
Climate Change and the Law

PART TWO – AN INTRODUCTION TO ADAPTATION IN ALBERTA

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ENVIRONMENTAL LAW CENTRE (ALBERTA) SOCIETY

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THE ENVIRONMENTAL LAW CENTRE (ALBERTA) SOCIETY

The Environmental Law Centre (ELC) has been seeking strong and effective environmental laws since it was founded in 1982. The ELC is dedicated to providing credible, comprehensive and objective legal information regarding natural resources, energy and environmental law, policy and regulation in Alberta. The ELC's mission is to educate and champion for strong laws and rights so all Albertans can enjoy clean water, clean air and a healthy environment. Our vision is a society where laws secure an environment that sustains current and future generations.

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Executive Summary

Anthropogenic climate change is here and its impacts are already unavoidable and irreversible. Going forward, as greenhouse gas (GHG) emissions continue to rise, these impacts are expected to worsen. Previously, human and natural systems have had the capacity to cope with climatic change. But the pace of modern climate change is on track to exceed these coping thresholds (and then some). Accordingly, adaptation will be necessary to build the capacity to cope with climate change such that risks are answered and opportunities are captured. Put simply, adaptation is the process of preparing for actual or projected changes in climate averages and extremes.

Adaptation vs Mitigation

Going forward, adaptation is a necessary complement to mitigation. Whereas the goal of mitigation is to reduce or prevent changes in the climate system, adaptation is concerned with addressing the consequences of these changes.

Adaptation and the Law

Climate adaptation can take many forms, including technological, financial, behavioural, and managerial activities. However, the focus of this report is on the role of our laws in facilitating adaptation. That is, the ways in which legal institutions and tools can be used to implement adaptation measures.

The law touches on nearly every area of modern society which makes it a particularly powerful tool for effecting adaptation. Relevant legal tools can include legislation, contracts, negligence (tort) law and other legal measures such as voluntary industry based codes, market or financial mechanisms, collaborative partnerships, and information based tools.

Note that legal tools may also face particular barriers. Governments may fear that action on adaptation will leave them open to lawsuits or give rise to compensatory duties. Privacy laws may also constrain the operation of early warning systems or the ability of institutions to target information to vulnerable residents based on personal data such as age, location or socio-economic status. Ultimately, adaptation law and policy must cope with multiple layers of uncertainty.

Actors of Adaptation

Opportunities for adaptation exist at different levels (i.e. global, national and local), in different industries, and across time-frames (i.e. short-term, long-term and very long-term). Given its heterogeneous nature, a variety of actors are required to address the challenges inherent in planning

and implementing adaptation. This is because different actors have different capacities to adapt to climate variability and change. These actors include: government (national, provincial and municipal), industry, non-governmental organizations (NGOs), indigenous peoples, and the general public.

Impact of Climate Change in Alberta

Alberta is currently experiencing and/or will likely experience climate impacts into the future due to climate change. Research suggests Alberta will likely experience changes to its water resources (e.g. reduced snow accumulation, glacier retreat, decreased water quality and increase in extreme hydrological events), ecosystems (e.g. decreased biodiversity, phenological mismatches and reduced migratory waterfowl populations) and soil (e.g. increased landslides, wind erosion and desertification). This information helps to contextualize and justify why adaptive measures are necessary in the province.

Risks, Opportunities and Adaptation

All of the aforementioned information brings us to the main focus of the report – what are the risks and/or opportunities associated with climate change in Alberta? What sort of legal adaptive measures are being (or should be) implemented to maintain resiliency in the face of these changes?

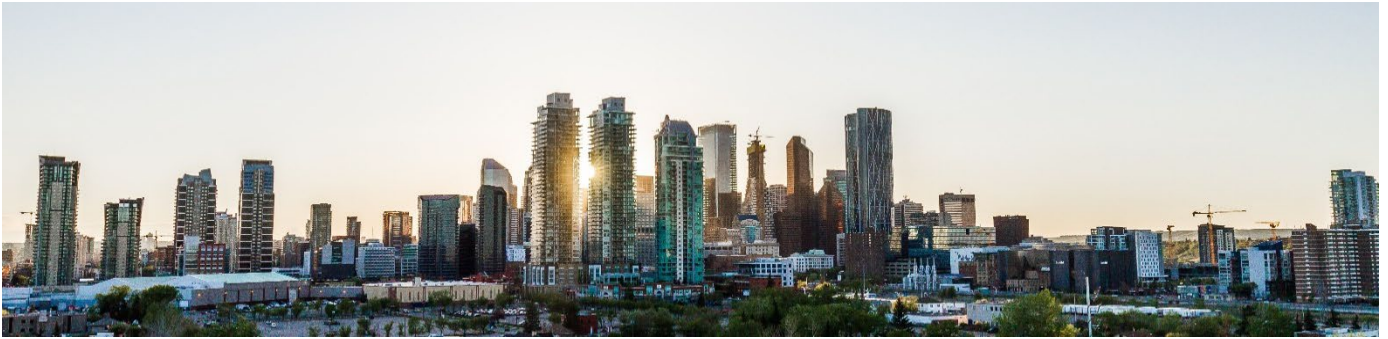
The report considers a wide variety of sectors organized within the following five categories:

- 1) Natural Resources (i.e. forestry, mining & energy);
- 2) Industry (i.e. tourism, agriculture, fisheries, manufacturing, trade & insurance);
- 3) Infrastructure (i.e. water, transportation & buildings);
- 4) Biodiversity (i.e. animal and vegetation ecosystems); and
- 5) Human Impacts (i.e. health and communities).

The anticipated impacts of climate change (good and bad) as well as the applicable legal framework and potential adaptive measures are reviewed and discussed within each category. In short, in the face of increasing climate uncertainty, adaptation can help to provide a path forward. Currently, some progress is being made in Alberta, particularly with respect to engagement, awareness, and planning. However, there is still a lack of action with respect to the actual implementation of adaptive measures.

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CLIMATE CHANGE AND THE LAW

PART TWO – INTRODUCTION TO ADAPTATION IN ALBERTA

INTRODUCTION TO ADAPTATION

Historically, societies have adapted to the impacts of extreme weather and climate change with practices such as crop diversification, irrigation, and insurance. However, the effects of modern climate change are expected to exceed our natural abilities to cope. Climate adaptation, that is, measures that seek to adapt our lives and environments to the consequences of climate change, will be necessary to maintain capacity.

Previously, in **Climate Change and the Law: Part One – An Introduction to Mitigation in Alberta**, the ELC explored mitigation and the regulatory framework required to support the mitigation of greenhouse gas (GHG) emissions in Alberta. Yet, mitigation alone is not sufficient to reverse the effects of climate change today. No matter how stringent or successful mitigation initiatives are, we have reached a point where anthropogenic climate change and its associated impacts are unavoidable and

irreversible.¹ That is, even if greenhouse gas concentrations were stabilized today, ocean warming and sea-level rise would continue for centuries.²

Human and natural systems have long had the capacity to cope with adverse circumstances. Historically, societies have adapted to the impacts of extreme weather and climate change with practices such as crop diversification, irrigation, and insurance. However, the effects of modern climate change are expected to exceed our natural abilities to cope. Climate adaptation, that is, measures that seek to adapt our lives and environments to the consequences of climate change, will be necessary to maintain this capacity.

Alberta is experiencing the impacts of climate change today and will continue to do so on an escalating basis into the foreseeable future. Governments, industry, and individuals must take action now to lessen the risks of climate change impacts. Still, the topic of adaptation is not yet well understood or “mainstream” in our society.

Accordingly, the purpose of this publication is to provide a primer on climate adaptation in Alberta, with an emphasis on legal adaptive measures. This report aims to demystify some of the following topics:

- The concept of adaptation, its relationship to mitigation, and how the law can be a powerful tool for adaptation;
- The actors needed to implement adaptation;
- Alberta’s climate characteristics and the anticipated changes to our water, ecosystems and soil due to climate change;

¹ IPCC, 2013: Summary for Policymakers in Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Stocker, T.F. et al., Cambridge University Press at 28, accessed online: http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf [IPCC, 2013: Summary for Policymakers]; F.J. Warren and P.A. Egginton (2008): Background Information: Concepts, Overviews and Approaches in: From Impacts to Adaptation: Canada in a Changing Climate 2007, edited by D.S. Lemmen et al., Government of Canada, Ottawa, ON, 27-56 at 29 accessed online: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2007/pdf/full-complet_e.pdf [Warren, 2008: Background Information].

² IPCC, 2013: Summary for Policymakers at 27-29.

- The risks and opportunities presented by these changes as well as potential legal adaptive measures for natural resources, industries, infrastructure, biodiversity and human health impacts in Alberta.

This primer is intended to provide a broad overview of legal adaptive measures and, hopefully, serve as a starting point for additional research and exploration of the challenges and path forward for climate change adaptation in Alberta.



What is ‘Adaptation’?

Adaptation is the process of preparing for actual or projected changes in climate averages and extremes.

In the context of climate change literature, the term “adaptation” has a specific meaning. The leading definition comes from the Intergovernmental Panel on Climate Change (IPCC), which defines adaptation as follows:

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.³

³ IPCC, 2014: Glossary in: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,

Similarly, the Government of Alberta adopted the following definition of adaptation in its *Climate Change Adaptation Framework Manual*:

Adaptation refers to processes, action and strategies that allow the organization system to cope with, manage, and adjust to changing climatic conditions such that risks are responded to and opportunities captured.⁴

Put more simply, adaptation is the process of preparing for actual or projected changes in climate averages and extremes. There are also different types of adaptation:

Incremental adaptation:	Adaptation actions where the central aim is to maintain the essence and integrity of a system or process at a given scale. ⁵
Transformational adaptation:	Adaptation that changes the fundamental attributes of a system in response to climate and its effects. ⁶
Anticipatory adaption:	Activities taken before impacts are observed. ⁷
Reactive adaptation:	Activities that are taken after impacts have been felt. ⁸
Planned adaptation:	An iterative process involving four basic steps: information development and awareness-raising; planning and design; implementation; and monitoring and evaluation. ⁹

edited by V.R. Barrows et al., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA at 1758, accessed online: http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-AnnexII_FINAL.pdf [IPCC, 2014: Glossary].

⁴ Alberta Environment and Parks (AEP), *Climate Change Adaptation Framework Manual*, (Alberta, AEP, 2010) at 3, accessed online: <http://aep.alberta.ca/forms-maps-services/publications/climate-change-adaptation-framework.aspx>.

⁵ IPCC, 2014: Glossary at 1758.

⁶ IPCC, 2014: Glossary at 1758.

⁷ Warren, 2008: Background Information at 29.

⁸ Warren, 2008: Background Information at 29.

⁹ Warren, 2008: Background Information at 29.

Mostly, adaptations that are anticipatory and/or planned will incur lower long-term costs and be more effective than reactive adaptations.¹⁰ There are, however, risks involved where adaptive measures are implemented in the face of future uncertainty. One such risk is “maladaptation”, meaning action or inaction that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future.¹¹ Maladaptation often arises out of actions that appear to foster adaptation in the short term, but actually affect a system’s long-term vulnerability or adaptive capacity.¹²

Generally speaking, maladaptation includes actions that, relative to alternatives:

1. increase GHGs;
2. disproportionately burden vulnerable populations;
3. have high opportunity costs;
4. reduce incentives to adapt; and
5. limit future adaptive options.¹³

Wherever possible, adaptive measures should seek to avoid maladaptation – although this is easier said than done. At least one commentator has attempted to develop a framework for assessing and avoiding environmental, sociocultural and economic maladaptation.¹⁴ In general, avoiding maladaptation requires careful consideration and integration of pre-existing characteristics, values, inequalities and uncertainties of a given system so that, insofar as it is possible, adaptive measures can take into account any potential vulnerabilities *before* implementing changes.

¹⁰ Warren, 2008: Background Information at 27-56.

¹¹ IPCC, 2014: Adaptation Needs and Options 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, edited by C.B. Field et al., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA at 857, accessed online: http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap14_FINAL.pdf [IPCC, 2014: Adaptation Needs and Options].

¹² Alexandre Magnan, “Avoiding maladaptation to climate change: towards guiding principles” (2014), Vol. 7, No. 1, Sapiens, accessed online: <https://journals.openedition.org/sapiens/1680>.

¹³ IPCC, 2014: Adaptation Needs and Options at 858.

¹⁴ Magnan, online.

Another important concept with respect to adaptation is that of “resilience”. The IPCC defines resilience as “[t]he capacity of social, economic, and environmental systems to cope with a hazardous...disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation”.¹⁵ In other words, it is the “amount of change a system can undergo without changing state”.¹⁶ One of the goals of adaptation is to build resilience into our existing systems.



INTER-RELATIONSHIP BETWEEN ADAPTATION AND MITIGATION

Whereas the goal of mitigation is to reduce or prevent changes in the climate system, adaptation is concerned with addressing the consequences of these changes. Both are necessary.

Adaptation is understood to be a necessary complement to mitigation. Whereas the goal of mitigation is to reduce or prevent changes in the climate system, adaptation is concerned with addressing the consequences of these changes. Both are necessary. As previously mentioned, at this point in time there is no amount of mitigation that will prevent climate change from continuing into the future.

¹⁵ IPCC, 2014: Glossary at 1772.

¹⁶ Warren, 2008: Background Information at 33.

Meanwhile, adaptation alone would lead to a magnitude of climate change that, over time, would cease to be adaptable or only at very high social, economic and environmental costs.¹⁷

The implementation of both adaptive and mitigative measures are dependent upon the existence and nature of their respective capacities (i.e. that which makes such measures possible and affects their extent and usefulness).¹⁸ While different, adaptive and mitigative capacities are driven by a similar set of factors. Adaptive capacity has been defined as “the ability or potential of a system to respond successfully to climate variability and change”, while mitigative capacity has been defined as the “ability to reduce anthropogenic greenhouse gases or enhance natural sinks”.¹⁹

Both adaptation and mitigation actions are implemented at the national, sub-national and local levels. However, their impacts are often felt at different levels. Mitigation has global benefits (although ancillary benefits may be realized at a local level), whereas adaptation is typically felt at a local or regional level.²⁰ Their impacts are also realized at different times. The benefits of mitigation carried out today will not be evidenced for decades due to the long residence time of GHGs in the atmosphere (although some impacts, such as improved air quality, may be realized sooner). Conversely, adaptation measures can reduce vulnerability to climate variability immediately.²¹ As a result of these asymmetries, the impetus for mitigation tends to stem from international agreements and the ensuing national policies, while adaptation actions have historically been motivated by the self-interest of affected people, communities, and countries.²²

Overall, the inter-relationships between mitigation and adaptation are complex, not yet fully known or understood, and can vary with the type of policy decisions and the scale of the project.²³ Mitigation can have both positive and negative implications for adaptation, and vice versa. For example:

¹⁷IPCC, 2007: Inter-relationships between Adaptation and Mitigation in: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental panel on Climate Change, edited by M.L. Parry et al., Cambridge University Press, Cambridge, UK, at 748 accessed online: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter18.pdf> [IPCC, 2007: Inter-relationships between Adaptation and Mitigation].

¹⁸ IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 763.

¹⁹ IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 763.

²⁰ IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 750.

²¹ IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 750.

²² IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 750.

²³ IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 763.

M>A ⇒ mitigation efforts that shift energy sources to small-scale hydropower could increase competition for water in areas that require irrigation for agricultural adaptation efforts;

M=A ⇒ mitigation actions that transfer finance to developing countries could also provide capital for adaptation;

A>M ⇒ adaptive responses to heatwaves that increase indoor cooling can hamper mitigation where electricity is produced from fossil fuels;

A=M ⇒ adaptive actions that create afforestation also assist with mitigation.²⁴

Nevertheless, both adaptation and mitigation play important roles and, if managed well, do not necessarily require direct trade-offs.

THE LAW AS FACILITATOR OF ADAPTATION

Climate adaptation can take many forms, including technological, financial, behavioural, and managerial activities. However, the focus of this report is on the role of law in facilitating adaptation. That is, the ways in which legal institutions and tools can be used to implement adaptation measures. The law itself touches on every area of modern society:

Law confers rights and imposes obligations; provides the architecture for regulating behavior and activities, including the performance of government functions; establishes the framework for public participation in government decision making; and arbitrates and resolves disputes between the state and private individual and between individuals.²⁵

It is precisely because the law has such a vast reach that it is a powerful tool for effecting climate change adaptation. Legal tools can vary in form and function and fall under different areas of law (e.g. public or private). Generally, laws fall into the category of either public or private (civil) law. Public law typically sets the rules for governments (i.e. the state) and their interactions with individuals, whereas private law governs interactions between individuals.

²⁴ IPCC, 2007: Inter-relationships between Adaptation and Mitigation at 759-761.

²⁵ Jan McDonald, “The role of law in adapting to climate change” (2011) Vol. 2 WIREs Climate Change 283 at 284.

Public Law	Private Law
<i>Governing state behavior and interactions between the state and individuals</i>	<i>Governing interactions between individuals</i>
<ul style="list-style-type: none"> Legislation Constitutional Law Administrative Law Criminal Law International Law 	<ul style="list-style-type: none"> Contract Law Tort Law (e.g. negligence) Property Law Family Law Succession law

Note, however, that these categories are not absolute. Governments can enter into contracts and individuals often look to government to legislate around private legal arrangements. For purposes of adaptation, both public and private law include legal tools that can help to implement adaptation policies and measures. These legal tools include legislation and common law (e.g. contract law and negligence law). There are also soft legal measures that can be used to advance adaptation as well.

Legislation

Legislation refers to written laws enacted by the elected representatives of government.

There are three types of legislation: statutes, regulations and bylaws. Statutes are debated and voted upon by either the federal Parliament or provincial legislature. They state the broad principles or rules that govern our lives and enable, constrain and shape the behavior of various actors.²⁶ Meanwhile, regulations establish the details that operationalize and allow for implementation of a statute (otherwise known as the “enabling act”). They are created by the federal and provincial bodies to whom the authority to make regulations has been delegated in the enabling act. Bylaws are created by municipal bodies and are usually enabled by provincial municipal statutes.

