objective. For instance, certain adaptation decisions can result in an increase in GHG emissions (e.g., the increased use of air conditioners during heat events); similarly, certain mitigation choices increase local vulnerability or risk (e.g., the increased exposure of the electricity grid to water supply shortages, which could result from expanded use of hydro-electricity). Priority should be given to minimizing or avoiding these negative consequences when planning actions to respond to climate change.

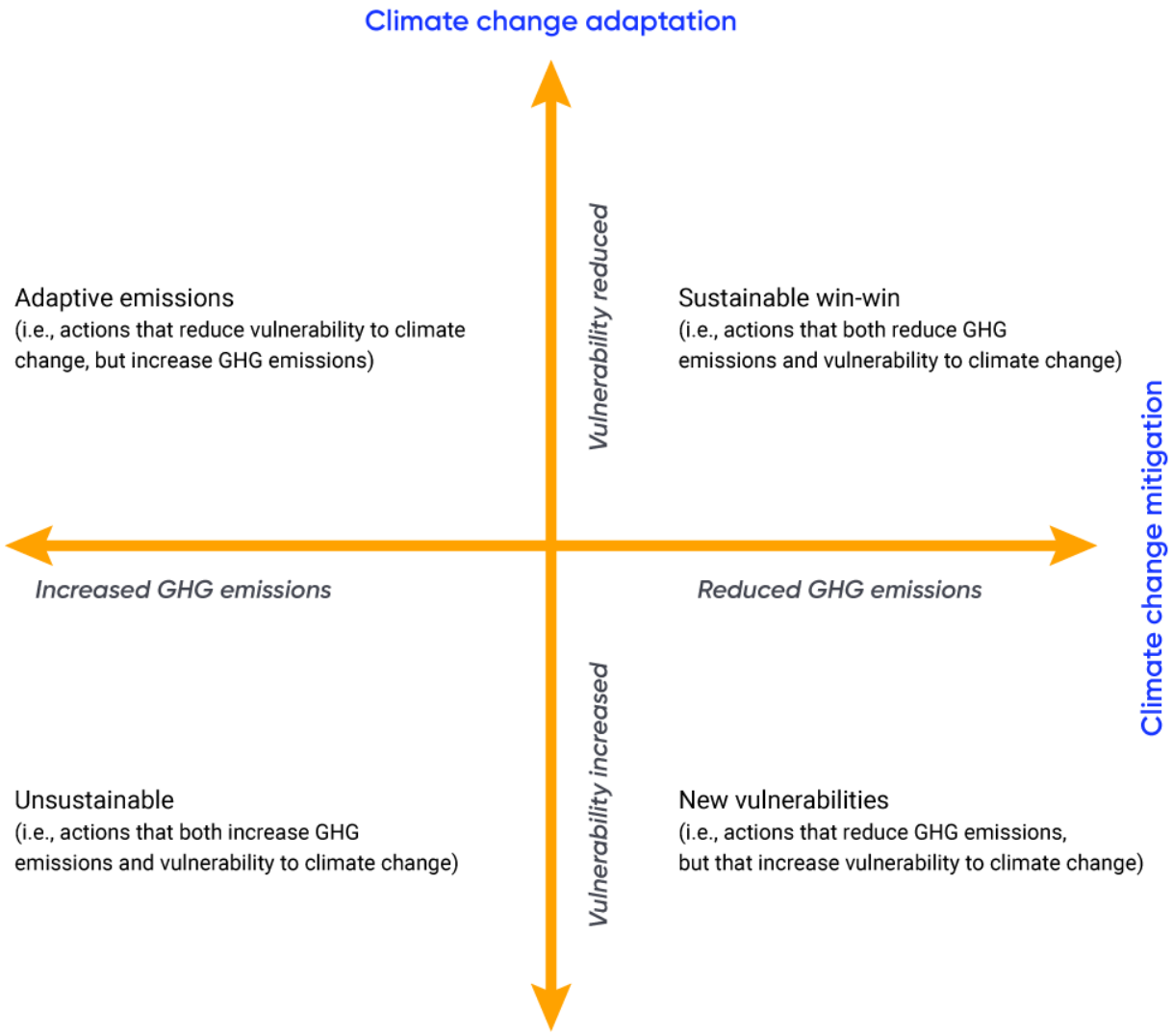

Figure 1.3: Examples of trade-offs and co-benefits of actions where there are linkages between climate change adaptation and mitigation. Source: Adapted from Jones et al., 2014.

