Global Affairs Canada | Affaires mondiales Canada

UNCLASSIFIED

MEMORANDUM FOR ACTION

TO:	**The Minister of Foreign Affairs**
CC:	**The Digital Inclusion Lab, Office of Human Rights Freedoms and Inclusion**
SUBJECT:	How developments in Artificial Intelligence technology can mitigate the impact of climate change on human rights.

SUMMARY:

Canada has a national and international obligation to respect, protect, fulfil and promote all human rights for all persons without discrimination. Failure to take affirmative measures to prevent human rights harms caused by climate change, including foreseeable long-term harms, breaches this obligation. Among other impacts, climate change negatively affects people's rights to health, housing, water and food. These negative impacts will increase exponentially according to the degree of climate change that ultimately takes place and will disproportionately affect individuals, groups and peoples in vulnerable situations, such as Indigenous communities across Canada. Therefore, Canada must act to mitigate climate change, including through policy and institutional actions, in order to prevent to the greatest extent possible, the current and future negative human rights impacts of climate change.

RECOMMENDATION(S):

- That you consider…
  - Moving from discussion to implementation of "permissionless innovation", so that the commitment to improve environmental conditions and in turn, human rights, through technology is not hindered by stringent and precautionary policies;
  - Establishing a National AI Research and Development Centre, which will engage various disciplines and be tasked with overseeing technological innovation in the country; and
  - Working together with other jurisdictions to establish an International Global Consortium for AI Ethics and Policy which will oversee and incentive multi-jurisdictional technological innovation to tackle the global concern of climate change.

NIMISHA DUBEY
FACULTY OF LAW, UNIVERSITY OF WINDSOR

☐ I wish to discuss
☐ I concur ☐ I do not concur

_____
Minister

BACKGROUND:

1. It is now beyond dispute that climate change caused by human activity has negative impacts on the full enjoyment of human rights.[1] The human rights framework also requires that global efforts to mitigate and adapt to climate change should be guided by relevant human rights norms and principles including the rights to participation and information, transparency, accountability, equity, and non-discrimination.[2] Simply put, climate change is a human rights problem and the human rights framework must be part of the solution.

2. It is expected that Indigenous peoples will experience the impacts of climate change in ways that most non-Indigenous Canadians will not, due to a heavy reliance on the environment, their locations, and their economic situations.[3] These communities are marginalized as a result of settler-colonialism and are continuing to suffer at the hands of a neo-colonial society; they are facing the consequences of over-development and greed that they took no part in. It is time that thoughts be put into action so that new technologies can be used to combat climate change and, in turn, enhance human rights.

CONSIDERATIONS:

3. Those involved in the development of technology have often advocated for a "permissionless innovation" approach to innovation policy. This tenet proposes that experimentation with new technologies and business models should generally be permitted by default.[4] In other words, unless a compelling case can be made that a new invention will bring serious harm to society, innovation should be allowed to continue unabated and problems, if any develop, can be addressed later.[5]

4. The concept of permissionless innovation stands in stark contrast to the sort of "precautionary principle" thinking that often governs policy toward emerging technologies. This principle refers to the belief that new innovations should be curtailed or disallowed until their developers can prove that they will not cause any harms.[6] Through these preemptive constraints, however, opportunities for experimentation are stifled. While some steps to anticipate or control for unforeseen circumstances are sensible, excessive safeguarding forecloses opportunities and experiences that offer valuable lessons for individuals and society.

5. Under its proposed Pan-Canadian Framework on Clean Growth and Climate Change, Canada has the goal of developing international partnerships to build areas of shared expertise and foster stronger bilateral relations.[7] These goals can be achieved through the establishment of a National AI Research and Development Centre. This Centre will produce knowledge and technologies based on the work and input of participants from various disciplines. A plan for a

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[1] United Nations Office of the High Commissioner for Human Rights. "Understanding Human Rights and Climate Change" (2015) United Nations at 2.
[2] *Ibid*.
[3] United Nations Permanent Forum on Indigenous Issues. (n.d.). "Backgrounder: Climate Change and Indigenous Peoples" at 2.
[4] Grubb, Michael. "Technology Innovation and Climate Change Policy" (2004) 41:2 KEIO Econ St 103 at p 129.
[5] *Ibid*.
[6] Thierer, A. "Does 'Permissionless Innovation' even mean anything?" (18 May 2017) *Tech Liberation Magazine*, accessed on 10 March 2018: https://techliberation.com/2017/05/18/does-permissionless-innovation-even-mean-anything/.
[7] Government of Canada (2018), *Pan-Canadian Framework on Clean Growth and Climate Change*, Cat No: En4-294/2016E at 38.

similar Centre has been proposed by the National Science and Technology Council in the United States which can be looked to for guidance.[8]

6. National efforts to develop AI policies, should, from the very beginning, be coordinated and supported by an international regulatory framework. Against this background, it is proposed that the Canadian government help establish a new intergovernmental organization — which could be named the Global Consortium for AI Ethics and Policy (GCAIEP) — to serve as an international forum for discussion and engage in international standard setting activities.