Legislation can help to facilitate adaptation in a variety of ways. It can require the collection of information and generation of data on specific climate risks, it can define and bind parties to take on

²⁶ Lee Godden et al., Victorian Centre for Climate Change Adaptation Research, Legal tools and measures for adaption and managing climate risk in Victoria (2013) at 12, accessed online: <http://www.vcccar.org.au/sites/default/files/publications/Legal%20tools%20and%20measures%20for%20adaptation%20and%20managing%20climate%20risk%20in%20Victoria.pdf>.

specific roles and responsibilities with respect to risk management and can create legally-binding plans and planning processes. Legislation can also provide guidance and/or a framework for decision-making, introduce opportunities for public participation, and provide financial or administrative incentives for adaptation.²⁷

There is a variety of legislation relevant to climate change adaptation, but most fall into one of these three categories:

1. **Legislation enacted directly for the purpose of climate change adaptation** - This type of legislation is specifically aimed at the governance and management of adaptation. It would include legislation such as Alberta's *Climate Leadership Act*²⁸, which was enacted for the purpose of putting a carbon levy on consumers of fuel in order to, among other things, raise revenue to support Alberta's ability to adapt to climate change.
2. **Legislation that, while not enacted directly for the purpose of adaptation, includes provisions addressing adaptation** - For example, the City Charters Regulations (enabled by the *Municipal Government Act*²⁹) includes provisions requiring Edmonton and Calgary to establish a plan for adapting to the effects of climate change.
3. **Legislation that does not expressly address adaptation, but still addresses issues pertinent to adaptation** - For instance, the *Forest and Prairie Protection Act*³⁰ addresses fire prevention, fire control and firefighting in Alberta's forested areas, all of which can enable or shape Alberta's response to the risk of the increasing number and intensity of wildfires due to climate change.

There are also specific areas of legislation that are more likely to play a role in adaptation, such as planning and environmental law.

²⁷ Lee Godden et al., at 13.

²⁸ SA 2016, c C-16.9.

²⁹ RSA 2000, c M-26 [MGA].

³⁰ RSA 2000, c F-19.

Common Law

Common law is judge-made law from the interpretation of cases brought before the courts (i.e. precedents). Common law cases include the interpretation of both public and private law, including legislation. Within common law, both contract law and tort law are most likely to influence or facilitate adaptation.

Contracts

A contract is a legally recognized agreement between two or more persons which gives rise to an obligation that may be enforced in the courts.³¹ Contracts are a key legal tool for facilitating commercial transactions between individuals, businesses, and governments, and set out the terms and conditions of the agreement, including what happens in the event one party does not deliver.

Contracts may be used as a tool to prescribe adaptive measures. For instance, a construction contract could require higher design standards than legally required (i.e. based on future climate projections); a rental agreement could require that a building meet certain energy efficiency standards, or an insurance contract could incorporate climate risk-based pricing to incentivize adaptation.

Contracts may also be used to manage climate risks, such as extreme weather events that render performance of the contractual obligations impossible. By way of example, a “force majeure” clause can exempt one party from completing its obligations under the contract in the event an act, that is beyond the control of either party, makes performance impossible (as opposed to just commercially impractical). The parties to the contract may define what constitutes a force majeure, but the term usually includes “acts of God”, explosions, storms, landslides, fires, floods, war or acts of terrorism.

Negligence (Tort) Law

Generally speaking, a tort is a civil wrong, other than a breach of contract, which gives rise to a remedy of damages. Torts can be intentional or not, but the most common type of tort is a negligence claim. The elements of a negligence claim include:

- a) the defendant owes a duty of care to the plaintiff (i.e. harm was reasonably foreseeable);
- b) the standard of care was breached;

³¹ CED 4th, Contracts I.1. at para. 1 (WL).

- c) the plaintiff suffered provable damages; and
- d) the damages were directly caused by the defendant's breach (i.e. causation).

The law of negligence can promote adaptation through litigation (or threat of litigation) against government or non-government actors for failing to adapt or take steps to adapt to climate change. The argument goes that it is or ought to be reasonably foreseeable that failing to take steps to adapt to climate change is likely to cause (or has caused) personal injury and/or damages to property for which compensation is appropriate. It is part of a rising trend of climate change litigation that seeks to strengthen climate action by pressuring policy-makers to take more ambitious action, to hold them to account, and to fill in the gaps of insufficient legislation.³²

Climate change litigation is still in its infancy in Canada. At least one class action suit for “failure to adapt” was launched in Ontario. In *Burgess v. Ontario Minister of Natural Resources and Forestry*³³ the representative plaintiff alleged the Ministry had a duty to avert foreseeable flooding in a series of popular lakes in cottage country, yet negligently allowed the lakes to flood which caused damage to adjacent structures. The plaintiff(s) sought \$900 million in damages, but the case was quietly discontinued in August 2018.

Most recently, Environnement Jeunesse, an environmental nonprofit in Quebec, applied to bring a class action lawsuit against the Canadian government on behalf of Quebec citizens aged 35 and under.³⁴ The action alleges the Government of Canada failed to take sufficient action to reduce GHGs and failed to take steps to prevent climate change, which amounts to a violation of the fundamental rights of its citizens under the *Canadian Charter of Rights and Freedoms* and Quebec's *Charter of Human Rights and Freedoms*. The lawsuit seeks various declarations and an order for the implementation of remedial measures to curb global warming.³⁵

³² Joanna Setzer, Grantham Research Institute on Climate Change and the Environment at The London School of Economics and Political Science, *Climate in the Courtroom: Litigation is increasingly used to influence action on climate change* (May 24, 2017), accessed online: <http://www.lse.ac.uk/GranthamInstitute/news/climate-in-the-courtroom-litigation-is-increasingly-used-to-influence-action-on-climate-change/>.

³³ (September 14, 2016), Barrie 16-1325 CP, Ont SCJ.

³⁴ *Environnement Jeunesse v. Canada*, (November 26, 2018), Montréal, 500-06, QC SCJ.

³⁵ I. Peritz, “Quebec group sues federal government over climate change”, *The Globe and Mail*, November 26, 2018, online: <https://www.theglobeandmail.com/canada/article-quebec-group-sues-federal-government-over-climate-change/>.

Other Legal Measures

In addition to more prescriptive legal tools such as legislation, contracts, and negligence, there are also non-prescriptive measures that promote adaptation. These include:

- Voluntary industry based codes
 - E.g. Engineers Canada developed a national guideline made up of 11 principles on climate adaptation and mitigation to inform engineering professionals on how to address the implications of climate change in their professional activities (i.e. Principle #1: integrate climate adaptation and resiliency into practice).
- Market or financial mechanisms
 - E.g. Energy Efficiency Alberta provides financial incentives and/or rebates for installing efficient lighting, HVAC or water heating equipment.
- Collaborative partnerships
 - E.g. the federal, provincial and territorial governments have partnered on the Pan-Canadian Framework on Clean Growth and Climate Change wherein they commit to actions that build climate change resilience.
- Information-based tools
 - E.g. Alberta's oil and gas companies are required by the Alberta Securities Commission and their accompanying standards of disclosure to evaluate and disclose risk, including climate related risks, which enables risk and vulnerability assessments and allows for critical evaluation of companies' approach to managing climate risk.

These types of tools do not actually prescribe behavior, rather they influence it with a lighter touch.

Legal Barriers to Adaptation

Concerns about legal consequences can be a barrier to action on the part of government or corporations. They may fear that releasing information or taking action on potential climate change impacts will leave them open to a lawsuit, either for failure to take action earlier, failure to take more aggressive action, or for the downstream effects of their actions.

While the law is an important tool for adaptation, it can also present barriers.

For one, concerns about legal consequences can be a barrier to action on the part of government or corporations. They may fear that releasing information or taking action on potential climate change impacts will leave them open to a lawsuit, either for failure to take action earlier, failure to take more aggressive action, or for the downstream effects of their actions.

There is also the issue of legal rights or duties to compensate. Sometimes, the “taking” of a property or the implementation of policies that result in a diminution of its productive use(s) can give rise to a right to compensation.³⁶ This issue could arise where adaptive measures seek to limit development or activities in a hazardous location, or where holders of development rights, water allocations, or resource harvesting quotas are impacted.

Generally, in Alberta, the *Expropriation Act*³⁷ provides that an expropriation authorized by law (i.e. granted by legislation) is compensable, whereas the imposition of restrictions on the use of land, even if very severe, are not. There is, however, a common law rule that provides that a *de facto* taking can also give rise to compensation, assuming the following two requirements are met: (1) an acquisition of a beneficial interest in the property or flowing from it; and (2) removal of all reasonable uses of the property.³⁸

³⁶ McDonald at 286-287.

³⁷ RSA 2000 c E-13.

³⁸ *Canadian Pacific Railway Co. v. Vancouver (City)*, 2006 SCC 5 at paras 28-30.

Privacy laws can sometimes present barriers to adaptation as well. In particular, they can constrain the operation of early warning systems or the efficacy of campaigns aimed at vulnerable groups where governments are unable to contact residents directly or obtain personal data on age, location and socio-economic status.³⁹

Finally, different legal tools and measures affect different groups in different ways. Adaptation law and policy must also cope with multiple layers of uncertainty. Efforts should be made to avoid exacerbating existing drivers of social and economic vulnerability and/or placing additional burdens on those least equipped to bear them.⁴⁰ This will require efforts to anticipate and understand the ways in which specific legal tools may shape responses.

ACTORS OF ADAPTATION

Governments of all levels play a role in advancing adaptation and are understood to act as both adapters and facilitators of adaptation.

Opportunities for adaptation exist at different levels (i.e. global, national and local), in different industries, and across time-frames (i.e. short-term, long-term and very long-term). Given its heterogeneous nature, a variety of actors are required to address the challenges inherent in planning and implementing adaptation. This is because different actors have different capacities to adapt to climate variability and change.⁴¹ The actors can include: governments (national, provincial and municipal), industry, non-governmental organizations (NGOs), indigenous peoples, and the general public.

³⁹ McDonald at 287.

⁴⁰ McDonald at 288.

⁴¹ IPCC, 2014: Adaptation Opportunities, Constraints, and Limits 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, edited by C.B. Field et al., (Cambridge University Press, Cambridge, United Kingdom and New York, NY USA, at 908, accessed online: https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap16_FINAL.pdf.

Government

Governments of all levels play a role in advancing adaptation and are understood to act as both adapters and facilitators of adaptation.⁴² As adapters, government agencies may adjust policies, programs, and operational decisions to respond to climate change. As facilitators they are responsible for removing barriers and creating incentives so that people and/or organizations are motivated to act proactively.⁴³

National Government

National governments are integral to advancing adaptation as they are often times in the best position to mobilize political will, create or support climate research institutions, establish funding priorities, and provide policy direction to other levels of government.⁴⁴

In Canada, the federal government plays an important role in delivering scientific information on climate change impacts, promoting information sharing with and amongst the provincial governments, building adaptive capacity, and mainstreaming adaptation efforts.⁴⁵ In addition, the federal government has sole jurisdiction over areas such as oceans, international treaties, and the First Nations and Inuit.

The federal government's adaptation efforts to date include:

- Adoption of the Federal Adaptation Policy Framework⁴⁶ to help guide domestic action by the Government of Canada to address adaptation to the impacts of climate variability and change;

⁴² J. Eyzaguirre & F.J. Warren, 2014: Adaptation: Linking Research and Practice in: Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, Government of Canada, Ottawa, ON, 253-286 at 263 [Eyzaguirre, 2014: Adaptation: Linking Research and Practice].

⁴³ Eyzaguirre, 2014: Adaptation: Linking Research and Practice at 263.

⁴⁴ IPCC, 2014: Adaptation Needs and Options at 842.

⁴⁵ Government of Canada (2011), Federal Adaptation Policy Framework, Environment Canada, Gatineau, QC, accessed online: https://www.canada.ca/en/environment-climate-change/services/climate-change/federal-adaptation-policy-framework.html#_5 [Federal Adaptation Policy Framework].

⁴⁶ Federal Adaptation Policy Framework.

- Creation of a climate change Adaptation Platform to bring together key groups in Canada to collaborate on climate change adaptation priorities. Members include representatives from government, industry, communities, Indigenous, academics, professionals and not for profit organizations; and
- Establishment of The Expert Panel on Climate Change Adaptation and Resilience Results to propose indicators to measure progress on federal, provincial, and territorial adaptation efforts in building Canada’s resilience to climate change. The panel recently published its report with a suite of 54 indicators in five key areas of action:⁴⁷
 - protecting and improving human health and well-being;
 - supporting particularly vulnerable regions (e.g. northern, coastal and remote regions);
 - reducing climate-related hazards and disaster risks;
 - building climate resilience through infrastructure; and
 - translating scientific information and indigenous knowledge into action.

Provincial Government

Provincial and territorial governments also play integral roles in advancing adaptation. They can play both a complementary role to the federal government in areas of federal jurisdiction, and a primary role in areas of provincial jurisdiction, such as land-use planning. Many provinces have developed stand-alone adaptation action plans, as well as taken steps to fund research, enhance emergency preparedness, strengthen infrastructure, build capacity for communities and municipal government, and share data and/or experiences with other levels of government.⁴⁸

The Alberta Government’s action on adaptation to date includes:

⁴⁷ Expert Panel on Climate Change Adaptation and Resilience Results, Measuring Progress on Adaptation and Climate Resilience: Recommendations to the Government of Canada, Government of Canada, Gatineau, QC at 6-7.

⁴⁸ Eyzaguirre, 2014: Adaptation: Linking Research and Practice at 265-266.

- Development of a *Climate Leadership Plan* designed to diversify Alberta’s economy, create jobs and reduce GHG emissions;⁴⁹
- Establishment of a Climate Change Advisory Panel to hear from Albertans across the province on climate change and production of a Climate Leadership Report to the Minister;⁵⁰
- Development of a Climate Change Adaptation Framework and accompanying manual to help organizations integrate climate change risk into existing risk management and planning approaches;⁵¹
- Funding of the Municipal Climate Change Action Centre which provides support and resources to municipalities to plan for and manage the local impacts of climate change; and
- Funding of the Prairie Adaptation Research Collaborative to pursue climate change impacts and adaptation research in the prairie provinces.⁵²

Municipal Government

Finally, local or municipal governments are in a unique position to take action on adaptation. They are most likely to feel the impact of climate change directly and have a variety of tools at their disposal to mount a flexible response. Municipal governments are also likely to receive considerable support from higher levels of government in the form of programs, policies, research and funding.⁵³

By way of example, in Alberta recent amendments to the *MGA* encourage municipalities to consider the environment in a multitude of operational and growth decisions. Municipalities can promote adaptation through land-use planning that minimizes risks from floods, wildfires or landslides, management of public lands and buildings, establishment of parks, creation of tax subsidies or other

⁴⁹ Government of Alberta, Climate Leadership Plan, online: <https://www.alberta.ca/climate-leadership-plan.aspx>.

⁵⁰ Government of Alberta, Climate Change Advisory Panel, online: <https://www.alberta.ca/climate-leadership-discussion.aspx>.

⁵¹ Government of Alberta, AEP, Climate Change Adaptation Framework, online: <http://aep.alberta.ca/forms-maps-services/publications/climate-change-adaptation-framework.aspx>.

⁵² Prairie Adaptation Research Collaborative (PARC), online: <http://www.parc.ca/>.

⁵³ Eyzaguirre, 2014: Adaptation: Linking Research and Practice at 266-267.

incentive programs, public outreach and education.⁵⁴ A number of municipalities either have or are in the process of developing their own adaptation and resilience plans.

Industry

Canadian businesses and industry sectors are becoming increasingly aware that a changing climate will impact their bottom line. As a result, industry is evolving to become an important partner in adaptation. Mostly, industry is interested in making their own operations resilient to climate change impacts. Businesses, industry councils and professional associations are researching and reviewing the risks to their operations, developing adaptation frameworks, and adjusting practices.

Nevertheless, industry adaptation efforts can also assist other actors. Business vulnerability assessments may be used to supplement government knowledge. Healthy businesses also contribute to overall financial capacity. Industry may also be interested in adaptation investment as a form of corporate philanthropy and/or for generating positive press.

Insurance companies are a prime example of how industry can take a leadership role in adaptation. Globally, insurers are concerned about the impacts of climate change as extreme weather has already begun to affect their profitability. In Canada, the Intact Financial Corporation has helped to fund the Intact Centre on Climate Adaptation, a research centre associated with the University of Waterloo. The Intact Centre works with homeowners, communities, governments and businesses to identify and reduce the impacts of climate change.⁵⁵

Non-Governmental Organizations

NGOs help to advocate for, and promote information and dialogue about, adaptation. NGOs may also be able to offer strategic advice and technical assistance on adaptation, as well as provide financing for select projects. One example is the Climate Action Network (Canada) which is made up of a coalition of environmental, climate, and energy organizations that are working together to address, among other things, the front-line impacts of climate change.⁵⁶

⁵⁴ G.R.A. Richardson & J. Otero, J. (2012), Land use planning tools for local adaptation to climate change, Government of Canada, Ottawa, ON, at 1, online: <https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/files/landuse-e.pdf>.

⁵⁵ Intact Centre on Climate Adaptation, Mandate, online: <https://www.intactcentreclimateadaptation.ca/>.

⁵⁶ Canada Climate Action Network, About CAN-Rac, online: <https://climateactionnetwork.ca/about-can-rac/>.