This report focuses on climate change adaptation—actions that reduce the negative impacts of climate change or that take advantage of potential new opportunities. Adaptation builds resilience and reduces risk related to current and future climate change impacts. It involves adjusting plans, policies and actions, and can be reactive (i.e., occurring in response to climate change impacts) or anticipatory (i.e., occurring before impacts of climate change are observed). As a concept, adaptation is straightforward; in practice, however, it can range from being simple to incredibly complex. Our understanding of the ways in which climate change affects vulnerable groups and segments of the population is continuing to develop, highlighting the important

socioeconomic and equity dimensions of adaptation decisions. Adaptation also offers the opportunity to generate significant co-benefits, such that investments to address climate change impacts in one particular sector or area can result in benefits elsewhere. Similarly, unintended consequences can result if planning and decisions do not adequately consider the broad system and context in which the decisions are being made.

To help address complexities and promote action on climate change adaptation, decision makers need access to reliable information. Knowledge assessments on climate change impacts and adaptation address this need by providing decision makers with the foundation necessary for making evidence-based decisions. Such assessments synthesize existing knowledge on the key issues by following a rigorous process that ensures the end products are credible, relevant and useful to decision makers. While being policy-relevant and structured to inform decisions, assessments are not policy-prescriptive, nor do they provide specific instructions or recommendations. Assessments can be carried out at different scales—from the international assessments of the IPCC to national, regional and local-scale initiatives. Knowledge assessments differ from risk assessments, which apply analytical methods to estimate the probability and consequence of risks associated with current and future climate change impacts. However, risk assessments can both inform and be informed by knowledge assessments. Recent examples of risk assessments in Canada include those at the national scale (e.g., CCA, 2019) and regional scale (e.g., Ministry of Environment and Climate Change Strategy, 2019).

1.2 Canada's National Knowledge Assessment process

Canada in a Changing Climate: Advancing our Knowledge for Action is Canada's national-scale knowledge assessment process. Launched in 2017, it builds upon past assessments of climate change impacts and adaptation led by the Government of Canada, which examined key issues for Canada from regional perspectives (Lemmen et al., 2016; Lemmen et al., 2008) and sectoral perspectives (Palko and Lemmen, 2017; Warren and Lemmen, 2014; Seguin, 2008). The current National Knowledge Assessment process is producing a series of reports that assess how and why Canada's climate is changing; the impacts of these changes on our communities, environment and economy; and how we are adapting (*see* Box 1.2). The resulting reports are resources for Canadians, raising awareness of the issues facing our country and providing information to support evidence-based decisions and actions for addressing climate change and adapting to its impacts. The *National Issues Report* is the second full report to be released in the current assessment series, following the release of *Canada's Changing Climate Report* in 2019.

Box 1.2: Overview of the products included in the 2016–2021 National Knowledge Assessment process

A total of five assessment reports will be released within the current National Knowledge Assessment process (2016–2022), over the course of three phases (*see* Figure 1.4). The first report in the series, *Canada's Changing Climate Report* (2019), provides the climate science foundation, assessing how and why Canada's climate has changed and what changes are projected for the future. The focus of the subsequent reports is on how these changes are affecting the country now and in the future; our vulnerability to climate change impacts; and the role of adaptation in reducing risks and building resilience. To reach broader audiences, the process is supported by an interactive website (changingclimate.ca), and a series of targeted supplementary products are being developed. Enhanced engagement has been a priority throughout the process. Starting with the scoping meeting in 2016, opportunities were made available for the public and experts to provide input on the current assessment, including through workshops, conference sessions, surveys and online.

See the FAQs for additional information about the current National Knowledge Assessment process.