7. Some have argued that technology is not a solution to climate change; instead, it further perpetuates its negative effects.[9] First, environmental pollution results from waste output contributed by "trial and error" methods.[10] Second, energy consumption caused by technological development processes contributes to unsustainability.[11] Third, there is a significant depletion of natural resources and ecological imbalances experienced as result from technological development, related to the second point.[12]

8. The effects of technology innovation on the environment are already beginning to be mitigated, however. With programs such as the Sustainable Development Technology Canada program, the environmental harms caused by technological development can be mitigated effectively. Furthermore, although permissionless innovation promotes a "trial and error" process which can result in unsustainable innovation practices, this is tempered by monetary incentives to use more efficient and sustainable methods for technological development.

COMMUNICATIONS IMPLICATIONS/ACTIONS:

9. is likely that most media coverage will remain positive in nature, since these steps, if taken, will lead to technological innovation, the mitigation of the effects of climate change, and the enhancement of human rights across all communities, nationally and internationally. Each of these outcomes are related to current government initiatives and priorities. Accordingly, any reaction from key stakeholders is likely to be welcoming of these new initiatives.

10. Potential negative reactions could source from proponents of the precautionary approach to innovation policy or those that believe further technological advancement contributes to climate change. These potentially negative news stories could be curtailed by pointing to the efforts already made and those that will be made to mitigate climate change and implement effective innovation policy.

11. Communications activities which should take place are: news releases, website profiling, communications plans, media briefings, parliamentary statements and social media posts. The impacts of climate change are not limited to Canadians; this is a global human rights concern and if Canada is taking innovate steps toward addressing these concerns, those actions deserve a wide scope of media attention.

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[8] National Science and Technology Council of the Executive Office of the President of the United States (2016), *Artificial Intelligence Research and Development Strategic Plan*, accessed on 19 February 2018: https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf.
[9] Foray, Domonique and Arnulf Grubler. 2000. "Technology and the Environment: An Overview" 53 *Technological Forecasting and Social Change* 3 at 7-8.
[10] *Ibid* at 8.
[11] *Ibid*.
[12] *Ibid*.

ANNEX A:

A Rights-Based Approach to Combating Climate Change:

How artificial intelligence technology can mitigate the impact of climate change on human rights in Canada and beyond.

Nimisha Dubey

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Prepared for the Global Affairs Canada – Digital Inclusion Lab Artificial Intelligence and Human Rights Student Symposium held on April 18th, 2018 in Ottawa, Ontario, Canada

1. INTRODUCTION

The role of human rights in Canada's foreign policy is in evolution and transition, adapting and reacting to the momentous changes taking place all around us. Today's demands require rapid adjustment, substantive change, and new and bolder strategies. In the past few years, Canada has repeatedly expressed a much stronger commitment to human rights than ever before; human rights have been elevated to a prominent and vital element of Canada's foreign policy alongside collective security, national unity, and propensity.[13] This new emphasis arises out of the growing recognition that human rights have become inextricably linked to many other foreign policy matters. Where human rights were once considered matters of purely domestic concern narrowly construed, global forces now mandate that they take on broader international dimensions, transcend borders, and command ever widening participation in their definition and implementation.

Climate change impacts, directly and indirectly, an array of internationally guaranteed human rights. States have an affirmative obligation to take effective measures to prevent and redress these climate impacts, and therefore, to mitigate climate change. This will ensure that all human beings have the necessary capacity to adapt to the climate crisis. Climate justice requires that climate action is consistent with existing human rights agreements, obligations, standards and principles. Those who have contributed the least to climate change unjustly and disproportionately suffer its harms, most notably Indigenous[14] communities within Canada. Indigenous peoples, who are inherently connected with the land around them, must be meaningful participants in and primary beneficiaries of climate action, and they must have access to effective remedies.