Indigenous Peoples

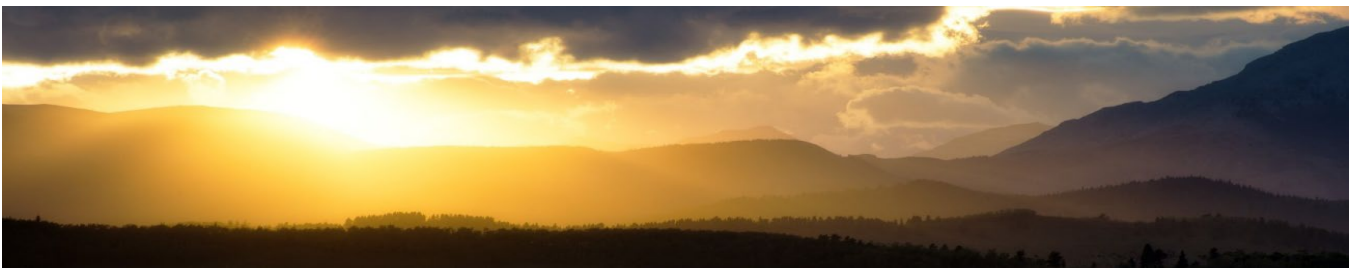
Indigenous peoples play a vital role in bringing adaptation to their communities and beyond. They have a deeper understanding of their cultural and historical ties to specific lands and contribute traditional knowledge that may include long term observations about the changing environment, including water levels, sea ice, and fish and animal migration patterns.

Indigenous peoples are also in the best position to define the range of options that a community might consider adopting and that are appropriate to its ecological and socio-cultural environments and in conformity with its priorities, values and worldviews. They are also able to enhance social cohesion and prevent or reduce inter-community conflicts.

Indigenous peoples participate in adaptation at the global, national and local level. Nationally, Indigenous Climate Action (ICA) is an indigenous led climate justice organization that prioritizes Indigenous voices and experiences within climate discussions and aims to empower their communities to take climate action. In Alberta, AEP has launched an Indigenous Climate Leadership Initiative to engage input from indigenous peoples on climate mitigation and adaptation. The initiative is still in development but includes, among other things, the Alberta Indigenous Energy Efficiency (Retrofit) Program (AIEERP), a grant program that supports Indigenous communities to improve energy efficiency and retrofit buildings.⁵⁷

General Public

Private households and individuals can also be actors of adaptation through behaviour modification, charitable donations, government lobbying, and climate litigation, among other things.



⁵⁷ Government of Alberta, Indigenous Relations, Alberta Indigenous Energy Efficiency (Retrofit) Program, online: <http://indigenous.alberta.ca/AIEERP.cfm>.

ALBERTA’S CLIMATE CHARACTERISTICS AND VULNERABILITIES

To understand why and how adaptive measures should be implemented in Alberta, it is first important to understand how climate change is expected to impact Alberta. This section aims to provide information on Alberta’s current climate characteristics and its future vulnerabilities, including the predicted climate change impacts to Alberta’s water resources, ecosystems and soil.

Climate Characteristics

Alberta is located in “the Prairies”, along with Saskatchewan and Manitoba, and has its own unique climate relative to other parts of the country. Alberta is home to the following five ecozones: Prairies, Montane Cordillera, Boreal Plains, Taiga Plains and Taiga Shield.⁵⁸



Figure 1: Ecozones of the Prairie Provinces (Source: Natural Resources Canada).

⁵⁸ D. Sauchyn & S. Kulshreshtha, 2008: “Prairies” in *From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen et al., Government of Canada, Ottawa, ON, 275-328 at 281 [Sauchyn, 2008: Prairies].

Each of these ecozones has its own unique characteristics, as set out in the table below:

Ecozone	Location	Characteristics
Prairie	Southeast Alberta	Agricultural and industrial heartland. Original land has been extensively modified. Persistent and sometimes severe moisture deficits. Mostly sustained by irrigation.
Boreal Plains	Central and Northern Alberta	Mixed and coniferous forest. Home to large oil and gas reserves, nearly all commercial forestry and expanding farmland.
Montane Cordillera	Rocky Mountains	High ecological diversity – ranging from low elevation fescue grassland through montane forest to subalpine forest and alpine tundra. Mostly designated as park and protected lands. Dominant economic activities are cattle ranching and outdoor recreation.
Taiga Plains	Northwestern Alberta	Cooler climate and shorter growing season.
Taiga Shield	Northeastern Alberta	Rich in mineral resources and supports traditional livelihood of Cree and Dene First Nations.

Naturally, Alberta’s climate differs across the various ecozones. Still, we can draw the following generalizations:

- Climate is generally cold and sub humid;
- Extreme differences in seasonal temperatures;
- Mean annual temperatures are highest in southern Alberta and decrease towards northern Alberta;
- Precipitation is varied – there are annual moisture deficits in southern and western plains, and moisture surpluses in Rocky Mountains and foothills, and in northern boreal forest;

- Runoff is shed from wetter regions eastward via the Saskatchewan-Nelson-Churchill river system into Hudson Bay, and northward via the Athabasca, Peace and Hay Rivers into the Mackenzie River and Arctic Ocean;
- Minimal runoff is generated across the southern part and large areas are drained internally by intermittent streamflow; and
- Demand for water is greatest in southern Alberta but there are more water resources in northern Alberta.⁵⁹

Warming of the earth's climate over the past century is indisputable and largely due to human activities. This warming is more pronounced over high northern latitudes and the rate of warming in Canada is expected to occur at approximately twice the global rate.

Vulnerabilities

Warming of the earth's climate over the past century is indisputable and largely due to human activities.⁶⁰ This warming is more pronounced over high northern latitudes⁶¹ and the rate of warming in Canada is expected to occur at approximately twice the global rate. This means that a 2°C increase globally will actually result in a 3°C or 4°C increase for Canada. Canada as a whole is likely to experience warmer, wetter weather with less snow and ice, with these impacts being amplified in the Arctic.

⁵⁹ Sauchyn, 2008: Prairies at 278-279.

⁶⁰ IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by R.K. Pachauri & L.A. Meyer, Geneva, Switzerland at 2, online: https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf.

⁶¹ E.J. Bush et al., 2014: An Overview of Canada's Changing Climate in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, edited by F.J. Warren & D.S. Lemmen, Government of Canada, Ottawa, ON, 23-64 at 26 online: < <https://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2014/16309>> [Bush, 2014: An Overview of Canada's Changing Climate].

The impacts of this warming in Alberta will manifest in various ways, and leading scientists predict that Alberta will experience changes to its water resources, ecosystems and soil. These anticipated changes are discussed briefly below:



Changes to Water Resources

Surface water

Surface water is likely to increase in winter and spring but decrease in summer and fall. Winter warming will reduce snow accumulation, causing declines in annual streamflow. Winter warming also has the effect of shifting streamflow timing to earlier in the year, which results in lower late season water supplies. Glacier retreat is already resulting in decreased summer and fall runoff, which impacts rivers during the period of lowest water flow and greatest demand. Its continuation is expected to exacerbate water shortages in drought years.⁶²

⁶² Sauchyn, 2008: Prairies at 290.

Groundwater

Groundwater is the source of potable water for about 23% of Albertans, most of whom live in rural communities. The impact of climate change on groundwater is not well understood,⁶³ and is complicated by the fact that groundwater resources reflect a dynamic equilibrium between recharge, discharge, and the resulting changes in groundwater storage.⁶⁴

Research suggests that future groundwater supplies are expected to decline in some regions and increase in others.⁶⁵ Generally speaking, winter snow plus spring precipitation is responsible for groundwater recharge on the Prairies.⁶⁶ In areas with increased winter and spring precipitation there may be a beneficial effect on groundwater levels, whereas areas with decreased winter and spring precipitation will experience reduced groundwater levels.⁶⁷ Summer precipitation does little in terms of recharge as it mainly increases surficial aquifers that are used for agricultural production.⁶⁸

Research also suggests that groundwater levels are sensitive to variation in temperature. Warming temperatures could accelerate evaporation, thus reducing the recharge rate to the groundwater resource and leading to a drop in the groundwater table.⁶⁹ In the case of increased drought, surficial aquifers are the most vulnerable while deep semi-confined aquifers are the least.⁷⁰

Water Quality

Threats to the water quality of aquatic ecosystems and water resources will be exacerbated by climate change. These include physical disruption (e.g. agriculture and forestry land-use, sewage effluent, storm water runoff), chemical contamination (e.g. organic pollutants, urban runoff, aquatic acidification), and biological contamination (e.g. waterborne pathogens).⁷¹

⁶³ Z. Chen, S. Grasby & K.G. Osadetz, "Relation between climate variability and groundwater levels in the upper carbonate aquifer, southern Manitoba, Canada" (2004), 290 *Journal of Hydrology* 43-63 at 44 [Chen et al.].

⁶⁴H. Maathuis & L.H. Thorleifson, 2000: *Potential Impact of Climate Change on Prairie Groundwater Supplies: Review of Current Knowledge*, Saskatchewan Research Council, Saskatoon, SK, SRC Publication No. 11304-2E00 at 29 [Maathuis].

⁶⁵ Sauchyn, 2008: *Prairies* at 290.

⁶⁶ Chen et al. at 58.

⁶⁷ Chen et al. at 59.

⁶⁸ Maathuis at 30.

⁶⁹ Chen et al. at 59.

⁷⁰ Maathuis at 29.

⁷¹ Sauchyn, 2008: *Prairies* at 291.

Meanwhile, reductions in streamflow due to climate warming will worsen these impacts, as their dilution capacity will likely decline and cause lake residence times to increase accordingly. Increased soil erosion due to drought will increase stream sediment loads and enhance nutrients in local water bodies, leading to the eutrophication (i.e. overly enriched with nutrients) of water bodies and increased pathogen loading in streams during the summer.⁷²

Increased Industrial Demand

Increased demand due to the continued growth of agricultural irrigation and the human population will compound issues of supply.⁷³

Extreme Hydrological Events

There will likely be greater frequency of extreme events such as severe drought and flooding. Increasing annual and seasonal temperatures will exacerbate drought conditions. For example, in the boreal forest and taiga areas, increased drought length and frequency will result in declining soil moisture and more extensive forest fires. The loss of vegetation and soil cover also leads to an inability to store water locally, which causes runoff to be instantaneous and results in flash floods.⁷⁴

Warmer temperature will also increase the likelihood of extreme rainfall, which leads to flooding.⁷⁵



2013 flooding in Calgary and southern Alberta, photo courtesy City of Calgary

⁷² Sauchyn, 2008: Prairies at 291.

⁷³ Sauchyn, 2008: Prairies at 291.

⁷⁴ Sauchyn, 2008: Prairies at 291.

⁷⁵ Sauchyn, 2008: Prairies at 291.

Changes to Ecosystems

Biodiversity

Changes in climate will benefit some species and act to the detriment of others. It is likely that increased temperatures and a longer growing season will bolster plant productivity, and increased CO₂ fertilization has been shown to have a positive enrichment effect on the growth of some vegetation, as it increases the efficiency of their water use.⁷⁶

Meanwhile, other changes may hamper or negate growth. Less precipitation and more frequent drought are expected to decrease plant growth and productivity. Higher average winter temperatures will lead to greater overwinter survival of pathogens and increased disease severity. Drought also weakens trees' defenses to virulent pathogens. Ultraviolet B radiation and ground level ozone levels are increasing and are also expected to negatively impact vegetation. In addition, changes in the timing and intensity of freeze-thaw events, diurnal temperature patterns, storms, and wind stress events may influence vegetation distribution or survival, especially of various tree species. The boreal forest in particular is expected to be significantly affected by climate change, especially at its southern boundary.⁷⁷



Woodland caribou, photo courtesy Environment Canada

⁷⁶ Sauchyn, 2008: Prairies at 292.

⁷⁷ Sauchyn, 2008: Prairies at 292.

Timing of Events

The timing of biological events can often be used to predict the time and success of planting, fishing and hunting activities, among others. For example, the flowering dates of key perennial plants in Alberta are closely related to the average temperature two months prior to bloom.⁷⁸ However, climate change is disrupting these patterns and, over the past century, has caused the onset of Spring to shift a full 26 days earlier.⁷⁹ These phenological changes have significant implications for pollinator and trophic interactions, global carbon cycling, and climate-vegetation feedbacks.⁸⁰

Vegetation Zone

Climate change is expected to bring a northward shift of the forest-grassland boundary in the Prairies. Modelling also predicts that in forest regions there will be a general reduction in tree growth, regeneration failure in dry years, and gradual reduction in tree cover and expansion of grassland patches. In the aspen parkland there will be shrinking of aspen groves, reduced invasion of grassland patches by shrubs and poplar sprouts, and decreasing shrub cover.

The greatest impacts are predicted to occur at the interfaces of drier grassland with the moister foothills grassland, and at the interface of grassland with parkland and forest. The boreal forest is also likely to experience significant changes in area and quality.⁸¹

Wildlife

The Prairies provide an important breeding ground for the majority of Canada's duck population. However, waterfowl numbers decrease in response to drought and habitat loss. The projected increase in aridity in the prairie grasslands is likely to negatively impact migratory waterfowl populations.

⁷⁸ Sauchyn, 2008: Prairies at 292.

⁷⁹ Sauchyn, 2008: Prairies at 292.

⁸⁰ H.R. Whittington et al., "Phenological responses of prairie plants vary among species and year in a three-year experimental warming study" (2015) *Ecosphere* 6(10):208, accessed online: <https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/ES15-00070.1>.

⁸¹ Sauchyn, 2008: Prairies at 293.

Climate change is also likely to affect wildlife migration patterns and population size.⁸² Aquatic ecosystems will also be stressed by warmer and drier conditions. It is expected that large algal blooms, accelerated eutrophication and serious impacts on fish species will occur.⁸³

Changes to Soil

Climate change is also expected to alter Alberta's soil landscapes. The Rocky Mountains are likely to experience increased rainfall in winter, rapid snowmelt and glacial melting which will cause an increased frequency of landslides, debris flows, rock avalanches and outburst floods. In the Prairies region, projected increases in drought and aridity will likely result in more widespread wind erosion and increased sand dune activity. Prolonged droughts are also likely to leave the semiarid to sub humid mixed grassland ecoregion at risk of desertification.⁸⁴



⁸² Sauchyn, 2008: Prairies at 293.

⁸³ Sauchyn, 2008: Prairies at 294.

⁸⁴ Sauchyn, 2008: Prairies at 295-296.

RISKS, OPPORTUNITIES AND ADAPTATION

Building on what is known about the likely impacts of climate change, this section aims to highlight both the risks and opportunities associated with climate change in Alberta, as well as the adaptive measures that could help to maintain resiliency in the face of these changes. In particular, this section considers a wide variety of subject areas under the rubric of a) natural resources; b) industry; c) infrastructure; d) biodiversity; and e) human impact. What sort of issues will these areas face due to climate change? What can and should be done to assist with adapting to these issues? Which laws pertain to climate change? Read on to learn more.

1) Natural Resources

a. Forestry

Forest land makes up just over 50% of the land in Alberta⁸⁵ and the forestry industry accounts for \$2.6 billion of the provincial gross domestic product (GDP).⁸⁶ Forests provide important ecological functions such as water conservation, water purification, biodiversity, and carbon storage and contribute to the business economy.



⁸⁵ Alberta Wilderness Association, Forests, online: AWA <https://albertawilderness.ca/issues/wildlands/forests/>.

⁸⁶ Alberta Agriculture and Forestry, Forest Business, online: Alberta Agriculture and Forestry <https://www.agric.gov.ab.ca/app21/forestrypage?cat1=Forest%20Business>.

Risks & Opportunities

Climate change is expected to bring changes to species distribution, with trees shifting northward in latitude and upslope in altitude. There are also likely to be increased “disturbance regimes” such as fire, pest (e.g. mountain pine beetle) and disease outbreaks, as well as drought, which will affect the quality and quantity of timber supply. These anticipated changes will likely cause the forest industry to suffer and operating costs could become prohibitive, causing local forestry economies to disappear.⁸⁷

There is, however, some potential that warmer climates and longer growing seasons may benefit populations in the northern portion of the species range.⁸⁸

Adaptation

Adaptation could be achieved, in part, by updating and incorporating adaptive measures into Alberta’s sustainable forest management practices. Put simply, sustainable forest management is a way of using and caring for forests so as to maintain their environmental, social, and economic values and benefits over time.⁸⁹ The Canadian Council of Forest Ministers (CCFM), in tandem with the forestry sector, has adopted sustainable forest management standards and practices that are implemented by federal, provincial and territorial laws, regulation and policies, as well as international agreements such as the Montréal Process.

In Alberta, the primary legislative vehicle for forest management is the *Forests Act*,⁹⁰ along with its associated regulations and codes of practice. The *Forests Act* governs forestry tenure and timber allocation, and generally sets out the sources of authority for managing forest resources on public lands. The associated *Timber Management Regulation*⁹¹ also addresses key aspects of forest management and provides a framework for all timber regulated activities.

⁸⁷ D.S. Lemmen et al., 2014: Natural Resources in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, edited by F.J. Warren and D.S. Lemmen, Government of Canada, Ottawa, ON, 65-98 at 69 [Lemmen, 2014: Natural Resources].

⁸⁸ Lemmen, 2014: Natural Resources at 73.

⁸⁹ Government of Canada, Sustainable Forest Management in Canada, online: Natural Resources Canada <http://www.nrcan.gc.ca/forests/canada/sustainable-forest-management/13183>.

⁹⁰ RSA 2000, c F-22.

⁹¹ Alta Reg. 60/1973.

Sustainable forest management practices are mainly incorporated into Alberta law through the *Forests Act* and its regulations. More specifically, sustainable forest management must be provided for in all Forest Management Plans (FMPs). FMPs are a technical document that detail where, when and how trees on Crown land are harvested and managed for sustainability.⁹² They are a requirement of all Forest Management Agreements (i.e. a type of forest tenure) that are negotiated between the Government of Alberta and forestry companies. Alternatively, in areas not subject to a Forest Management Agreement, the Crown is responsible for preparing the FMP. The Alberta Forest Management Planning Standard (i.e. the standard for preparing and implementing FMPs) provides that Alberta has adopted the CAN/CSA-Z809-2002 *Sustainable Forest Management: Requirements and Guidance Document* as the forest management planning system, and FMPs must abide by these standards, except where specifically excluded.⁹³

Going forward, Alberta could update its laws and standards to incorporate adaptive measures such as assisted tree migration, development of drought tolerant and pest resistant genotypes, and *ex situ* preservation of rare populations⁹⁴ into Alberta's sustainable forest management practices. Note, however, that these adaptive measures are closely linked with issues of biodiversity and should be exercised with caution.