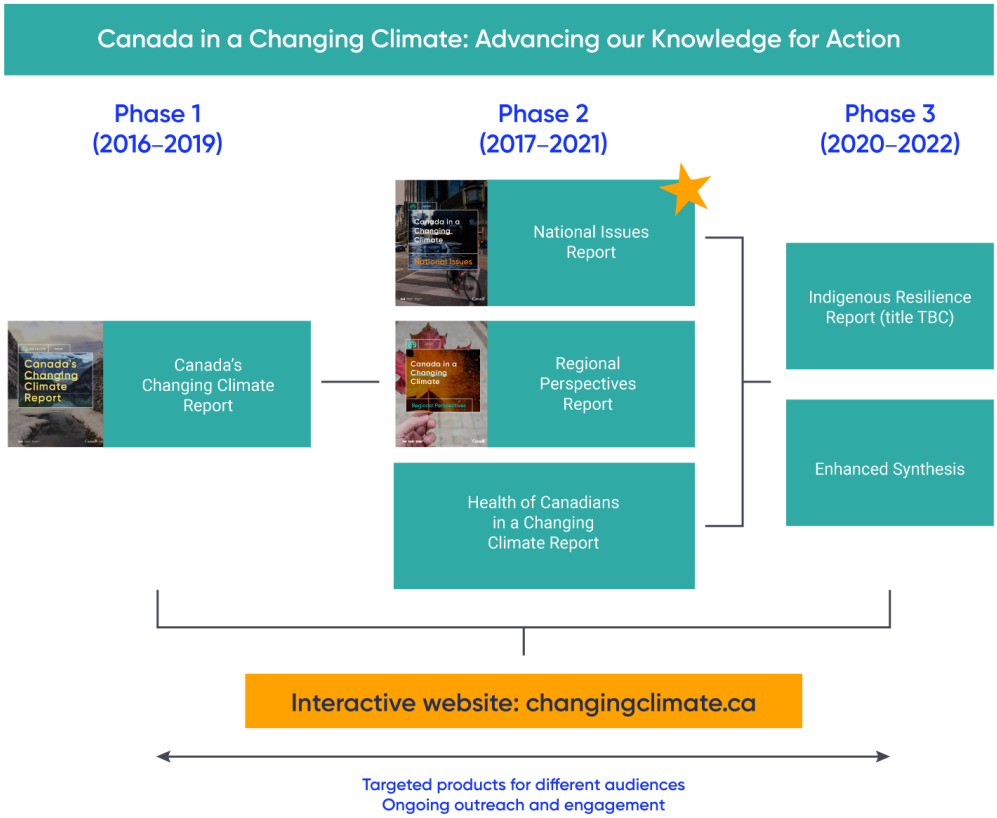

Figure 1.4: Reports developed under the current National Knowledge Assessment process (2016–2022), *Canada in a Changing Climate: Advancing our Knowledge for Action*.

1.3 Scope and structure of the *National Issues Report*

The *National Issues Report* provides a nation-wide perspective on how climate change is impacting our communities, environment and economy, and how we are adapting to reduce risks. The report focuses on themes of national importance that benefit from an integrated, pan-Canadian perspective. It is intended to support evidence-based decisions, and to help decision makers learn from examples of adaptation in practice and to take action on adaptation. In addition to the Introduction, the report includes the following eight chapters:

- Cities and Towns;
- Rural and Remote Communities;
- Water Resources;
- Ecosystem Services;
- Costs and Benefits of Climate Change Impacts and Adaptation;
- Sector Impacts and Adaptation;
- Climate Disclosure, Litigation and Finance; and
- International Dimensions.

Together, these chapters present a clear picture of how climate change is currently affecting and will affect Canada's society, environment and economy. The report reinforces the conclusions of past assessments, which found that impacts of climate change are being felt by all sectors across the country, and that impacts are often cumulative, cross-sectoral, and increasing in frequency and magnitude. Each chapter discusses key vulnerabilities, risks and challenges, new and innovative approaches to adaptation, and also identifies knowledge gaps and emerging issues to help establish a baseline and inform future work. Case stories are featured throughout the report to showcase examples of adaptation from across the country, and to allow diverse voices to be heard.

The content of each chapter is structured around **key messages**—high-level statements that provide an overview of the key issues facing the region or sector, and that reflect the state of knowledge on climate change impacts and adaptation. This approach allowed the chapters to go into greater depth on issues of priority to stakeholders and partners, as identified through engagement and outreach activities, rather than assessing all relevant issues pertaining to a given topic or region. Each chapter contains five to eight key messages, each of which is supported by a plain language summary.

The report draws from existing knowledge on climate change impacts and adaptation from a wide range of sources, including peer-reviewed literature, broader literature, practitioner perspectives, as well as Indigenous Knowledge and local knowledge. It does not include original research. Enhanced inclusion of Indigenous Knowledge was a priority for the report, and most chapters include a key message on Indigenous Knowledge and/or case stories that focus on Indigenous themes related to climate change impacts and adaptation. Due to production timelines, it was necessary to include cut-off dates for incorporating new knowledge sources;

as such, the chapters may not reference the newest available literature or knowledge on a given topic. The assessment content was also finalized before the learnings from the COVID-19 pandemic emerged and therefore does not address the impacts of the pandemic, or any potential relationships between climate change and COVID-19.

1.4 References

Bush, E. and Lemmen, D.S. (Eds.) (2019). Canada's Changing Climate Report. Government of Canada, Ottawa, Ontario. 444 p. Retrieved March 2021, from <https://changingclimate.ca/CCCR2019/>

Bush, E., Gillett, N., Watson, E., Fyfe, J., Vogel, F. and Swart, N. (2019). Understanding Observed Global Climate Change, Chapter 2 *in* Canada's Changing Climate Report, (Eds.) E. Bush and D.S. Lemmen. Government of Canada, Ottawa, Ontario, 25–72. Retrieved March 2021, from <https://changingclimate.ca/CCCR2019/chapter/2-0/>

Council of Canadian Academies (2019). Canada's Top Climate Change Risks: The Expert Panel on Climate Change Risks and Adaptation Potential. Council of Canadian Academies, Ottawa, Ontario. Retrieved March 2021, from <https://cca-reports.ca/reports/prioritizing-climate-change-risks/>

Environics Research Group (2017). Public Perceptions of Climate Change and Health Final Report. Prepared for Health Canada, 71 p.