Canada has an obligation to respect, protect, fulfil and promote all human rights for all persons without discrimination. Failure to take affirmative measures to prevent human rights harms caused by climate change, including foreseeable long-term harms, breaches this obligation. Artificial Intelligence ("AI") technology is one solution. These technological tools can be used and funded by the government to help equip those challenged with maintaining Canada's commitment to mitigate the effects of climate change.

2. THESIS

This article introduces why and how human rights policies as part of Canada's overall foreign policy commitment to eradicate climate change can be assisted by AI. The Canadian government can ensure that it is prepared to face the opportunities and challenges presented by AI at the provincial, federal, and international level through a reactive approach to policy and legislation, establishing a National AI Research & Development Centre calling on experts from various disciplines, and fostering global partnerships with the goal of creating an International Global Consortium for AI Ethics and Policy. These three approaches will help position Canada at the forefront in the field of AI innovation so that its applications can be leveraged to enhance human rights affected by climate change.

This paper looks at Canada's general policies in the area of climate change, human rights, and innovation. Some attempt is made to identify emerging issues and sketch directions for future development in the area of climate change and innovation policy.

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[13] The Honourable Raynell Andreychuk. "Implementing Canada's Human Rights Obligations: A Report of the Standing Senate Committee on Human Rights" (2001) *Journals from the Senate* accessed on 31 January 2018: https://sencanada.ca/content/sen/committee/371/huma/rep/rep02dec01-e.htm.

[14] A collective noun for First Nations, Inuit, Metis, and its usage has growing popularity within the Government of Canada. *Indigenous Corporate Training Inc.* (20 July 2016) "Indigenous Peoples terminology and guidelines for usage.", accessed on 23 February 2018: https://www.ictinc.ca/blog/indigenous-peoples-terminology-guidelines-for-usage.

The first section will be devoted to providing brief definitions of terms used throughout this work. Following, I will discuss how and why human-rights are impacted by climate change more generally, and then highlight this issue by placing emphasis on the climate change impact to Indigenous communities across Canada. This section will also touch on the lack of technological and innovation policy within Canada that could aid in the development of technologies to tackle climate change. Then, I propose potential policy and institutional responses to the aforementioned issues; whether it be taking a step back from implementing restrictive innovation policies or establishing national and global centres, Canada must begin taking action. If Canada hopes to be a trailblazer in AI innovation, it must be prepared for an influx of technological revolution at the national and international levels – a position that it is not currently in. Finally, I address counter-arguments and alternative views to these proposed solutions before concluding.

At this point, it is important to note that the following work presents a starting point for the Canadian government. Further research must be conducted, conversations held, and proposals considered before any meaningful steps can be taken toward mitigating climate change using AI technology. This piece is to be recognized as presenting information and options which have been in the public realm for some time and have gone unnoticed or were never applied within the context of AI development in Canada. The information below is to be taken and dissected by the appropriate officials so that Canada can begin taking its commitment toward mitigating climate change seriously.

3. DEFINITIONS

3.1 *Artificial Intelligence*

Professor John McCarthy, known as the "Father of AI", published a series of questions and answers regarding the technology in a paper called "*What is Artificial Intelligence*" in 2007.[15] The paper is intended to address the layman's questions about AI and provide a basic understanding of the technology. There is no universal definition of AI, but only a series of characteristics that are unique to the program. McCarthy defines AI as "the science and engineering of making intelligence machines, especially intelligent computers".[16] He relates this to the task of using computers to understand human intelligence, however the intelligence of AI is not so confined as to be only biologically observable.[17] The ultimate effort of AI, is to make computer programs that can solve problems and achieve goals in the world as well as humans.[18]

Machine learning is branch of AI that aims to achieve this purpose. As author Harry Surden has discussed, the idea that the computers are "learning" is largely a metaphor and does not imply that computers systems are artificially replicating the advanced cognitive systems thought to be involved in human learning.[19] He states, rather, that these algorithms are considered to be learning in a *functional* sense; in other words, they are capable of changing their behavior to enhance their performance on some task through experience.[20] Commonly, machine learning algorithms are used to detect patterns in data in order to automate complex tasks or make

[15] John McCarthy. "What is Artificial Intelligence?" (12 November 2007) *Computer Science Department, Stanford University*, accessed on 21 November 2017, online: www-formal.stanford.edu/jmc/whatisai.
[16] *Ibid*.
[17] *Ibid*.
[18] *Ibid*.
[19] Harry Surden. "Machine Learning & Law" (2014) 89 Washington Law Review 87 at p 89.
[20] *Ibid*.

predictions.[21] If performing well, machine learning algorithms may produce automated results that approximate those that would have been made by a similarly situated person.[22]