Other key acts that govern activities in Alberta's forests are:

- **Public Lands Act, RSA 2000, c P-40** – governs the overall use, disposition and administration of Crown lands;
- **Alberta Land Stewardship Act, SA 2009, c A-26.8** – establishes Regional Plans that provide strategic direction on the management of Alberta's forests by setting environmental, economic and social objectives that enable sustainable development;

⁹² Alberta Agriculture and Forestry, Forest Management Plans – Forest Management, accessed online: <http://www.agric.gov.ab.ca/app21/forestrypage?cat1=Forest%20Management&cat2=Forest%20Management%20Plans>.

⁹³ Alberta Sustainable Resource Development, Alberta Forest Management Planning Standard, Version 4.1, April 2006 at 7, online: [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/formain15749/\\$FILE/ForestManagementPlanningStandard-2006.pdf](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/formain15749/$FILE/ForestManagementPlanningStandard-2006.pdf).

⁹⁴ Canadian Council of Forest Ministers, Vulnerability of Canada's Tree Species to Climate Change and Management Options for Adaptation: An Overview for Policy Makers and Practitioners, by M. Johnston et al., (2009) at 28-32, online: https://www.ccfm.org/pdf/TreeSpecies_web_e.pdf.

- ***Forest and Prairie Protection Act***, RSA 2000, c F-19 – provides a basis for administration of wildfire prevention and management (with the exception of urban municipalities and federal lands); and
- ***Regulated Forestry Profession Act***, RSA 2000, c R-13 – provides details on the right to title and regulations surrounding the practice of forestry in Alberta.

Another quasi-legal adaptation measure is to redefine sustainable forest management certification standards. The Canadian Standards Association (CSA), the Forest Stewardship Council Canada (FSC) and the Sustainable Forestry Initiative (SFI) are all independent third-party certification systems that are used in Canada to complement our existing laws. Certification provides the added assurance that a forestry company is operating legally and complying with internationally accepted standards for sustainable forest management. In Alberta, the area managed under third party certification schemes is 20.2 million hectares.⁹⁵

Additional legislation that touches on forest management includes the *Water Act*,⁹⁶ *Species at Risk Act*,⁹⁷ *Environmental Protection and Enhancement Act*⁹⁸ (which enables regulations that govern pesticide use), *Pest Control Products Act*,⁹⁹ and *Plant Protection Act*.¹⁰⁰

b. Mining

Mining in Alberta is estimated to employ at least 10,000 people and accounts for approximately \$2.3 billion¹⁰¹ of the provincial GDP. Sand and gravel, and stone are the leading non-energy minerals excavated and mined in Alberta with a production value of \$289 million and \$6 million respectively.¹⁰²

⁹⁵ Sustainable Forest Management in Canada, Forest Governance in the Province of Alberta, online: https://www.sfmcanada.org/images/Publications/EN/AB_info_Provinces_and_territories_EN.pdf.

⁹⁶ RSA 2000, c W-3.

⁹⁷ SC 2002, c 29 [SARA].

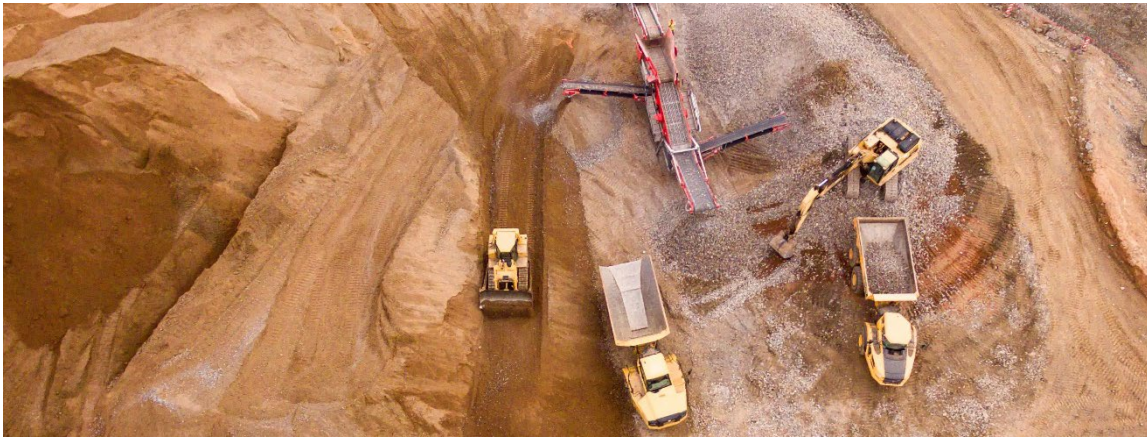
⁹⁸ RSA 2000, c E-12 [EPEA].

⁹⁹ SC 2002, c 28.

¹⁰⁰ SC 1990, c 22.

¹⁰¹ Natural Resources Canada, Canadian Mineral Production, Information Bulletin published March 2018, online: <http://www.nrcan.gc.ca/mining-materials/publications/17722>.

¹⁰² Government of Alberta, "Minerals", online: Alberta Energy <https://www.energy.alberta.ca/Minerals/Pages/default.aspx>.



Risks & Opportunities

Climate change poses significant challenges to mining's built infrastructure, as past engineering did not take it into account. Events such as permafrost degradation, resulting soil instabilities, changes in the hydrological cycle and extreme weather all pose risks to the structural integrity of the roads, buildings, berms, tailing dams and containment ponds that make up mine infrastructure. This infrastructure will likely require increased maintenance costs and/or remedial work to ensure structural integrity.¹⁰³

In addition, increased precipitation can exacerbate costs associated with drying mined materials.¹⁰⁴ It is also anticipated that extreme weather events such as flooding, drought, forest fires and extreme cold will reduce operational capacity, especially given that many mines are located in remote areas with limited services.¹⁰⁵

In terms of opportunities, increased precipitation in some areas could help to control dust emissions associated with processing at sand, gravel, limestone and dolomite mines.¹⁰⁶

¹⁰³ Lemmen, 2014: Natural Resources at 78.

¹⁰⁴ Lemmen, 2014: Natural Resources at 80.

¹⁰⁵ Lemmen, 2014: Natural Resources at 80.

¹⁰⁶ Lemmen, 2014: Natural Resources at 80.

Adaptation

Adaptation efforts should be aimed at creating greater resilience for built infrastructure and minimizing and/or eliminating environmental issues post-decommissioning. To date, adaptation planning in the mining sector has been voluntary. Going forward, it should be worked into some of the existing legislation that governs mining and its built infrastructure.

Mining in Alberta is primarily governed by the *Mines and Minerals Act*,¹⁰⁷ the *EPEA*, the *Public Lands Act*, the *Water Act*, and their associated regulations. One approach to adaptation could be the implementation of regulations that mandate that mines must plan for climate change both during their operational lifespan and through decommissioning.¹⁰⁸ This would ensure that climate change is considered in the design and construction phase (i.e. when engineering strategies can be implemented to protect infrastructure), as well as in the mine closure phase (i.e. to ensure holding ponds and other containment infrastructure as well as any buildings, roads, etc. are equipped to handle adverse conditions in the future).

For instance, adaptation planning could be incorporated into the environmental assessment (EA) process.¹⁰⁹ EAs in Alberta are governed by the *Canadian Environmental Assessment Act, 2012*¹¹⁰ and the *EPEA*. Generally speaking, EAs must be submitted prior to commencing work on most large-scale, physical projects, including mining operations. Where required, the EA process is mandatory, entrenched, and familiar. Incorporating adaptation planning into the EA process would allow operators to use existing planning tools and processes to consider climate change impacts and would help ensure adaptation is being addressed in the mining sector. EAs are also usually tied to other regulatory processes such as permits and license renewals which could be used to follow-up and enforce adaptation.¹¹¹

¹⁰⁷ RSA 2000, c M-17.

¹⁰⁸ David Suzuki Foundation, *Climate Change and Canadian Mining: Opportunities for Adaptation*, by Tristan Pearce et al., 2009, at 114 online: <https://davidssuzuki.org/science-learning-centre-article/climate-change-canadian-mining-opportunities-adaptation/>.

¹⁰⁹ C. Rodgers et al., *Assessing the Treatment of Climate Change Impacts and Adaptation in Project-Level EAs in the Canadian Mining Sector*, Climate Change Impacts and Adaptation Division, Natural Resources Canada, 2014, at 13-14.

¹¹⁰ SC 2012, c 19, s. 52 [*CEAA, 2012*].

¹¹¹ Rodgers et al., at 13-14.

Note, however, that the requirements for an EA vary by legislation and not all mining activities or mines will attract an EA. Efforts to expand EAs for all mines and mining activities would be necessary to ensure even application.

Another approach could be updating and strengthening the applicable building codes and design standards to better withstand future weather impacts. This approach is discussed in greater detail under the “Building” section below.

Additional legislation that touches on mining includes the *Wildlife Act*¹¹² and the SARA.

c. Energy

Alberta is the largest producer of primary energy in Canada¹¹³ and the energy sector makes up approximately 23% of the provincial GDP.¹¹⁴ Alberta’s energy supply includes both renewable and non-renewable sources.



¹¹² RSA 2000, c W-10.

¹¹³ Lemmen, 2014: Natural Resources at 82.

¹¹⁴ Note this number includes mining and quarrying. Altogether, when upstream linkages are included, the Government of Alberta estimates the energy sector accounted for 42% of Alberta’s GDP in 2016: Government of Alberta, Economic Commentary, April 4, 2016, online: https://www.albertacanada.com/files/albertacanada/SP-Commentary_04-04-16.pdf.

Risks & Opportunities

Climate change is expected to impact energy demand, supply, and transmission.

Energy Demand

In terms of demand, climate change is likely to result in reduced energy demand for winter heating and increased demand for summer cooling. Reduced demand for heating will primarily impact fuels such as natural gas and heating oil, while increased cooling will affect electricity consumption.¹¹⁵

Energy Supply

Climate change is also expected to affect Alberta's energy supply, though the sources of energy will be affected differently. Generally speaking, renewable energy sources are more sensitive to climate variability than non-renewable sources.¹¹⁶

With respect to renewables, hydroelectricity is likely to be the most vulnerable. Climate change is expected to bring greater hydrologic variability which could increase the risk of overflows (i.e. non-productive discharge), especially during winter and spring melts. Changes will also likely increase evaporation and evapotranspiration which could lead to lower water levels and decreased power generation.¹¹⁷ In addition, it is expected that changes in distribution of flow throughout the year will present challenges to dam and reservoir management.¹¹⁸

Other renewable sources may face risks as well. Wind power can be impacted by extreme wind speeds that can damage equipment or require it to be shut down, resulting in reduced generating capacity. Increases in average air temperatures cause decreased air density and can also affect wind power. Meanwhile, solar power can be impacted by changes in cloud cover as well as extreme weather events.¹¹⁹

¹¹⁵ Lemmen, 2014: Natural Resources at 82.

¹¹⁶ Lemmen, 2014: Natural Resources at 84.

¹¹⁷ Lemmen, 2014: Natural Resources at 85.

¹¹⁸ Lemmen, 2014: Natural Resources at 87.

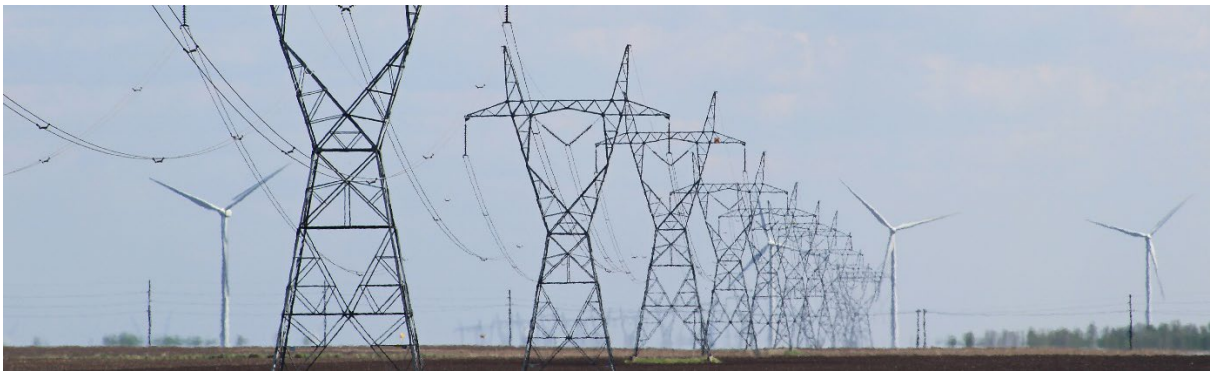
¹¹⁹ Lemmen, 2014: Natural Resources at 87.

With respect to non-renewables, research suggests that climate change impacts on water resources are likely to have significant implications for the oil and gas sector. Many oil producing activities, especially in the oil sands, are water intensive and depend on surface and groundwater sources in the already water-strapped Prairies. There is significant concern that traditional sources, such as the Athabasca River, will not be able to keep up with expanded oil sands development while also maintaining sufficient downstream flows necessary to avoid ecosystem impacts.¹²⁰

Energy Transmission

Finally, climate change poses additional risks to our energy transmission infrastructure. Increased extreme weather events and temperatures can interrupt power supply through damage to power lines, roads, pipelines, and railroads.¹²¹

In terms of opportunities, climate change is not likely to provide any direct advantage to existing modes of energy production. As mentioned above, climate change is likely to increase demand for energy which could benefit some energy suppliers. However, given that climate change is also likely to hinder the ability to produce said energy, the effect will not be net positive. There may be indirect opportunities that arise out of climate change such as increased interest in and/or research on renewables or energy efficient modes of production.



¹²⁰ Lemmen, 2014: Natural Resources at 90.

¹²¹ Lemmen, 2014: Natural Resources at 92.

Adaptation

A variety of adaptation measures are necessary to address the anticipated changes to energy demand, supply and transmission.

Energy Demand

On the demand side, adaptation measures should be aimed at reducing energy consumption and promoting energy efficiency in buildings, appliances, and equipment. While such measures are useful for the purposes of climate change mitigation (as previously discussed in Part One – Introduction to Mitigation in Alberta), they also assist with adapting to future energy disruptions and/or scarcity.

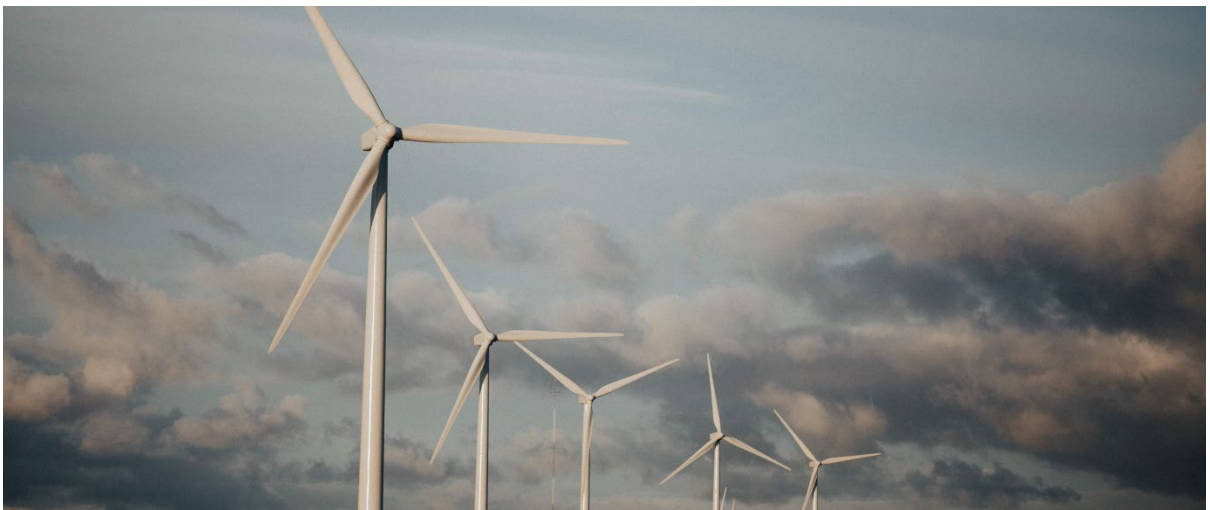
Generally speaking, building energy efficiency is regulated by the Alberta Building Code (ABC) 2014 (discussed in greater detail in the “Buildings” section below), which has adopted by regulation the energy efficiency requirements for house and small buildings set out by the National Energy Code for Buildings (NECB) 2011. Energy efficiency requirements affect the building envelope, lighting, HVAC and service water heating components of a building. The NECB was most recently updated on December 18, 2015 (with additional changes introduced in 2017). The next update to the ABC (date currently unknown) is expected to adopt the NECB 2015.¹²² These are, however, minimum standards and adaptation measures should aim to increase the net efficiency standards for both new and existing buildings.

Meanwhile, appliances or energy using products are regulated at the federal level by the *Energy Efficiency Regulations, 2016*.¹²³ As discussed in Part One – Introduction to Mitigation in Alberta, the *Energy Efficiency Regulations, 2016* control the import and interprovincial trade of energy using products as well as prescribe minimum energy performance standards (MEPS). The regulations were recently updated in 2016 to include more stringent MEPS as well as improve harmonization with United States standards. Several provinces, excluding Alberta, have enacted provincial energy efficiency regulations to extend the scope of (or improve upon) these standards to products manufactured and sold within their provinces. Another adaptation measure could include introducing energy efficiency regulations in Alberta.