Government of Canada (2019). Infographic – Canada's Changing Climate: Projected changes this century. Retrieved January 2021, from <https://changingclimate.ca/site/assets/uploads/sites/2/2019/04/6269_infographic_Canada_v05.pdf>

IPCC [Intergovernmental Panel on Climate Change] (2014). Summary for Policymakers, *in* Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. (Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change), (Eds.) C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea and L.L. White. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA, 1–32. Retrieved March 2021, from <https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgII_spm_en.pdf>

IPCC [Intergovernmental Panel on Climate Change] (2019). IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, (Eds.) H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama and N.M. Weyer. Retrieved March 2021, from <https://www.ipcc.ch/srocc/>

IPCC [Intergovernmental Panel on Climate Change] (2018). Summary for Policymakers, *in* Global Warming of 1.5°C. An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, (Eds.) V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor and T. Waterfield. Retrieved March 2021, from <https://www.ipcc.ch/sr15/chapter/spm/>

Jones, R.N., Patwardhan, A., Cohen, S.J., Dessai, S., Lammel, A., Lempert, R., Mirza, M.M.Q. and von Storch, H. (2014). Foundations for decision making, Chapter 2 *in* Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. (Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change), (Eds.) C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Eabi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea and L.L. White. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA, 195–228. Retrieved March 2021, from <https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap2_FINAL.pdf>

Klein, R.J.T., Midgley, G.F., Preston, B.L., Alam, M., Berkhout, F.G.H., Dow, K. and Shaw, M.R. (2014). Adaptation opportunities, constraints, and limits, Chapter 16 *in* Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. (Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change), (Eds.) Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea and L.L. White. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA, 899–943. Retrieved March 2021, from <https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap16_FINAL.pdf>

Lemmen, D.S., Warren, F.J., James, T.S. and Mercer Clarke, C.S.L. (Eds.) (2016). Canada's Marine Coasts in a Changing Climate; Government of Canada, Ottawa, Ontario, 274 p. Retrieved March 2021, from <https://www.nrcan.gc.ca/climate-change/impacts-adaptations/canadas-marine-coasts-changing-climate/18388>

Lemmen, D.S., Warren, F.J., Lacroix, J. and Bush, E. (Eds.) (2008). From Impacts to Adaptation: Canada in a Changing Climate 2007. Government of Canada, Ottawa, Ontario, 448 p. Retrieved March 2021, from <https://www.nrcan.gc.ca/impacts-adaptation-canada-changing-climate/10253>

Ministry of Environment and Climate Change Strategy (2019). Preliminary Strategic Climate Risk Assessment for British Columbia. Report prepared for the Government of British Columbia, Victoria, BC. Retrieved March 2021, from <https://www2.gov.bc.ca/gov/content/environment/climate-change/adaptation/risk-assessment>

Natural Resources Canada (2019). Canada in a Changing Climate: 2019 user survey.

Palko, K. and Lemmen, D.S. (Eds.). (2017). Climate risks and adaptation practices for the Canadian transportation sector 2016. Government of Canada, Ottawa, Ontario. Retrieved March 2021, from <https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-risks-adaptation-practices-canadian-transportation-sector-2016/19623>

Seguin. J. (Ed.) (2008). Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity. Health Canada, Ottawa, Ontario. Retrieved March 2021, from <http://publications.gc.ca/collections/collection_2008/hc-sc/H128-1-08-528E.pdf>

USGCRP (2018). Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States, (Eds.) D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock and B.C. Stewart. U.S. Global Change Research Program, Washington, DC, USA, 1,515 p. Retrieved March 2021, from <https://nca2018.globalchange.gov/>

Warren, F.J. and Lemmen, D.S. (2014): Synthesis *in* Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, (Eds.) F.J. Warren and D.S. Lemmen. Government of Canada, Ottawa, Ontario, 1–18. Retrieved March 2021, from <https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Synthesis_Eng.pdf>

Zhang, X., Flato, G., Kirchmeier-Young, M., Vincent, L., Wan, H., Wang, X., Rong, R., Fyfe, J., Li, G. and Kharin, V.V. (2019). Changes in Temperature and Precipitation Across Canada; Chapter 4 *in* Canada's Changing Climate Report, (Eds.) E. Bush, and D.S. Lemmen. Government of Canada, Ottawa, Ontario, 112–193. Retrieved March 2021, from <https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/Climate-change/pdf/CCCR_Chapter4-Temperature%20and%20Precipitation%20Across%20Canada.pdf>