3.2 *Human Rights*

Human rights are universal legal guarantees that protect individuals, groups and peoples against actions and omissions that interfere with their fundamental freedoms and entitlements.[23] Human rights law obliges governments and other duty-bearers to respect, promote, protect and fulfil all human rights.[24] Human rights are universal and are based on the inherent dignity and equal worth of all human beings; they are equal, indivisible, interrelated and interdependent, and cannot be waived or taken away.[25] Furthermore, human rights are legally protected, and impose obligations in relation to actions and omissions, particularly of States and State actors.[26]

In Canada, human rights are protected by federal, provincial and territorial laws. Canada's human rights laws stem from the UN Universal Declaration of Human Rights ("HR Declaration"). In 1948, John Humphrey, a Canadian lawyer and scholar, played a significant role in writing the HR Declaration.[27] The first two articles of the HR Declaration are about equality and freedom from discrimination, the foundation of the Canadian *Human Rights Act*.[28]

Human rights entail both rights and obligations; States assume obligations and duties under international law to respect, to protect and to fulfil human rights.[29] The obligation to respect means that States must refrain from interfering with or curtailing the enjoyment of human rights.[30] The obligation to protect requires States to protect individuals and groups against human rights abuses.[31] The obligation to fulfil means that States must take positive action to facilitate the enjoyment of basic human rights.[32] At the individual level, while humans are entitled to human rights, we must also respect the human rights of others.[33]

3.3 *Climate Change*

The United Nations Framework Convention on Climate Change ("UNFCCC") defines climate change as a change of climate that is attributed directly or indirectly to human activity, altering the composition of the global atmosphere.[34] Human activity includes the pollution that arises from industrial activity and other sources that produce greenhouse gases.[35] These gases, such as carbon dioxide, have the ability to absorb the spectrum of infrared light and contribute to the

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[21] *Ibid*.
[22] *Ibid*.
[23] Mahoney, Kathleen. "Human Rights and Canada's Foreign Policy" (1991) 47 Int'l J. 55 at 559.
[24] *Ibid*.
[25] *Ibid*.
[26] *Ibid* at 560.
[27] *Ibid* at 561.
[28] *Ibid*.
[29] *Ibid* at 562.
[30] *Ibid*.
[31] *Ibid*.
[32] *Ibid*.
[33] *Ibid*.
[34] (1992) at art 1(2).
[35] David Suzuki Foundation. "What is Climate Change?" (5 October 2017) accessed on 11 March 2018: https://davidsuzuki.org/what-you-can-do/what-is-climate-change/; Climate Action Network. "What is Climate Change?" (n.d.) accessed on 11 March 2018: https://climateactionnetwork.ca/what-is-climate-change/.

warming of our atmosphere.[36] Once produced, these gases can remain trapped in the atmosphere for tens or hundreds of years.[37]

Geological evidence suggests that we have entered a period of unnatural warming – for 400,000 years, carbon levels in the atmosphere had never exceeded 300 parts per million.[38] In 1950, this level was exceeded and has been increasing since.[39] In 2013, CO2 levels surpassed 400 ppm for the first time in recorded history.[40] As the balance of gases in the atmosphere changes from human pollution, these emissions directly contribute to the warming of the environment, with far-reaching consequences across continents and cultures.[41]

4. CLIMATE CHANGE AND HUMAN RIGHTS

Climate change has profound impacts on a wide variety of human rights, including the rights to life, self-determination, development, food, health, water and sanitation and housing.[42] The human rights framework also requires that global efforts to mitigate and adapt to climate change should be guided by relevant human rights norms and principles including the rights to participation and information, transparency, accountability, equity, and nondiscrimination.[43] Simply put, climate change is a human rights problem and the human rights framework must be part of the solution.

Despite the clear human rights implications of failure to act to prevent climate change, the Canadian and international communities have not taken adequate preventive action. In fact, some of the climate change mitigation and adaptation efforts that have been employed to date have had counterproductive human rights impacts, particularly on the most marginalized.[44] Taken as a whole, existing climate change mitigation and adaptation efforts have fallen far short of the level of ambition necessary to prevent and/or remedy the negative human rights impacts of climate change in fulfilment of the obligations of States and other duty-bearers.[45]

Integrating human rights in climate actions will necessitate higher levels of ambition and improve mitigation and adaptation strategies by making them more effective and inclusive. During the March 2015 Human Rights Council panel discussion, several delegations underlined the importance of integrating human rights in climate policy, including participation, access to information and access to justice.[46] A human rights based approach addresses cross cutting social, cultural, political and economic problems, while empowering persons, groups and peoples, especially those in vulnerable situations.[47] This can make considerable contributions to climate change policies, making them less myopic and more responsive, sensitive, and collaborative.[48]