¹²² Government of Alberta, Municipal Affairs, Notice: Code Updates, March 8, 2018, online: <http://www.municipalaffairs.gov.ab.ca/documents/BldgFireElevCodeUpdate.pdf>.

¹²³ SOR/2016-311.

Alberta has recently created a new provincial agency, Energy Efficiency Alberta, aimed at providing programs and services that improve energy efficiency. Energy Efficiency Alberta currently provides rebates for replacing select appliances with energy efficient models and installing solar. They are also set to administer any Property Assessment Clean Energy (PACE) programs established by Alberta municipalities under the *Clean Energy Improvements Regulation*¹²⁴ (in force as of January 1, 2019). PACE programs permit homeowners to make energy efficiency or renewable energy upgrades to private property with no money down. The municipality pays for the upgrade and then recovers the costs from the owner through property taxes. Going forward, energy efficiency regulations could be the natural next step.



Energy Supply

With respect to supply, energy production in Alberta is regulated by a plethora of legislation, including the following acts:

- ***Responsible Energy Development Act***, SA 2012, c R-17.3 – establishes the Alberta Energy Regulator (AER) which has a mandate to provide for the efficient, safe, orderly, and environmentally responsible development of oil, oil sands, natural gas, and coal resources. This includes allocating and conserving water resources, managing public lands, and protecting the environment.

¹²⁴ Alta Reg. 212/2018.

- ***Mines and Minerals Act*** – governs the management and disposition of rights for Crown owned mines and minerals. Part 8 of the Act is specific to energy resource development administered by the AER.
- ***Oil and Gas Conservation Act***, RSA 2000, c O-6 – establishes a regulatory regime administered by the AER for the development of oil and gas resources and related facilities.
- ***Oil Sands Conservation Act***, RSA 2000, c O-7 – establishes a regulatory regime administered by the AER for the development of oil sands resources and related facilities.
- ***Pipeline Act***, RSA 2000, c P-15 – establishes a regulatory regime administered by the AER for the construction and operation of certain pipelines in Alberta.
- ***Electric Utilities Act***, SA 2003, c E-5.1 – establishes a regulatory regime for Alberta’s electric industry, including the Alberta Electric System Operator (AESO), which manages and operates the provincial power grid.
- ***Gas Utilities Act***, RSA 2000, c G-5 - establishes a regulatory regime for gas utilities, and the provision of gas services to consumers.
- ***Renewable Electricity Act***, SA 2016, c R-16.5 – establishes a regulatory regime for the development of renewable (i.e. solar, wind, geothermal, bioenergy and hydro) energy.
- ***Public Lands Act*** - governs the overall use, disposition, and administration of Crown lands.
- ***Water Act*** – governs water rights in Alberta, including the diversion, allocation, and use of water for energy resource activities.

Additional legislation that impacts energy production includes Alberta’s *Wildlife Act*, *EPEA*, as well as federal legislation such as the *CEAA, 2012* and *SARA*.

Adaptation measures for the production of renewables such as hydroelectric include revising and re-optimizing design criteria for new and existing hydro power plants as well as protecting or restoring natural flow regulators such as wetlands to provide buffering capacity during times of low and peak flows.¹²⁵ Both of these measures could be achieved through additional

¹²⁵ Lemmen, 2014: Natural Resources at 87.

government regulation to legislation such as the *Renewable Electricity Act*, *Water Act* and *Public Lands Act*.

Adaptation measures for oil and gas production should include technological innovation aimed at improving water-use efficiency or reducing water use, as well as increased regulatory oversight to limit, monitor and adjust freshwater withdrawal from selected bodies of water.

Currently, the upstream oil and gas and oil sands sectors (among others) are part of a voluntary effort initiated by the Alberta Water Council to produce sector specific Conservation, Efficiency and Productivity (CEP) plans. CEP plans aim to identify best practices for water management as well as opportunities for water use efficiencies. The upstream oil and gas/oil sands sector produced a CEP plan in 2011.¹²⁶ In a 2015 progress report they claimed they had achieved a 40% improvement from baseline (2002-2004).¹²⁷

Generally speaking, it does appear that the energy industry's water use has been improving in efficiency. In 2016, energy development accounted for approximately 10 percent (or 1 billion cubic metres) of all water allocated in Alberta.¹²⁸ Of this, the energy industry used only 22 percent (or 224 million cubic metres).¹²⁹ Monitoring suggests that from 2012 to 2016, the energy industry's water use remained relatively unchanged while aggregate hydrocarbon production increased.¹³⁰

Nevertheless, the energy industry still uses a significant amount of water and further improvements must be made to adapt to future scarcity. Alberta's *Water Act* regulates water allocation and licenses for, among others, the energy industry. Changes to the *Water Act* could prioritize water conservation objectives over industry allocations and/or provide incentives for water conservation and efficiency of water use initiatives.

¹²⁶ Canadian Association of Petroleum Producers & The Oil Sands Developers Group, "Water Conservation, Efficiency and Productivity Plan – Upstream Oil and Gas Sector", March 2011 online: <https://awchome.ca/LinkClick.aspx?fileticket=Yd8tQfj6KM8%3d&tabid=209>.

¹²⁷ Canadian Association of Petroleum Producers, "Update on Upstream Oil & Gas CEP Plan Implementation", October 28, 2015 online: <https://awchome.ca/LinkClick.aspx?fileticket=1z2VcOv3nss%3d&tabid=209>.

¹²⁸ Alberta Energy Regulator, Water Allocation Summary in Alberta Energy Industry Water Use Report, 2016 online: https://www2.aer.ca/t/Production/views/AlbertaWaterUseReport/Disclaimer?%3Aembed=top&%3AshowShareOptions=true&%3Adisplay_count=no [Alberta Water Use Report, 2016].

¹²⁹ Alberta Water Use Report, 2016.

¹³⁰ Nonsaline Water Use Summary in Alberta Water Use Report, 2016.

Within the energy industry, oil sands mining is by far the biggest consumer of nonsaline water (as compared to enhanced oil recovery, in situ, and hydraulic fracking). The main source of nonsaline water used by oil sands mines comes from the Athabasca River. The Alberta government has put the *Lower Athabasca Region Surface Water Quantity Management Framework for the Lower Athabasca River*¹³¹ (the Framework) in place to manage the cumulative water withdrawals from the Athabasca River. The Framework establishes weekly management triggers and water withdrawal limits to enable proactive management of oil sands water use from the river.¹³² Similar framework and/or water management plans should be put into place for other major river basins in Alberta.

Energy Transmission

Energy transmission in Alberta is also regulated by various pieces of legislation. With respect to electricity, the *Electric Utilities Act* and its associated *Transmission Regulation*¹³³ are the key legislative and regulatory framework for transmission planning and grid operations. Meanwhile, the transmission of natural gas, crude oil, coal in a gaseous state etc. is generally regulated by the *Pipeline Act* and associated *Pipeline Regulation*.¹³⁴ Both are (mostly) overseen by the Alberta Utilities Commission (AUC).¹³⁵

Adaptive measures will involve upgrading, reinforcing, and potentially rerouting the infrastructure that supports energy transmission in Alberta. This may require changes to the *Transmission Regulation* and/or *Pipeline Regulation*, among others. Measures that address other infrastructure such as buildings, roads, and rail are discussed in greater detail in the Infrastructure section below.

¹³¹ Government of Alberta, Lower Athabasca Region Surface Water Quantity Management Framework for the Lower Athabasca River, 2015, online: <http://aep.alberta.ca/water/programs-and-services/river-management-frameworks/athabasca-river-water-management-framework.aspx>.

¹³² Government of Alberta, Athabasca River Management Framework, online: <http://aep.alberta.ca/water/programs-and-services/river-management-frameworks/athabasca-river-water-management-framework.aspx>.

¹³³ Alta Reg 86/2007.

¹³⁴ Alta Reg 31/2005.

¹³⁵ The AUC does not regulate rural electrification associations, municipally owned utilities (with the exception of EPCOR and ENMAX) or natural gas co-ops. For more information see the AUC website: <http://www.auc.ab.ca/pages/who-we-regulate.aspx>.



Photo courtesy CP Rail

2) Industry

a. Tourism

Tourism and other consumer services account for approximately 5% of Alberta's GDP¹³⁶ and tourism generates more than \$8 billion per year in the province.¹³⁷ The Alberta tourism brand relies heavily on Alberta's natural beauty and the outdoor experiences it can offer. Climate change is predicted to impact our natural environment tremendously and it stands to reason that nature based tourism will suffer as a result.

Risks & Opportunities

The increased frequency and magnitude of extreme weather events such as storms, floods, high winds, and forest fires due to climate change will pose challenges to tourism infrastructure as well as visitor safety and emergency preparedness, resulting in higher operating expenses (e.g.

¹³⁶ Government of Alberta, Highlights of the Alberta Economy 2018, April 2018 accessed online on November 29, 2018: http://www.albertacanada.com/files/albertacanada/SP-EH_highlightsABEconomyPresentation_.pdf [Highlights of the Alberta Economy 2018].

¹³⁷ Travel Alberta, Visitor Economy, online: <https://industry.travelalberta.com/visitor-market-insight/visitor-insights/visitor-economy>.

insurance, back-up water and power systems, evacuations, etc.) and increased business interruptions.¹³⁸

Risks to cold-weather tourism such as skiing and snowmobiling industries include less snow and shortened winter seasons. While snow-making may be able to counter decreased snow for downhill skiing, it is impractical for cross-country skiing and snowmobiling due to the vast expanse of trails. Changes are likely to increase operating costs for ski operators and could cause a contraction in the number of ski areas. The melting and subsequent loss of viewable glaciers is also likely to impact tourism in Banff and Jasper National Parks.¹³⁹

Risks to warm-weather tourism include decreased water quality and increased drought. As lake temperatures warm, their oxygen carrying capacity is diminished, which allows algae growth and water pollution to increase. Decreased water quality could have repercussions for boating, fishing and swimming. Meanwhile, increased drought could exacerbate irrigation issues for the golf industry in drier areas.¹⁴⁰ Forest fires will threaten air quality and visitor safety as well as destroy forests and animal habitat.

Other nature-based tourism may also be impacted. Pests such as mountain pine beetle can reduce forests and impact landscape aesthetic. Changes in biodiversity and wildlife will likely impact sport fishing, hunting and bird watching.¹⁴¹ Increased incidence of vector-borne diseases (e.g. Lyme disease) can also discourage tourism.

Nevertheless, climate change is also expected to bring some benefits for warm weather tourism, including a longer season and increased demand for golf, theme/water parks, zoos, boating, fishing, camping, hiking and other warm weather recreation. There may also be opportunities for increased eco-tourism and “last chance” viewing of at-risk natural attractions, such as glaciers or caribou.¹⁴²

¹³⁸ P. Kovacs & J. Thistlethwaite, 2014: Industry in Canada in a Changing Climate: Perspectives on Impacts and Adaptation, F.J. Warren & D.S. Lemmen (eds), Government of Canada, Ottawa, ON 135-158 at 146 online: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter5-Industry_Eng.pdf. [Kovacs, 2014: Industry]; World Tourism Organization (UNWTO), 2009: From Davos to Copenhagen and Beyond: Advancing Tourism’s Response to Climate Change, UNWTO Background Paper at 5 online: <http://sdt.unwto.org/sites/all/files/docpdf/fromdavostocopenhagenbeyonduwtopaperelectronicversion.pdf>.

¹³⁹ Kovacs, 2014: Industry at 147-148.

¹⁴⁰ Kovacs, 2014: Industry at 147.

¹⁴¹ Kovacs, 2014: Industry at 148.

¹⁴² Kovacs, 2014: Industry at 147-148.



Adaptation

Long term planning and adaptation in the tourism industry is often discouraged because most tourism operators are small or medium sized businesses and lack the resources to commit to in-depth research and planning. Accordingly, there may be a role for government in creating policy to support and promote adaptation as well as addressing the lack of data on the costs and benefits of adaptation in the tourism sector.

Tourism is also impacted by parks legislation such as the *Provincial Parks Act*¹⁴³ and *Canada National Parks Act*¹⁴⁴ and land or water use legislation such as the *Public Lands Act* and *Water Act*. Other adaptation measures could include using existing park and land-use planning legislation to set limits on the number of visitors or types of activities permitted at ecologically sensitive tourist destinations and/or to create additional parks and protected areas within the province. These measures are aimed at protecting the health and longevity of Alberta's natural attractions and by extension, the tourism industry they support.

¹⁴³ RSA 2000, c P-35.

¹⁴⁴ SC 2000, c. 32.

b. Agriculture

Alberta has a total farm area of 20.3 million hectares and its farm cash receipts in 2016 amounted to \$13.5 billion.¹⁴⁵ Alberta is the largest beef producer and second largest crop producer in the country.¹⁴⁶

Risks & Opportunities

Water issues present the greatest climate change risk to agriculture in the Prairies. The agricultural sector is extremely water-dependent: it consumes the most water overall and accounts for more than 40% of total water allocations in the province.¹⁴⁷ Alberta also has the most irrigated land in the country (489, 937 hectares) which, in 2016, represented just over 70% of the total area of irrigated land in Canada.¹⁴⁸ Accordingly, predicted water issues such as increased drought frequency and water shortages due to competing demands may limit the ability to expand irrigated agriculture and livestock, while increased spring floods may increase soil nutrient losses and algae blooms in catchment basins.¹⁴⁹

Warmer weather will also challenge the agricultural sector. Less snow cover during the winter can lead to less cover protection against soil erosion by winter winds. Warmer climates also lead to increased pests and diseases, including invasive alien species.¹⁵⁰

Nevertheless, climate change may also present some opportunities. It will likely bring a warmer and longer growing season to Alberta, which may permit an increase in land suitability for spring seeded small grain (SSSG) crops in the Prairies, as well as a Northward creep for certain crops (e.g. soybean, corn).¹⁵¹

¹⁴⁵ Highlights of the Alberta Economy 2018.

¹⁴⁶ Highlights of the Alberta Economy 2018.

¹⁴⁷ Data current to 2009. Government of Alberta, Facts About Water in Alberta, (Edmonton, AB December 2010) at 36, 40.

¹⁴⁸ Statistics Canada, Agricultural Water Survey, 2016, September 8, 2017, accessed online at <https://www150.statcan.gc.ca/n1/daily-quotidien/170908/dq170908c-eng.htm>.

¹⁴⁹ I.D. Campbell et al., 2014: Food Production in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, edited by F.J. Warren & D.S. Lemmen, Government of Canada, Ottawa, ON, 99-134 at 107 online: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter4-Food-Production_Eng.pdf [Campbell, 2014: Food Production].

¹⁵⁰ Campbell, 2014: Food Production at 107.

¹⁵¹ Campbell, 2014: Food Production at 109-110.

Livestock producers could also benefit. Warmer climates could increase grassland productivity, which, in turn, could increase pasture carrying capacity and reduce cost per animal. Higher annual temperatures could also allow producers to plant previously unsuitable perennial pastures and winter annual crops, which could supplement winter pastures.¹⁵²



Adaptation

Historically, agricultural practices have been adapted to cope with climatic variability. This tradition continues and present-day adaptation measures will likely include technological development and improvements to farm production practices.

Nevertheless, institutional responses such as government programs and insurance can also play a role in assisting the agricultural sector with adaptation. Agriculture in Alberta is subject to extensive regulation, including the following acts:

- ***Agricultural Operation Practices Act***, RSA 2000, c A-7 – regulates nuisance claims arising out of agricultural activities (e.g. odour, dust, noise, smoke) and establishes a permitting process for the construction or expansion of confined feeding operations as well as related offences and penalties.
- ***Agricultural Pests Act***, RSA 2000, c A-8 – permits the declaration that an animal, bird, insect, etc. is a pest or nuisance to land, livestock or property in Alberta and imposes duties on owners and occupants of land to control and destroy said pests.

¹⁵² Campbell, 2014: Food Production at 113.

- ***Animal Health Act***, SA 2007, c A-40.2 – enables the province to respond to and control the spread of animal diseases affecting animal health, public health and food safety.
- ***Animal Protection Act***, RSA 2000, c A-41 – prohibits animal abuse or neglect and enables Peace Officers to respond to animals in distress or animals that have been abandoned.
- ***Livestock and Livestock Products Act***, RSA 2000, c L-18 - regulates the poultry, egg, and honey industries in Alberta.
- ***Agricultural Financial Services Act***, RSA 2000, c A-12 - establishes the Agriculture Financial Services Corporation (AFSC) which provides lending, financial assistance, and insurance to agricultural producers, as well as compensation for losses and damage relating to agricultural products.
- ***Water Act*** – governs water rights in Alberta, including the diversion, allocation, and use of water for agricultural activities, including irrigation.

Adaptation measures could include expanded subsidy and support programs, including insurance, to provide additional compensation for disaster-related income loss. In Alberta, entities such as the AFSC can make adjustments to their business risk management programs and/or insurance coverages to respond to producers' needs. Such programs can also influence farm level productions and management strategies by transferring risk in agriculture.¹⁵³

In addition to government, private insurance and industry groups may also play a role with subsidy and support programs. For instance, in response to bluetongue, a viral disease that can be fatal to sheep, the Canadian Sheep Federation helped to create a commercial bluetongue insurance program to provide coverage for Canadian sheep producers. In addition, the Canadian Food Inspection Agency (CFIA) has pre-emptively established five ecologically based regions in Canada for bluetongue control. The hope is that should bluetongue occur in one of those regions, then trade in animals and/or products from the other four regions will not be affected.¹⁵⁴

¹⁵³ B. Smit & M. W. Skinner, "Adaptation Options in Agriculture to Climate Change: A Typology", in *Mitigation and Adaptation Strategies for Global Change* 7:85-114, 2002 at 99 [Smit].

¹⁵⁴ Campbell, 2014: Food Production at 112.

Other adaptation measures could include resource management programs that involve the development of government policies and programs to encourage or discourage changes in land use, water use and management practices.¹⁵⁵ These could include changes to land-use policies under legislation such as *ALSA*, water use permits and wetland restoration policies under the *Water Act* and “best management” practices set out in other agricultural legislation or policy.¹⁵⁶

c. Fisheries

Alberta does not currently have a commercial fishing industry. Fishing in the province is largely made up of recreational and subsistence fishing. Subsistence fisheries are most often accessed by Indigenous people and represent an economic system based on cultural and social networks that support the distribution of goods and food for consumption by the harvesters, their families and the community. Subsistence fisheries also contribute to food security.¹⁵⁷



¹⁵⁵ Smit at 100.

¹⁵⁶ Smit at 100.

¹⁵⁷ Campbell, 2014: Food Production at 119.

Risks & Opportunities

Fisheries may be impacted by both water quantity and water quality issues resulting from climate change. High variability in instream flows, sedimentation during storm events, and other water quality related impacts may have localized impacts on fisheries.

Generally speaking, warming temperatures are likely to impact aquatic species at the edge of their distributional range, possibly causing extirpation or expansion. Note climate change is especially disadvantageous to cold weather species (e.g. Lake Whitefish, Mountain Whitefish).¹⁵⁸ Traditional subsistence fisheries harvested at fixed locations or times are highly vulnerable and have relatively little adaptive scope.¹⁵⁹ Issues with existing fish populations could exacerbate food insecurity for traditional subsistence fisheries, especially where there are already other limiting factors in place such as licensing and fishing allocation policies.

On the other hand, there may be a rise in the population of some fish, such as warm water species at the northern end of their range and invasive species, which could allow for increased fishing of those species.¹⁶⁰

Adaptation

Regulation of fisheries and fishing in Alberta is primarily governed by the federal *Fisheries Act*,¹⁶¹ the *Fisheries (Alberta) Act*,¹⁶² *Hunting, Fishing and Trapping Heritage Act*,¹⁶³ and the *Water Act*. Fishing in Alberta is prohibited without a license. Licenses are regulated by the *General Fisheries (Alberta) Regulation*¹⁶⁴ (enabled by the *Fisheries (Alberta) Act*), which creates license categories including sportfishing, commercial fishing, and domestic fishing. Domestic fishing licenses are free of charge and provide for subsistence needs on eligible waters. They are available to First Nations' people defined as "Indians" under the *Indian Act* as well as recognized Métis harvesters and other persons who can demonstrate need.

¹⁵⁸ Campbell, 2014: Food Production at 120-121.

¹⁵⁹ Campbell, 2014: Food Production at 126.

¹⁶⁰ Campbell, 2014: Food Production at 121.

¹⁶¹ RSC 1985, c F-14.

¹⁶² RSA 2000, c F-16.

¹⁶³ SA 2008, c H-15.5.

¹⁶⁴ Alta Reg. 203/1997.

The Government of Alberta already has various conservation-based regulations in place including season closures, area closures, minimum size limits for angling, and minimum mesh sizes for gill nets.¹⁶⁵ Adaptation measures aimed at sustaining the subsistence food fisheries could include varying the above-noted conservation regulations as well as the license time, place and harvest quantity of certain species. Governments may also have to modify new or existing treaty provisions to accommodate climate change impacts going forward.¹⁶⁶ Fisheries are also dependent on healthy habitats, and so adaptation measures to ensure the health of our lakes and rivers (discussed in greater detail in the “Water” section below) are important as well. These adaptation measures should be reflected through reforms in the provincial *Water Act* and the federal *Fisheries Act*.

d. Manufacturing

Alberta’s manufacturing industry accounts for just over 6% of Alberta’s provincial GDP.¹⁶⁷ Its six largest sectors (in no particular order) are machinery, fabricated metals, chemicals, refineries, food processing and wood products.¹⁶⁸

Risks and Opportunities

Climate change poses numerous physical risks to manufacturing. Extreme weather or changes in the environment can limit the availability of key manufacturing inputs and increase costs for manufacturers. For example, if forest fires destroyed significant forest lands, the manufacturing costs for producing construction wood products, pulp and paper products, etc. would increase. Extreme weather could also disrupt operations by damaging infrastructure and interrupting supply chains.¹⁶⁹

¹⁶⁵ Government of Alberta, Fish and Wildlife Policy, “Sustaining the Subsistence Food Fishery and Conserving Fish Stocks for Future Generations: A Summary of Domestic Fishing Regulations in Alberta”, May 2018, online at <https://open.alberta.ca/dataset/6c0a85ce-5b49-422c-ac49-572c9a2e0d7c/resource/1940e5fd-16be-455d-a19c-5749885e12cb/download/sustainingsubsistencefoodfishery-may2018.pdf> on September 20, 2018.

¹⁶⁶ Campbell, 2014: Food Production at 127.

¹⁶⁷ Highlights of the Alberta Economy, 2018.

¹⁶⁸ Government of Alberta, “Economic Commentary: Alberta’s Manufacturing Industry is Recovering in 2017”, October 10, 2017 at 3 online: https://investalberta.ca/media/143429/commentary_10-10-17.pdf.

¹⁶⁹ Kovacs, 2014: Industry at 152.

Other issues such as drought and water shortages may pose a risk for industrial processes that use water for cooling, irrigation, cleaning and/or refining new material. Finally, higher temperatures could create unworkable conditions for employees.¹⁷⁰

In terms of opportunities, climate change and an accompanying increase in consumer environmental awareness could cause changes to consumer demand and preferences and give rise to new products. For example, there are growing movements towards becoming “plastic free” or “zero-waste” in various municipalities which could translate into demand for new products that meet these needs. Note, however, that an increase in demand for more energy efficient products would likely correspond with a decrease in demand for GHG intensive manufacturing.¹⁷¹

Adaptation

Manufacturing (excluding the labour aspect) is primarily governed by the *Water Act*, *EPEA*, and the *Safety Codes Act*¹⁷² and its associated regulations.

Adaptation measures could include amending regulations and/or policies to encourage manufacturers to reduce their exposure to climate change impacts. This could include reducing water allocation for manufacturing processes in areas where water scarcity is expected, or increasing the energy efficiency standards for products manufactured and sold in the province.¹⁷³ Manufacturers themselves may also wish to purchase or increase their business interruption insurance to minimize losses in the event extreme weather disrupts operations.¹⁷⁴

e. Trade

Exports and trade make up a significant portion of Alberta’s economy. In particular, Alberta’s energy exports (i.e. crude oil and natural gas) usually account for more than one-half of its total

¹⁷⁰ Kovacs, 2014: Industry at 152.

¹⁷¹ Kovacs, 2014: Industry at 152-153.

¹⁷² RSA 2000, c S-1.

¹⁷³ Kovacs, 2014: Industry at 153.

¹⁷⁴ Kovacs, 2014: Industry at 153.

international exports¹⁷⁵ and is the largest interprovincial export as well.¹⁷⁶ Other top export industries include oilseed and grain farming, chemicals and plastics, and manufacturing.¹⁷⁷

Risks and Opportunities

Climate changes threatens trade through potential supply chain disruptions and the loss of comparative trade advantages (i.e. the ability to produce goods/services at a lower opportunity cost than other countries). For instance, water shortages and drought in Alberta could cause it to lose its international comparative trade advantage when it comes to energy exports and its interprovincial comparative trade advantage for frozen beef and veal products, as both industries are heavily water reliant.

Conversely, climate change may also cause Alberta to gain comparative trade advantage from other countries and/or provinces. For example, if drought or pests limit agriculture production elsewhere, then Alberta may gain a comparative trade advantage when it comes to the agricultural production of certain crops. This is especially so if climate change creates a longer growing season.¹⁷⁸

Adaptation

Generally speaking, international trade falls under the jurisdiction of the federal government and internal (domestic) trade is controlled by the provincial government. Alberta is a party to both the Canadian Free Trade Agreement (CFTA) and the New West Partnership Trade Agreement (NWPTA), both of which govern domestic trade, investment, and labour mobility. The Government of Alberta also operates trade offices in a number of international countries to advance trade, investment, and other interests in those areas.

¹⁷⁵ Government of Alberta, “Alberta’s International Merchandise Exports: A 10 Year Review”, April 2011, at 3 online: http://www.albertacanada.com/files/albertacanada/SP-EH_AIME-10-year-review.pdf.

¹⁷⁶ Government of Alberta, “InFocus: Alberta’s Interprovincial Trade Flows”, Economic Trends Newsletter, October 2, 2017 at 3, archived online: <https://www.alberta.ca/economic-trends.aspx>.

¹⁷⁷ Statistics are based on 2014 data. Government of Alberta, International Trade, online: <http://www.albertacanada.com/business/export/international-trade.aspx>.

¹⁷⁸ Kovacs, 2014: Industry at 154.

Adaptation measures for Alberta’s exports and trade should include drawing up policies that target and promote growth in sectors that may be able to address impending scarcity in other provinces and countries, including new partners. Alberta Economic Development and Trade should also look at adopting measures to reduce the vulnerability of the supply chain (discussed more fulsomely in the “Infrastructure” section below).¹⁷⁹

f. Insurance

Insurance provides financial security against losses due to inclement weather (among other things). This makes the insurance industry, in particular property insurance, especially vulnerable to the effects of climate change. In Canada, loss and damage due to extreme weather has recently come to represent the largest cost to the property insurance industry (previously it was fire and theft).¹⁸⁰ The two costliest natural disasters in Canadian history both took place in Alberta: the 2016 Fort McMurray wildfires (valued at \$3.58B insured losses) and the 2013 Southern Alberta flood (valued at \$1.7B insured losses).¹⁸¹ As the frequency of extreme events such as this increase, the insurance industry can expect still greater challenges ahead.



¹⁷⁹ Kovacs, 2014: Industry at 154.

¹⁸⁰ Kovacs, 2014: Industry at 142.

¹⁸¹ Insurance Bureau of Canada, “Northern Alberta Wildfire Costliest Insured Natural Disaster in Canadian History – Estimate of insured losses: \$3.58 billion”, July 7, 2016, online: <http://www.ibc.ca/bc/resources/media-centre/media-releases/northern-alberta-wildfire-costliest-insured-natural-disaster-in-canadian-history>.

Risks and Opportunities

As set out above, the risks to the insurance industry from climate change are mostly weather-related. An increase in the intensity of precipitation events is likely to overwhelm Canada's aging sewer systems and cause significant water damage to homes and businesses.¹⁸² Increased frequency and severity of storms such as tornadoes, hail storms and lightning events as well as wildfires may also increase property damages and losses.

In addition to property damage, extreme weather events could also increase auto insurance claims for damage and commercial claims for business interruption.¹⁸³ Furthermore, the rise of climate change litigation is likely to cause an increase in defense and/or indemnity payments made under liability insurance policies issued to executives or corporations in GHG producing industries.¹⁸⁴

Going forward, the insurance industry can expect to pay out higher amounts with greater frequency than ever before. Insurance companies will be challenged to offer affordable coverage, while at the same time obtaining enough risk-based capital to remain solvent.¹⁸⁵

Nevertheless, the insurance industry will also likely benefit from new market opportunities arising out of climate change. Insurers are developing new products, such as enhanced flood insurance, green buildings insurance, and energy savings insurance, where policies protect the owner or installer of an energy efficient project from under-achievement of its predicted savings.¹⁸⁶ New business operations for clean and renewable energy technologies also represent an enormous new capital base that will require insurance. Furthermore, improved loss modeling using future climates may also help to achieve better economic assessments and improved policy wordings.¹⁸⁷

¹⁸² Kovacs, 2014: Industry at 142-143.

¹⁸³ Kovacs, 2014: Industry at 142-143.

¹⁸⁴ Kovacs, 2014: Industry at 143.

¹⁸⁵ D. Arent et al., 2014: Key Economic Sectors and Services in Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Globe and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by C.B. Field et al., Cambridge University Press, Cambridge, UK and NY, USA, 659-708 at 680 [IPCC, 2014: Key Economic Sectors and Services].

¹⁸⁶ E. Mills, "The Greening of Insurance" (December 14, 2012) Vol. 338 Science 1424 [Mills, Science]; E. Mills, "From Risk to Opportunity: 2007 Insurer Responses to Climate Changes", Ceres Report, November 2007, at 15 [Mills, Ceres Report].

¹⁸⁷ Mills, Science at 1424-1425.

Adaptation

Historically, insurers have not hesitated to take a leadership role in minimizing risks for consumers, governments and themselves (e.g. founding fire brigades and advocating for enhanced building codes).¹⁸⁸ Climate change is no exception. The insurance industry maintains meticulous statistics on natural disasters, among other things, to calculate risk and for decades their data has shown an increase in extreme weather events. Today’s insurers are generally understood to be leaders in climate change adaptation and mitigation, and sponsor and support research and adaption through organizations such as the Munich Climate Insurance Initiative and the Intact Centre on Climate Adaptation.

The insurance industry also has an array of adaptive tools at their disposal. Insurers can make adjustments to their contracts, such as altering coverage to limit their risk in certain situations (e.g. refusing to insure properties that are built in a flood prone area) or providing incentives for those that take steps to prevent property losses (e.g. installing backwater valves or storm shutters).¹⁸⁹ They can also protect themselves by pricing climate risks into their contracts and purchasing reinsurance for catastrophic losses.¹⁹⁰ Additionally, insurers can introduce insurance designed to instill behaviours that reduce GHGs. These include pay-as-you-drive insurance policies that directly link the amount you pay to the amount driven, reduced rates for hybrid/electric vehicles and energy efficient buildings, and insurance that promotes “rebuilding right” after a loss (i.e. rebuilding to meet green construction standards).¹⁹¹

Regulatory support and intervention would also assist with adaptation. Insurance in Alberta is primarily governed by the *Insurance Act*.¹⁹² The Act governs the licensing, governance and reporting obligations of insurance companies in the province as well as the insurance contracts themselves, including policy requirements and statutory conditions. Given that some insurers may choose to focus solely on financial risk management rather than climate change solutions, regulators such as the Office of the Superintendent of Financial Institutions (OSFI) and the Alberta Superintendent of Insurance (ASI) should work with the industry to implement, through

¹⁸⁸ Mills, Ceres Report at 5, 9.

¹⁸⁹ Kovacs, 2014: Industry at 144.

¹⁹⁰ Kovacs, 2014: Industry at 144.

¹⁹¹ Mills, Ceres Report at 11-12, 16.

¹⁹² RSA 2000, c I-3.

regulation or otherwise, the aforementioned changes to insurance contracts.¹⁹³ Regulators should also help to ensure insurer solvency in the face of catastrophic or extreme weather events.¹⁹⁴

3) Infrastructure

a. Water

As a country, Canada is rich in freshwater resources - it has the third largest renewable freshwater supply worldwide.¹⁹⁵ Yet within Canada, Alberta is considered a relatively dry province. It has a low average annual yield and holds only 2.2% of Canada's freshwater.¹⁹⁶ It is also unbalanced. More than 80% of Alberta's water supply is found in the northern part of the province, but 80% of the demand is in the south.¹⁹⁷

Alberta's water infrastructure is used to store, manage and deliver water. It includes dams and reservoirs, water and wastewater treatment plants, irrigation canals, sewage systems for draining stormwater and flood mitigation structures.

¹⁹³ Mills, Ceres Report at 31.

¹⁹⁴ National Association of Insurance Commissioners, The Potential Impact of Climate Change on Insurance Regulation, 2008, online: http://www.naic.org/documents/cipr_potential_impact_climate_change.pdf at 2.

¹⁹⁵ Statistics Canada, Human Activity and the Environment, 2016: Freshwater in Canada, March 21, 2017 at 6 online: <https://www150.statcan.gc.ca/n1/en/pub/16-201-x/16-201-x2017000-eng.pdf?st=a23dlnhk> [Human Activity and the Environment, 2016].

¹⁹⁶ Human Activity and the Environment, 2016 at 11; Government of Alberta, Facts about water in Alberta, Alberta Environment, Edmonton, AB, December 2010 at 5.

¹⁹⁷ Facts about water in Alberta at 4.



Risks and Opportunities

Alberta faces risks to its water supply, quality, and storm water and/or wastewater infrastructure.

Water supply is likely to be affected by seasonal shifts in river flows (e.g. earlier snowmelt and spring runoff), more extreme events (e.g. flooding, storms, droughts, etc.), changing ice conditions and lower water levels in many parts of the province. There is likely to be increased competition for water due to growing demand from our population and industry. These supply issues will be compounded by Alberta’s water allocation system and the priorities of certain water rights. In particular, southern Alberta communities are predicted to be particularly vulnerable in cases of drought.¹⁹⁸

Water quality faces risks from flooding and erosion, which can disrupt water bodies and introduce increased water turbidity and contamination into our water intake. Higher temperatures and more frequent wildfires can also result in taste or odour issues and cause increased water treatment costs or equipment upgrades. Some chemicals, such as chlorine, degrade faster in warmer water and may require increased amounts to be effective.¹⁹⁹

¹⁹⁸ J. Andrey, P. Kertlend & F.J. Warren, 2014: Water and Transportation Infrastructure in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, edited by F.J. Warren & D.S. Lemmen, Government of Canada, Ottawa, ON, 233-252 at 239 online:

https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter8-Infrastructure_Eng.pdf [Andrey, 2014: Water and Transportation Infrastructure].

¹⁹⁹ Andrey, 2014: Water and Transportation Infrastructure at 240.