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[36] *Ibid*.
[37] *Ibid*.
[38] *Ibid*.
[39] *Ibid*.
[40] *Ibid*.
[41] *Ibid*.
[42] United Nations Office of the High Commissioner for Human Rights. "Understanding Human Rights and Climate Change" (2015) United Nations at 2.
[43] *Ibid*.
[44] *Ibid* at 5.
[45] *Ibid*.
[46] *Supra* note 30.
[47] *Ibid*.
[48] *Ibid*.

4.1 *What human rights principles apply in the context of climate change?*

The HR Declaration, the International Covenant on Economic, Social and Cultural Rights ("ICESCR"), and the UN Declaration on the Right to Development ("Development Declaration") all make clear that State human rights obligations require both individual action and international cooperation.[49] According to the HR Declaration everyone is entitled to a social and international order in which the rights and freedoms therein can be fully realized and everyone has duties to the community.[50] Similarly, the ICESCR declares that States should "take steps, individually and through international assistance and co-operation, especially economic and technical, to the maximum of [their] available resources, with a view to achieving progressively the full realization of rights recognized in the present Covenant".[51]

The basic human rights principles of equality and non-discrimination require action to address and remedy the disproportionate impacts of climate change on the most marginalized and to ensure that climate actions benefit persons, groups and peoples in vulnerable situations and reduce inequalities. The disproportionate impacts of climate change on persons in vulnerable situations raise concerns of climate justice, fairness, equity and access to remedy.[52] The HR Declaration, the International Covenant of Civil and Political Rights ("ICCPR") and other human rights instruments make it clear that all persons who suffer human rights harms are entitled to access to effective remedy.[53] The Human Rights Council panel repeatedly called for climate justice and immediate action to mitigate and adapt to climate change.[54]

The Development Declaration, by calling for the fair distribution of the benefits of development and for developed countries to assist developing countries, embraces the need for equitable development.[55] International cooperation, equality and non-discrimination, accountability and equity reflect human rights commitments and are critical to address climate change. The principle of equity, including intergenerational equity, is also specifically recognized in the UNFCCC which calls for all parties to "protect the climate system for the benefit of present and future generations of humankind."[56]

4.2 *Which human rights are most affected by climate change?*

As a starting point, States are legally bound to respect, protect, promote, and fulfil all human rights. In doing so, they have committed to work individually and collectively, to eliminate discrimination and promote equality, and to expend maximum available resources for the progressive realization of economic, social and cultural rights as well as the advancement of civil and political rights and the right to development. The following discussion of specific issues demonstrates the grave consequences of failure to comply with these obligations.

4.2.1 The right to life

According to the HR Declaration "everyone has the right to life, liberty and security of person."[57] The ICCPR reiterates that "every human being has the inherent right to life."[58] All States have

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[49] *Ibid* at 7.
[50] United Nations. "Universal Declaration of Human Rights" (1948) at art 28.
[51] United Nations Office of the High Commissioner for Human Rights. "International Covenant on Economic, Social and Cultural Rights" (1966) at art 2.1.
[52] *Supra* note 30 at 11.
[53] *Ibid* at 1.
[54] *Ibid* at 28.
[55] United Nations General Assembly. "Declaration on the Right to Development" (1986) at art 2.3.
[56] *Supra* note 22 at art 3.1.
[57] *Supra* note 38 at art 3.
[58] United Nations Office of the High Commissioner for Human Rights. "International Covenant on Civil and Political Rights (1966) at art 6.1.

committed to respect, protect, promote, and fulfil the right to life. This entails, at the very least, that States should take effective measures against foreseeable and preventable loss of life. Climate change clearly poses a threat to human life.

According to the Intergovernmental Panel on Climate Change ("IPCC"), the risk of having further extreme weather events and the resulting endangerment of human lives is "moderate to high at temperatures of 1°C to 2°C above preindustrial levels."[59] A recent report by the World Bank affirms this risk, finding that "further health impacts of climate change could include injuries and deaths due to extreme weather events."[60] In the context of climate change, extreme weather events may be the most visible and most dramatic threat to the enjoyment of the right to life but they are by no means the only one. Climate change kills through drought, increased heat, expanding disease vectors and a myriad of other ways. According to a report by the Climate Vulnerable Forum and DARA International, climate change is already responsible for approximately 400,000 deaths per year and that number is expected to rise to 700,00 by 2030.[61] In order to uphold the right to life, States must take effective measures to mitigate and adapt to climate change and prevent foreseeable loss of life.