Increased floods also threaten our stormwater and wastewater infrastructure as they can damage physical infrastructure and disrupt water treatment chemicals stored on site. Where sewer and storm water systems are still combined there is an increased risk of water quality impacts as well.²⁰⁰ Meanwhile, more frequent winter thaw can increase the flow of cold surface runoff in combined sewer systems, reducing water temperature, which in turn affects the efficacy of biological nitrogen removal and secondary clarification processes. In addition, heavier rainfalls can increase pumping costs and move debris that can block culverts and catch basins. This, in turn, can result in localized flooding or erosion.²⁰¹

Adaptation

Water quality, supply and infrastructure is governed primarily by the *MGA*, *Water Act*, and *EPEA*, their associated regulations, as well as a number of standards, guidelines and Codes of Practice. The Government of Alberta has also adopted a “Water for Life” strategy for sustainability and action plan to support its goals of maintaining: (1) healthy aquatic ecosystems; (2) reliable quality water supplies for a sustainable economy; and (3) safe, secure drinking water.²⁰²

Adaptation measures to address water quality, supply, and infrastructure issues would require various changes to this regulatory framework. First, the Province should consider making updates to its water allocation system set out in the *Water Act*.²⁰³ Currently, water allocations are based on a First-in-Time, First-in-Right (FITFIR) system that gives priority to senior licensees over junior licensees, regardless of use. It also means that in times of drought, junior licensees can be left with an uncertain water supply. The Province should consider moving to a “share” based system whereby each shareholder is allocated a percentage of the available water. This

²⁰⁰ For example, the City of Edmonton’s remaining combined sewers continue to emit sewage during storm events. Data regarding effluent in combined sewers within the City of Edmonton can be viewed online <https://www.google.com/maps/d/viewer?mid=18pZw0jV9dr9tvpq6gn-lgx6A8524SbdH&ll=53.51372300472261%2C-113.5087843&z=12>.

²⁰¹ Andrey, 2014: Water and Transportation Infrastructure at 242.

²⁰² For more information see AEP, Water for Life, online: <http://aep.alberta.ca/water/programs-and-services/water-for-life/default.aspx>.

²⁰³ For a full suite of approaches to managing climate risks see Arlene Kwasniak “Climate Change and Water: Law and Policy Options for Alberta” Canadian Institute of Resources Law Occasional Paper #57, March 2017, online: https://cir.ca/files/cirl/water-and-climate-change_kwasniak.pdf.

ensures that water insecurity can be shared proportionally among all water users. The system should also prioritize water shares based on use, for example, to ensure a certain amount of water is allocated for basic human use or agricultural irrigation in the event of shortages.

Other measures with respect to water quality and supply should include the creation of water management plans for every major river basin in the province and implementation of water conservation objectives that are informed by instream flow. Given that Alberta faces fairly certain supply issues in the future, the province and/or municipalities may also wish to develop water conservation policies for both household and industrial users. To date, Alberta has only approved two water management plans (South Saskatchewan River Basin and Battle River Basin) and supported the voluntary preparation of water conservation, efficiency and productivity (CEP) plans by the seven major water using sectors in the province.²⁰⁴

Adapting Alberta's water infrastructure can also be achieved through improved land-use planning and development. This could include better mapping of areas of risk, the separation of drainage systems from sanitary systems (i.e. downspout disconnection), and the use of low-impact development.²⁰⁵ Low impact development seeks to better manage storm water at its source, and includes reducing impervious surfaces, incorporating green roofs, and utilizing open drainage such as swales.²⁰⁶ Some of these adaptive measures may require changes to *ALSA* and/or the *MGA*.

Additional measures could include improved monitoring and maintenance of drainage systems, the diversification of water sources or intake points to increase resilience in the event one source becomes compromised, and updates to the Codes, Standards and Related Instruments (CSRI) that govern engineering practices and infrastructure design.²⁰⁷

²⁰⁴ Alberta Water Council, "Water Conservation, Efficiency and Productivity", online: <https://awchome.ca/Projects/CEP/tabid/209/Default.aspx>.

²⁰⁵ See Kwasniak 2017 and Andrey, 2014: Water and Transportation Infrastructure at 242.

²⁰⁶ See for example Credit Valley Conservation et al., Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0, (2010) at 3-1-3-2 online: <https://cvc.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/low-impact-development-stormwater-management-planning-and-design-guide/>.

²⁰⁷ Andrey, 2014: Water and Transportation Infrastructure at 242.

b. Transportation

Transportation supports nearly every other industry in the province. Networks of road, rail and air move approximately 40% of Alberta’s international exports to market (the remainder is moved by pipeline).²⁰⁸ Transportation makes up approximately 6% of the provincial GDP²⁰⁹ and is estimated to employ nearly 130,000 people.²¹⁰

Alberta contains just under one quarter of all roads in the country.²¹¹ Alberta’s transportation network is made up of 228,600 km of road and 6,679 km of rail.²¹² The Fort Chipewyan Winter Road also provides about 450 km of road from December to March, linking Fort McMurray to Fort Smith in the North West Territories. Generally speaking, the Prairies have a relatively high number of road-km per capita due to its large municipal and provincial road network, and low population density.²¹³ Alberta also has two international airports located in Calgary and Edmonton, as well as 11 regional airports and 72 community airports.



²⁰⁸PROLOG Canada Inc. for Alberta Economic Development Authority, *The Transportation Sector in Alberta: Present Position and Future Outlook – An Update*, April 30, 2005, at 3 online: <http://www.transportation.alberta.ca/Content/docType56/Production/AEDA2005.pdf>.

²⁰⁹ Highlights of the Alberta Economy, 2018.

²¹⁰ Government of Alberta, “Transportation & Market Access”, online: http://www.albertacanada.com/files/albertacanada/Transportation-and-Market_access-profile.pdf.

²¹¹ Statistics Canada, “Canada’s Core Public Infrastructure Survey: Roads, bridges and tunnels, 2016”, *The Daily*, August 24, 2018, at 1 online: <https://www150.statcan.gc.ca/n1/daily-quotidien/180824/dq180824a-eng.htm>.

²¹² A. Phillips & W. Towns, 2017: *The Prairies in Climate risks and adaptation practices for the Canadian transportation sector 2016*, edited by K. Palko & D.S. Lemmen, Government of Canada, Ottawa, ON, 105-137 at 110, 112 [Phillips, 2017: *The Prairies*].

²¹³ Phillips, 2017: *The Prairies* at 110.

Risks & Opportunities

Climate change is expected to affect all modes of transportation in Alberta with the greatest risk coming from increased extreme weather events. For instance, heavy rainfalls can lead to flooding, washouts, bridge scour, slope failures and even landslides, all of which can damage road and rail infrastructure.²¹⁴ They can also increase the likelihood of accidents and cause reduced travelling speeds for truck drivers due to road conditions and visibility.²¹⁵ Air transportation risks include increased frequency of delays or cancellations due to precipitation and fog, and runway damage due to standing water.²¹⁶

Meanwhile, a greater frequency of freeze-thaw cycles can stress road surfaces and bridges, foul rail track ballast, and generate more rockslides, affecting rail operations in the mountains.²¹⁷ Warmer winters may result in shorter operational seasons for freight operators on winter roads. Drought can lead to severe cracking of roadways, while extreme heat can cause asphalt roadways to rut and bleed,²¹⁸ overheat cargo, and impact rail track integrity.²¹⁹ Wildfires can destroy wooden bridges and cause disruptions to road and rail transportation.²²⁰ Finally, extreme cold can impact rail infrastructure by causing steel tracks and wheels to become brittle and susceptible to breakage, and airbrakes to be prone to leaks and freezing. Extreme cold can also impact aviation transportation by causing an increased need for de-icing (which is not always available in smaller communities) and ground or delay aircraft.²²¹

Alberta's winter roads face their own unique challenges. Warmer winters are expected to have a negative impact on winter-road construction and maintenance costs, as well as reduce the reliability and operating season length of winter roads. This can result in significant social and economic impacts for the northern communities served by these roads.²²²

²¹⁴ Andrey, 2014: Water and Transportation Infrastructure at 245; Phillips, 2017: The Prairies at 117.

²¹⁵ Phillips, 2017: The Prairies at 118.

²¹⁶ Phillips, 2017: The Prairies at 131.

²¹⁷ Phillips, 2017: The Prairies at 117, 125, 128.

²¹⁸ Phillips, 2017: The Prairies at 117.

²¹⁹ Andrey, 2014: Water and Transportation Infrastructure at 245.

²²⁰ Andrey, 2014: Water and Transportation Infrastructure at 245; Phillips, 2017: The Prairies at 118.

²²¹ Phillips, 2017: The Prairies at 131.

²²² Phillips, 2017: The Prairies at 122

However, in terms of opportunities, climate change may present the opportunity to diversify and improve some of Alberta's transportation routes and types. Higher ambient temperature can also improve diesel fuel efficiencies.²²³

Adaptation

Alberta's transportation infrastructure is regulated by, among others, the *Traffic Safety Act*,²²⁴ *Highways Development and Protection Act*,²²⁵ *Railway (Alberta) Act*,²²⁶ *Regional Airports Authorities Act*,²²⁷ and the federal *Aeronautics Act*.²²⁸

Most adaptation measures in this area focus on improving physical infrastructure. They include completing vulnerability assessments and retrofitting or replacing infrastructure at high risk sites in advance of scheduled maintenance or replacement schedules.²²⁹ They also include updating design standards to keep pace with projected climate scenarios, and establishing and maintaining more sophisticated weather monitoring and dissemination systems.²³⁰

From a legal perspective, adaptation measures could also include amending the *Traffic Safety Act's* licensing and insurance legislation to require more education on driving in inclement weather,²³¹ and amending the *Highways Development and Protection Act* to require climate adaptation assessments and plans for all major roadways in the Province. The Province may also wish to update or optimize the timing of seasonal weight road restrictions to avoid premature pavement deterioration.²³²

²²³ Phillips, 2017: The Prairies at 118.

²²⁴ RSA 2000, c T-6.

²²⁵ SA 2004, c H-8.5.

²²⁶ RSA 2000, c R-4.

²²⁷ RSA 2000, c R-9.

²²⁸ RSC 1985, CA-2.

²²⁹ Phillips, 2017: The Prairies at 119.

²³⁰ ICF Marbek for Alberta Environment and Sustainable Resource Development, Climate Change Risk Assessment and Adaptation Report: Ministry of Transportation, Final Report, June 2012 at 24 online:

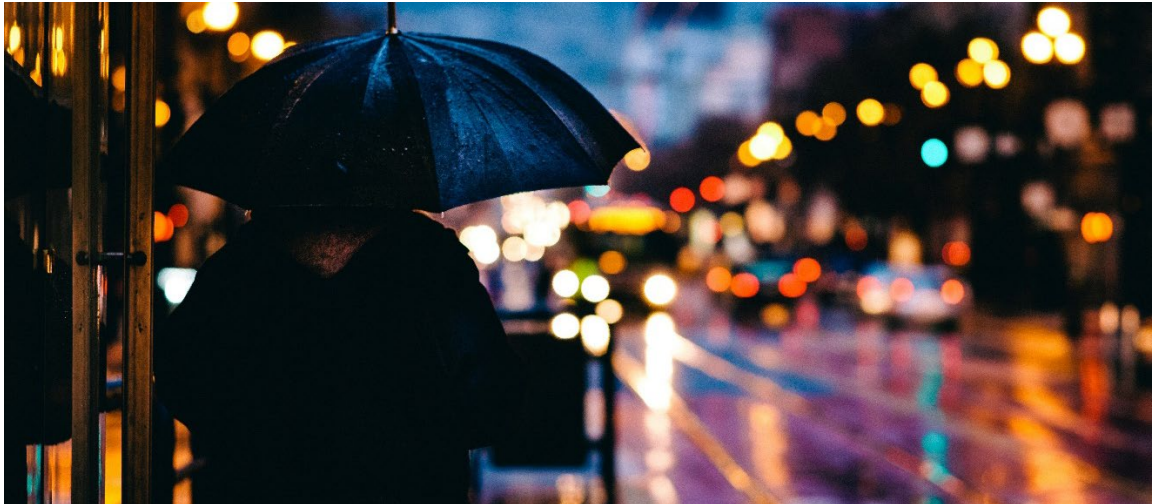
https://www.transportation.alberta.ca/Content/docType29/Production/Climate_Change_Risk_Assessment.pdf [ICF Marbek].

²³¹ ICF Marbek at 24.

²³² Phillips, 2017: The Prairies at 118.

c. Buildings

A 2016 survey of Canadian municipalities found that the average age of municipal buildings was 37 years old and the replacement value for buildings in fair, poor, and very poor condition totaled \$32 billion.²³³ Relative to the rest of the country, Alberta's built structures are fairly young.



Risks and Opportunities

Climate change poses wide-ranging issues for public and private buildings as, traditionally, designers of Canadian buildings made the assumption that historical climatic patterns would hold constant throughout a structure's useful life. Now, however, it is expected that extreme weather events will exceed the design threshold of residential and commercial structures, and events such as increased wind speed, extreme rain, flooding and overheating will all pose risks to existing built infrastructure.²³⁴ In fact, insurers have already noted an increase in property insurance claims resulting from extreme weather-related events.²³⁵ For instance, in 2014, Aviva

²³³ Canadian Infrastructure Report Card: Informing the Future, 2016 at 32 online: http://canadianinfrastructure.ca/downloads/Canadian_Infrastructure_Report_2016.pdf.

²³⁴ Kovacs, 2014: Industry at 149.

²³⁵ Institute for Catastrophic Loss for the Insurance Bureau of Canada, Telling the Weather Story, June 2012 at 17 online: http://assets.ibc.ca/Documents/Studies/McBean_Report.pdf.

Canada found that water damage made up 51% of all of its property claims, an all-time high that caused it to pay out \$190 million in water damage claims.²³⁶

More gradual increases in temperature and precipitation also pose a risk, as they hasten the weathering processes that gradually deteriorate buildings.²³⁷ The effects of climate change are likely to be further compounded by aging infrastructure and housing stock as well as poor land planning that has allowed developers to build in areas that are already vulnerable to extreme weather.²³⁸

Climate change is likely to increase demand for new, stronger and more energy efficient buildings – either as new builds or through retrofitting. Opportunity also lies in reconstruction after extreme weather events such as flooding or forest fires. For instance, the rebuild in Fort McMurray after the devastating wildfires of 2016 is estimated to be worth \$1.3 billion.²³⁹

Adaptation

One of the most effective adaptation measures for built structures is to update and strengthen building codes. Alberta's built infrastructure is regulated by, among others, the *Public Works Act* and *Safety Codes Act*, which empowers the Alberta Building Code (ABC). Currently, the ABC is based on the 2010 edition of the National Building Code of Canada (NBCC). As previously mentioned, Alberta has also adopted the 2011 NECB.

Going forward, it is anticipated that the ABC and NECB standard will soon be updated to the 2015 national code editions. However, the technical provisions of the NBCC 2015 still assume that past climate will be representative of the future climate, an assumption that is increasingly

²³⁶ Canadian Underwriter, "More than half of all home insurance claims last year from water damage: Aviva Canada", March 25, 2010, online: <https://www.canadianunderwriter.ca/insurance/more-than-half-of-all-home-insurance-claims-last-year-from-water-damage-aviva-canada-1002977973/>.

²³⁷ Kovacs, 2014: Industry at 150.

²³⁸ Kovacs, 2014: Industry at 150.

²³⁹ W. Snowden, "Fort McMurray wildfire costs to reach almost \$9B, new report says", CBC News, January 17, 2017 online: <http://www.cbc.ca/news/canada/edmonton/fort-mcmurray-wildfire-costs-to-reach-almost-9b-new-report-says-1.3939953>.

invalid under climate change.²⁴⁰ Instead, the ABC and related legislation should integrate climate resilience into building design guides and codes. This will require the incorporation of newer climate load and design values that are based on emerging and future weather trends, as well as new design technologies and techniques.²⁴¹

In addition, Alberta should continue working to meet the goals of the Pan-Canadian Framework on Clean Growth and Climate Change. Among other measures, the Pan-Canadian Framework calls for improving the energy efficiency of new construction through the development and adoption of increasingly stringent model building codes, starting in 2020, with the goal of adopting a ‘net zero energy ready’ building code by 2030.²⁴² Similarly, federal, provincial and territorial governments are working to develop a model code for upgrading existing buildings by 2022, for subsequent adoption.²⁴³

Still another adaptation measure is to use policies to promote retrofits to improve the resiliency of existing homes to extreme weather.²⁴⁴ For instance, subsidy programs or regulations that encourage the installation of backwater valves to prevent sewer back-ups and sealing of gaps around pipes, cables, windows and door frames can help to limit damage incurred in future floods.



²⁴⁰ Canada’s Climate Change Adaptation Platform, “Adaptation State of Play Report”, Infrastructure and Buildings Working Group, March 2017 at 27, online: https://engineerscanada.ca/sites/default/files/ibwg_sop_2017.pdf.

²⁴¹ Kovacs, 2014: Industry at 150.

²⁴² Government of Canada, Pan-Canadian Framework on Clean Growth and Climate Change: Canada’s Plan to Address Climate Change and Grow the Economy, 2016 at 17 online: <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework/climate-change-plan.html> [Pan-Canadian Framework].

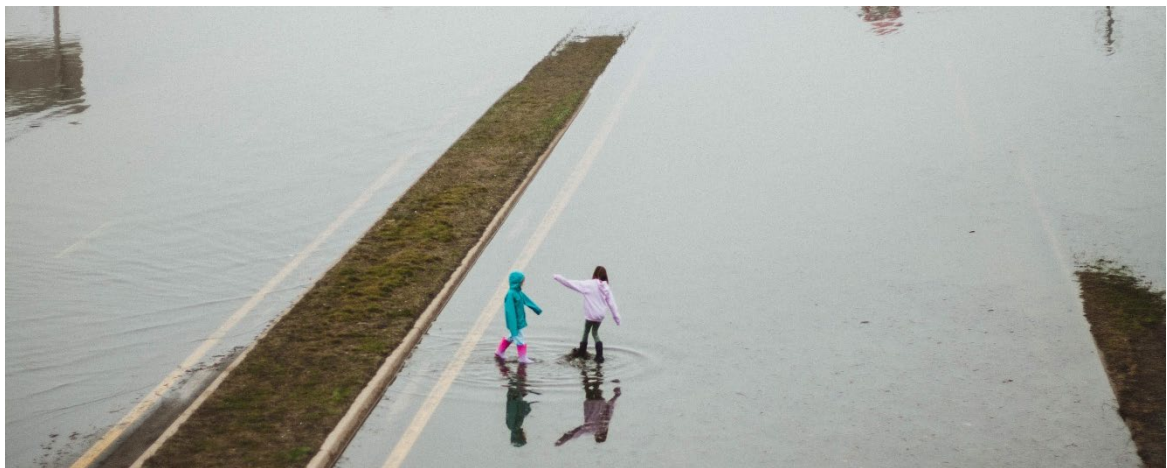
²⁴³ Pan-Canadian Framework at 17.

²⁴⁴ Kovacs, 2014: Industry at 151.

Financial instruments can also be used to build adaptive capacity. Alberta recently introduced the *New Home Buyer Protection Act*²⁴⁵ which mandates and regulates new home warranties in the province. Builders are responsible for indemnifying homeowners from various types of defects and damage in the first 1-10 years after construction. These types of warranties provide financial incentives for builders to ensure their work is protected against climate risks.

Home insurance is another available instrument. For instance, insurance contracts could be mandated to offer discounts for homes that comply with resilient building practices. Note however that these warranties and/or policies are exposed to considerable climate risk and legislatures must ensure that the companies offering them have the expanded budgets necessary to support them.

Another adaptation measure is to improve Alberta's land use planning, which is generally regulated by legislation such as the *MGA* and/or *ALSA*. Municipalities should take additional steps to ensure the construction of residential and commercial buildings are limited to areas protected from current and future weather hazards. Policy makers should produce climate models, conduct floodplain modelling, and consider other hazard mitigation studies to inform decision making.²⁴⁶



²⁴⁵ SA 2012, c N-3.2.

²⁴⁶ Kovacs, 2014: Industry at 151.

4) Biodiversity

a. Animal and Vegetation Ecosystems

Alberta is home to six major ecosystems (i.e. natural regions) and an estimated 60,000 species.²⁴⁷ This biodiversity and its associated “ecosystem services” help provide clean air and water, climate regulation, carbon storage, pollination and flood regulation, along with the raw materials for food, shelter, clothing and medicine.²⁴⁸ Biodiversity is also critical to various economic sectors such as agriculture and tourism.



²⁴⁷ Alberta Biodiversity Monitoring Institute (ABMI), “The Diversity in Alberta”, online: <http://www.abmi.ca/home/biodiversity/biodiversity-in-alberta.html?scroll=true>.

²⁴⁸ P. Nantel et al., 2014: Biodiversity and Protected Areas in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, edited by F.J. Warren and D.S. Lemmen, Government of Canada, Ottawa, ON, 159-190 at 162 online: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter6-Biodiversity_Eng.pdf [Nantel, 2014: Biodiversity and Protected Areas].

Risks and Opportunities

Climate change is likely to cause shifts in species distribution including expansion, contraction and fragmentation in species-specific patterns²⁴⁹ Among many impacts, this could cause changes to the timing of life history events, which can create phenological mismatches (i.e. when migrating species arrive at a site after peak prey availability has passed), and hybridization (i.e. interbreeding between two animals or plants of different species), which can drive rare species into extinction or increase the adaptability of others by introducing greater genetic variation.²⁵⁰ Major changes in forest species composition is also expected.²⁵¹

Increased moisture stress in prairie ecosystems will likely decrease productivity in natural grasslands (although this may be offset by longer growing seasons and reduced competition from other shrubs).²⁵² Meanwhile, in aquatic ecosystems, water temperature is a principal determinant of fish survival and reproduction.²⁵³ Warming will affect the habitat of many fish species, increasing the potential habitat for invasive species and creating favourable conditions for unwanted algal blooms²⁵⁴ Warming is also associated with a range of physiological stresses that affect species health, such as hypoxia.²⁵⁵

In addition, the cumulative effects of climate change, other disturbance regimes, and human-induced stresses are likely to threaten many species. For instance, habitat fragmentation is an impediment to range expansion (and therefore the adaptive success) of various plant, animal and aquatic species.²⁵⁶ Water pollution, wetland drainage and lowering of the ground water table have significantly degraded freshwater ecosystems in much of North America over the past 60 years and, in combination with climate change, will continue to lead to changes in

²⁴⁹ Nantel, 2014: Biodiversity and Protected Areas at 161.

²⁵⁰ Nantel, 2014: Biodiversity and Protected Areas at 161.

²⁵¹ Nantel, 2014: Biodiversity and Protected Areas at 166.

²⁵² Nantel, 2014: Biodiversity and Protected Areas at 163.

²⁵³ Nantel, 2014: Biodiversity and Protected Areas at 171.

²⁵⁴ Nantel, 2014: Biodiversity and Protected Areas at 163.

²⁵⁵ Nantel, 2014: Biodiversity and Protected Areas at 171.

²⁵⁶ Nantel, 2014: Biodiversity and Protected Areas at 171.

aquatic biodiversity.²⁵⁷ Forest fires are expected to increase significantly and invasive species such as the mountain pine beetle will disproportionately benefit from climate change.²⁵⁸

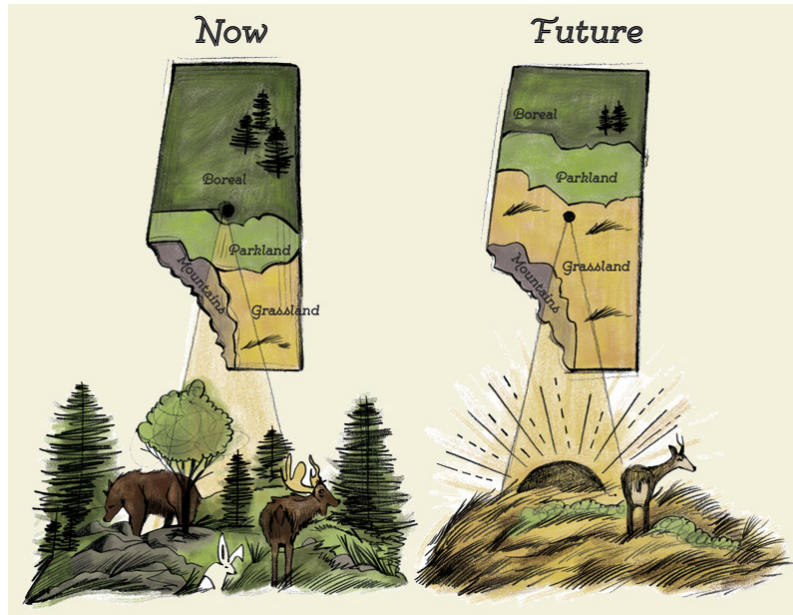


Figure 2: Biodiversity and Climate Change (Source: Alberta Biodiversity Monitoring Institute).²⁵⁹

Nevertheless, there may be some opportunities. Forest productivity could increase with higher atmospheric CO₂ concentrations and longer growing seasons.²⁶⁰ Warming may allow certain species to move North and occupy niche spots in new habitats²⁶¹ and, by the end of the century, more lakes in northerly locations could provide suitable habitat for warm water species.²⁶²

Adaptation

Generally speaking, ecosystems have natural responses to new environmental situations and can make autonomous adjustments. In the face of climate change, however, these responses

²⁵⁷ Nantel, 2014: Biodiversity and Protected Areas at 171.

²⁵⁸ Nantel, 2014: Biodiversity and Protected Areas at 171-172.

²⁵⁹ ABMI, “Biodiversity & Climate Change”, online: <http://www.abmi.ca/home/biodiversity/biodiversity-climate-change.html?scroll=true>.

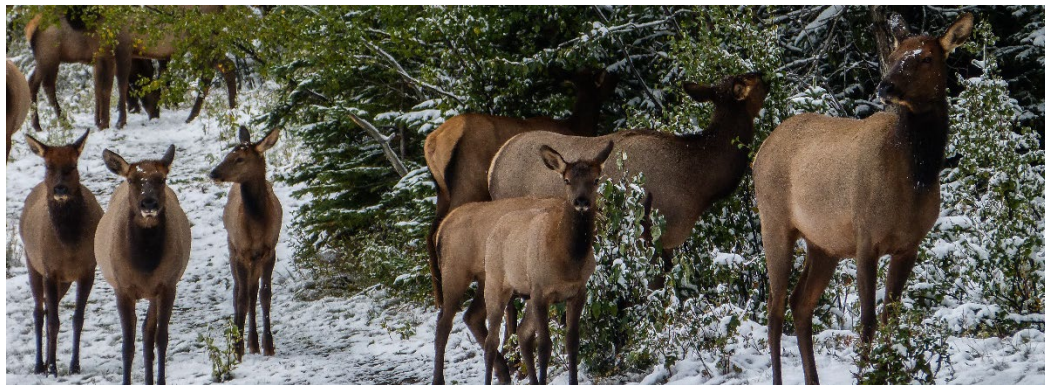
²⁶⁰ Nantel, 2014: Biodiversity and Protected Areas at 163.

²⁶¹ Nantel, 2014: Biodiversity and Protected Areas at 163.

²⁶² Nantel, 2014: Biodiversity and Protected Areas at 168.

are considered insufficient to halt the loss of biodiversity and the ecosystem services it provides. Going forward, “planned adaptation” that is aimed at maintaining or restoring biodiversity and ecosystem services will be required.²⁶³

A key component of resilient ecological systems are conservation networks made up of parks and other types of protected areas.²⁶⁴ This is because they help to protect intact ecosystems, which are critical for the conservation of biodiversity in periods of rapid environmental change. They also provide habitat for native species and opportunities for autonomous adaption, migration, and natural selection processes through maintenance of genetic diversity.²⁶⁵



Parks and other protected areas in Alberta are primarily regulated by the *Provincial Parks Act*, the *Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act*,²⁶⁶ and *Willmore Wilderness Park Act*.²⁶⁷ Adopting or amending legislation that strengthens protections for Alberta’s existing parks and protected areas is a powerful adaptation measure. All levels of government should also expand existing parks and protected areas, or create new parks altogether. Canada, along with the provinces and territories, have set biodiversity goals and targets for 2020 (as part of Canada’s commitments under the United Nations’ Convention on Biological Diversity) which includes the target of protecting at least 17 per cent of its terrestrial

²⁶³ Nantel, 2014: Biodiversity and Protected Areas at 174.

²⁶⁴ Nantel, 2014: Biodiversity and Protected Areas at 174.

²⁶⁵ Nantel, 2014: Biodiversity and Protected Areas at 175.

²⁶⁶ RSA 2000, c W-9.

²⁶⁷ RSA 2000, c W-11.

lands by 2020.²⁶⁸ Currently, 14.6 percent of Alberta land is protected: 8.2 percent as National Parks and 6.4 percent as provincial protected areas.²⁶⁹ Note, however, the Government of Alberta recently announced plans to consult with Albertans about creating a wildland park, three provincial parks, and four recreation areas in the Bighorn backcountry, adding an additional 4,000 square kms and increasing Alberta’s total protected area to 15.2 percent.²⁷⁰

Another adaptation measure is to connect these protected areas through sustainably managed landscapes and waterscapes. Connectivity permits species migration into new areas, facilitates gene flow, and provides food, water and shelter during periods of natural scarcity or disturbances.²⁷¹ The connection of protected areas can be fostered through federal and provincial parks legislation, land planning legislation (e.g. Regional Plans under *ALSA*, Forest Management Plans under the *Forests Act*), and Alberta’s *MGA*. An example would include the Yellowstone to Yukon Conservation Initiative (Y2Y), which aims to create an interconnected network of protected lands (i.e. a 3,200 kilometre “movement corridor”) that runs from Yellowstone National Park to the Yukon Territory.²⁷²

Adaptation may also be achieved through supporting species recovery and restoring degraded ecosystems.²⁷³ Ecological restoration can have far-reaching impacts. For example, the restoration of beaver populations (that influence wetland hydrology and enhance water retention) in Elk Island National Park has led to significant increases in open water areas, even during dry years.²⁷⁴ These activities would require strengthening and/or enforcing legislation such as the federal *SARA* and Alberta’s *Wildlife Act* and pursuing the adoption of endangered species legislation.

²⁶⁸Government of Canada, 2020 Biodiversity Goals and Targets for Canada, 2016 online: <http://biodivcanada.ca/default.asp?lang=En&n=9B5793F6-1>.

²⁶⁹ Alberta Wilderness Association, “Introduction to Protected Areas”, online: <https://albertawilderness.ca/issues/wildlands/protected-areas/>.

²⁷⁰ AEP, “Bighorn Country Proposal”, online: <https://talkaep.alberta.ca/bighorn-country>; Nature Conservancy of Canada, “NCC thanks the Government of Alberta for investing in nature”, online: <http://www.natureconservancy.ca/en/where-we-work/alberta/stories/ncc-thanks-government-of-ab.html>.

²⁷¹ Nantel, 2014: Biodiversity and Protected Areas at, p. 175-176.

²⁷² Yellowstone to Yukon Conservation Initiative, “Why Y2Y”, online: <https://y2y.net/vision/why-y2y>.

²⁷³ Nantel, 2014: Biodiversity and Protected Areas at 176.

²⁷⁴ Nantel, 2014: Biodiversity and Protected Areas at 178.



5) Human Impact

a. Health and Communities

Weather and climate already have direct impacts on human health and well-being. Going forward, climate change poses additional and significant risks including smog, vector-borne diseases and heat waves. These climate change impacts will disproportionately affect vulnerable populations.

Risks and Opportunities

Climate change is expected to bring with it a wide range of health risks to Albertans. These include:

- **Air Quality** – climate change will exacerbate existing health risks associated with poor air quality through heat and other meteorologically related increases in ambient air pollutants, aeroallergens, and biological contaminants and pathogens;²⁷⁵

²⁷⁵ P. Berry et al., 2014: Human Health in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, edited by F.J. Warren and D.S. Lemmen, Government of Canada, Ottawa, ON, 191-232 at 197 online: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2014/pdf/Chapter7-Human-Health_Eng.pdf [Berry, 2014: Human Health].

- **Food and Water Quality** – increase in food borne illnesses due to warmer weather and decreased availability of food from countries hit by climate change, increase in water borne disease outbreaks and blue–green algae, which can result in unacceptable taste and odours;²⁷⁶
- **Diseases** – may affect health risks from zoonosis and vector borne diseases. This is mostly future gazing at this time, though Lyme vectors are spreading into Canada and the incidence of Lyme disease is increasing. Further, as temperatures increase Canada’s vulnerability to exotic diseases (e.g. malaria) also increases.;²⁷⁷
- **Natural Hazards** – Alberta can expect an increase in the intensity of heavy rain events and storms, and in the occurrence of wildfires, droughts and extreme heat. Aside from the obvious risks of death and physical and mental injury, these events can be expected to cause power outages, food shortages, disrupt medical care and social services, force people from their homes and communities, etc.;²⁷⁸
- **Ultra-violet Radiation (UVR)** – warmer temperatures may result in increased UV exposure due to higher levels of ambient UVR along with changes in human behavior (i.e. more outdoor activities, limited use of personal protective measures);²⁷⁹
- **Vulnerable Populations** – certain populations, such as seniors, children/infants, socially and economically disadvantaged and those with chronic diseases are vulnerable. Climate change poses special challenges to the health of indigenous populations and those in remote, Northern communities due to impacts on traditional food sources and diets, their dependence on the land, reliance on reasonably predictable and stable weather patterns and cultural impacts;²⁸⁰
- **Landscapes** - urban and rural communities also have characteristics which render them more vulnerable. Cities have high population densities and a built environment – they are more likely to suffer from extreme heat events due to presence of asphalt and limited green space, and from floods due to paving and old drainage systems. Rural regions face their own

²⁷⁶ Berry, 2014: Human Health at 200.

²⁷⁷ Berry, 2014: Human Health at 202.

²⁷⁸ Berry, 2014: Human Health at 203.

²⁷⁹ Berry, 2014: Human Health at 209.

²⁸⁰ Berry, 2014: Human Health at 212.

challenges as livelihoods may be more closely tied to natural resources and more exposed to extreme weather with less people or resources available to respond.²⁸¹

At this time, there do not appear to be any opportunities for human health as a result of climate change.



Adaptation

Given the breadth of probable human health impacts, adaptation will require mainstreaming climate change considerations into a wide variety of legislation, regulatory instruments and tools that influence health and well-being.

Adaptative measures could include updating public health legislation and policies to provide for the identification and assessment of vulnerable populations, increased public awareness and education around promoting personal protection from climate change related health risks, and strengthened monitoring and alert systems during heatwaves, reduced air quality events and other extreme weather.²⁸² Still other adaptation methods include improving disease or health surveillance and/or monitoring methods and prevention, such as vector control and vaccinations.²⁸³

²⁸¹ Berry, 2014: Human Health at 214.

²⁸² Berry, 2014: Human Health at 218-219.

²⁸³ Berry, 2014: Human Health at 218-219.

Adaptation could also be furthered by strengthening building codes and municipal land planning legislation to improve the quality of housing stock and infrastructure, as well as develop infrastructure such as green roofs, reflective road/building surfaces, and urban green spaces with the purpose of eliminating or reducing heat islands.²⁸⁴



²⁸⁴ Berry, 2014: Human Health at 218.

CONCLUSION

Anthropogenic climate change is happening and we cannot avoid its impacts. As previously discussed, Alberta is already experiencing the impacts of climate change (e.g. shifting vegetation ranges, extreme weather events) and will continue to do so on an escalating basis into the future. These impacts are expected to bring with them more risks than opportunities.

Fortunately, adaptation can help to provide a path forward. Currently, some progress is being made, particularly with respect to engagement, awareness, and planning. But there is still a lack of action with respect to the actual implementation of adaptive measures. Action is being hampered by barriers such as limited resources, gaps in information and technology, and lack of political will.²⁸⁵ Continuing efforts to address these barriers and further mainstream adaptation are necessary to maintain the capacity of Alberta's social, economic, and environmental systems. Our future depends on it.

²⁸⁵ Eyzaguirre, 2014: Adaptation: Linking Research and Practice at 280.