4.2.2 The right to water and sanitation

Although the right to water is not explicitly recognized in the ICESCR, General Comment No. 15 of the Committee on Economic, Social and Cultural Rights articulates this right stating: "The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses."[62] In its resolution, the General Assembly recognized "the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights."[63] Pursuant to General Comment No. 15, "States parties have to adopt effective measures to realize, without discrimination, the right to water."[64] According to the IPCC, "climate change is projected to reduce renewable surface water and groundwater resources in most dry subtropical regions…intensifying competition for water".[65] The IPCC further found that climate change will likely increase the risk of water scarcity in urban areas and "rural areas are expected to experience major impacts on water availability and supply."[66]

According to a recent World Bank report, a 2°C average global increase in temperature may result in 1 to 2 billion no longer having enough water to meet their needs.[67] Reduced access to water will disproportionately impact persons, groups and peoples in vulnerable situations. For example, reduced access to water introduces added burdens for women and girls in developing countries, who are often responsible for fetching water for their families from distant sources and have distinct needs for water and sanitation.[68]

During the panel discussions, it was reported that several speakers stressed the importance of water and sanitation, and the impacts that climate change could have on this right.[69] According to Minister Abul Hassan Mahmood Ali, "millions at the bottom of the development pyramid…are

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[59] Intergovernmental Panel on Climate Change. "Fifth Assessment Report" (2008) at p 19.
[60] The World Bank. "Turn down the heat: why a 4-degree Celsius warmer world must be avoided. (2012) at xvii.
[61] DARA and Climate Vulnerable Forum. "A guide to the cold calculus of a hot planet" 2d ed. (2012) at 17.
[62] (2002). [New York: United Nations] at art 2.
[63] United Nations General Assembly. "The human right to water and sanitation" (2010) at art 1.
[64] *Ibid*.
[65] *Supra* note 47 at 13.
[66] *Ibid* at 15-16.
[67] *Supra* note 48 at 24.
[68] *Supra* note 49.
[69] *Supra* note 30 at 18.

exposed to various climatic shocks. Slow-onset disasters like river erosion, desertification, ground water contamination, or inland salinity intrusion do not make headlines, yet impact people's living."[70] There can be no doubt that the right to water and sanitation which is derived from the rights to health and an adequate standard of living found within the ICESCR is threatened by inadequate climate action.

4.2.3 The right to development

The ICESCR and ICCPR emphasize that all peoples should "freely determine their political status and freely pursue their economic, social and cultural development".[71] The Development Declaration presents an integrated framework for this pursuit. It articulates a holistic vision of development as "an inalienable human right by virtue of which every human person and all peoples are entitled to participate in, contribute to, and enjoy economic, social, cultural and political development, in which all human rights and fundamental freedoms can be fully realized."[72] The Development Declaration underscores that people must be the central subjects, active participants, and beneficiaries of development; it articulates that all States and all persons have responsibilities for development and States should work individually and collectively to create an internationally enabling environment for development in which the benefits of development are equitably shared by all.[73]

In particular, States should take steps individually and collectively to guarantee all persons the ability to enjoy economic, social, cultural and political development. According to World Bank President, Jim Yong Kim "unless the world takes bold action now, a disastrously warming planet threatens to put prosperity out of reach of millions and roll back decades of development."[74] The IPCC found that "limiting the effects of climate change is necessary to achieve sustainable development, including poverty eradication."[75]

Moreover, in the recently adopted Sustainable Development Goals,[76] combating climate change has been recognized as instrumental to sustainable development, highlighting the importance of addressing climate change and its adverse effects to secure sustainable, inclusive development that benefits all persons.[77] At the Human Rights Council meeting, panelists agreed that the right to development should inform humanity's collective response to climate change.[78] Mary Robinson, former High Commissioner and current President of the Mary Robinson Foundation for Climate Justice, affirmed that all individuals and peoples had a right to development and that climate action should be directed toward fulfilling that right.[79] She emphasized that the international community must work together to address challenges that climate change poses to the realization of human rights, especially the right to development.[80]

5. IMPACTS OF CLIMATE CHANGE ON THE RIGHTS OF INDIGENOUS PEOPLES

It is expected that Indigenous peoples will experience the impacts of climate change in ways that most non-Indigenous Canadians will not, due to a heavy reliance on the environment, their

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[70] *Ibid*.
[71] ICESCR, *supra* note 39 at art 1.1; ICCPR, *supra* note 46 at art 1.1.
[72] *Supra* note 43 at art 1.1.
[73] *Ibid* at art 2.2.
[74] *Supra* note 48.
[75] *Supra* note 47 at 17.
[76] United Nations Sustainable Development Knowledge Platform. "Transforming our world: the 2030 Agenda for Sustainable Development" (2015).
[77] *Ibid* at Preamble.
[78] *Supra* note 30 at 16.
[79] *Ibid*.
[80] *Ibid*.

locations, and their economic situations.[81] Indigenous peoples, similar to other natural-resource dependent communities around the world, depend on the environment for subsistence, maintenance of culture, and other important aspects of their livelihoods.[82] Studies of the developing world have reported that vulnerability and limited capacity to adapt to environmental situations have been linked to factors such as a high reliance on natural resources, a limited ability to adapt financially, high poverty, and a lack of systems of arrangements for dealing with these issues.[83] Indigenous communities are characterized similarly and are vulnerable to the impacts of climate change.

Climate change means more than just changes in weather, and for Indigenous peoples, it goes beyond the scientifically studied physical elements of climate change impacts. Given that most Indigenous peoples have unique relationships with the land, the impacts of climate change on ecosystems will invariably impact cultural, social, and traditional activities associated with the land as well as the ability to exercise their Indigenous and treaty rights.[84] The discussion that follows is an attempt to highlight the issues of climate change so that its effects on Indigenous peoples may be discussed within the community, federal and provincial government departments, institutions, and organisations that currently have an interest in eradicating climate change issues.

5.1. The right to life: *Effects on Human Health*

An increase in temperature can affect Indigenous peoples in many ways. Since many Indigenous peoples have substandard housing that offer little to no protection against the heat, summer heat waves are a major concern, especially in regions such as the prairies and Ontario, where summer temperatures are usually higher than the rest of Canada.[85] Increasing intense temperatures in the summer lead to extreme heat waves and smog conditions which may affect the respiratory capability of vulnerable parts of the community, including Indigenous youth, seniors, and the sick.[86] As a result of increasing ultraviolet radiation levels from the sun, the incidence of skin cancer and other skin disorders may arise for which Indigenous peoples will need to seek medical care – an option that is already limited due to the remote location of these communities.[87]

Many Indigenous peoples are living below the poverty line and cannot afford luxuries such as air conditioning units.[88] A combination of environmental and social/economic issues exacerbate the negative impacts that warmer temperatures could pose.[89] Increased precipitation and higher moisture levels in some Indigenous communities will likely increase the incidences of indoor mould. Moulds can also trigger asthma attacks and can weaken the immune system of those exposed.[90]

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[81] United Nations Permanent Forum on Indigenous Issues. (n.d.). "Backgrounder: Climate Change and Indigenous Peoples" at 2.
[82] Thomas, DSG and Twyman, C. 2005. "Equity and justice in climate change adaptation amongst natural resource dependent societies." 15 *Global Environmental Change* 115 at 118.
[83] *Ibid*.
[84] *Ibid*.
[85] Last, J., Trouton, K., and Pengelly, D. 1998. "Taking our breath away: The health effects of air pollution and climate change" *David Suzuki Foundation* (Vancouver, BC) at 55; Health Canada. 2001. *Climate Change and Health Well Being: A policy Primer* (Ottawa, ON) at 4, accessed on 28 March 2018: http://publications.gc.ca/collections/Collection/H46-2-01-260E.pdf.
[86] Last, J., *ibid* at 57-58.
[87] *Ibid* at 59.
[88] *Ibid* at 61.
[89] Health Canada*, supra* note 82 at 13.
[90] *Ibid*.

5.2. The right to water and sanitation: *Effects on Water Quality*

Water quality is an issue that is of great importance to Indigenous peoples and culture. Many Indigenous peoples see water as the "the giver of life"; water is the most important life-sustaining element of this planet, without it, life could not exist.[91] Indigenous peoples rely on bodies of water for many purposes such as transportation, drinking water, recreation, harvesting, and agricultural activities.[92] Extreme weather events resulting from climate change, threaten water quality for many Indigenous peoples. For example, water quality is affected by changes in precipitation and evaporation rates and by changes in the flow of streams and rivers in and out of a particular watersheds.[93] If water levels decline in lakes and streams, water quality may deteriorate "because of the inability to flush out contaminants and nutrient additions from agriculture and wastewater."[94] Reduced water quality can have an impact upon the health of a community, surrounding environment, the viability of businesses such as farming and fishing and on recreational activities such as swimming.[95]

For Indigenous communities situated in low-lying coastal regions such as in the Atlantic Provinces, water quality may be affected by rising sea levels, storm surges, and the intrusion of salt water because of coastal flooding.[96] Floodwaters may contaminate fresh water sources and render the fresh water sources unusable.[97] In cases of open area sewage treatment, an increase in flooding can cause sewage and liquid waste to contaminate water sources, community areas, and the surrounding environment.[98] This raises the risk of the spread of water-borne diseases such as cholera and typhoid.[99] Indigenous peoples in these communities may need to find alternative secure drinking water sources which places undue strain on these resource-depleted communities.[100] It should be unjustifiable that in the 21st century, Canadian communities are still lacking access adequate drinking water.

5.3. The right to development: *Effects on Community Infrastructure*

An increase in temperature translates into rising sea levels and less sea ice. These conditions can lead to an increase in extreme weather events, such as storm surges and higher wave energy.[101] As sea levels rise and storm surges increase, coastal erosion also increases, decreasing the traditional territories of many Indigenous communities. Marine geological surveys show that "coastal zones have been retreating on average by at least 0.5 m/year for several thousand years."[102] As coastal regions are flooded and eroded, property is lost and coastal infrastructure and community resources are put at risk.[103] In some severe cases, the community itself may need to be relocated to a region less prone to flooding.[104] Community

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[91] Centre for Indigenous Environmental Resources. 2006. "Report II: How Climate Change uniquely impacts the physical, social and cultural aspects of First Nations." *The Assembly of First Nations* at 7.
[92] *Ibid*.
[93] *Ibid* at 8.
[94] *Ibid*.
[95] *Ibid*.
[96] Environment and Climate Change Canada. 2016. "Canadian Environmental Sustainability Indicators: First Nations Water and Wastewater System Risk" *The Government of Canada* at 5.
[97] *Ibid*.
[98] *Ibid* at 6-7.
[99] *Ibid* at 8.
[100] *Ibid*.
[101] Intergovernmental Panel on Climate Change. 2001. "Impacts, Adaptation, and Vulnerability." *Contribution of the Working Group II to the Third Assessment of the IPCC*, McCarthy, J.J. (ed.) [Cambridge: Cambridge University Press] at 967.
[102] *Ibid*.
[103] *Ibid* at 968-969.
[104] *Ibid*.

infrastructure and many cultural sites may be at risk of being lost, destroyed or flooded due to a rise in sea levels.[105]

Climate change may also affect infrastructure in northern Indigenous communities that are located on permafrost. The melting of permafrost can "threaten older buildings, communal roads, transportation routes, water supplies and waste disposal structures in the communities."[106] As permafrost melts, communities will become more susceptible to the impacts of a changing landscape and the cost of adapting and rebuilding community infrastructure can be more than the community can afford.[107] Indigenous northern communities currently have limited access to resources; any impacts will increase pressures on the already insufficient infrastructure funding.

In raising the connection between climate change's impact on human rights and the rights of Indigenous peoples, it is my hope that the Canadian government will understand their obligation to attend to this issue. Communities that are marginalized as a result of settler-colonialism are continuing to suffer at the hands of a neo-colonial society; they are facing the consequences of over-development and greed facilitated by our legislature and parliament. It is time that thoughts be put into action so that the effects of climate change can begin to be mitigated by the use of innovative technologies. Canada, however, is not currently well-positioned to be introducing these programs in a safe and meaningful way.

6. CURRENT STATE OF CLIMATE CHANGE LAW & POLICY

6.1 *International Conventions*

The Canadian Government has explicitly recognized that climate change is a shared global problem with significant impacts on the economy, development, and security.[108] Canada's international assistance seeks to help countries mitigate and adapt to climate change, recognizing the importance of understanding the links between climate change and human rights.[109] This includes looking for solutions to the many impacts of climate change that are: sustainable, equitable, and feasible.

Although not having done much about it, the Canadian government also recognizes that climate change can worsen existing situations of poverty and fragility and create new vulnerabilities for Indigenous communities.[110] Again, climate change-associated drought, flooding and severe weather could create adverse effects on the right to an adequate standard of living.[111] There are impacts to health as a result of decreasing access to safe drinking water, basic sanitation, and access to food, which creates competition and conflict over basic resources.[112]

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[105] *Ibid*.
[106] *Ibid* at 970.
[107] *Ibid*.
[108] Government of Canada. 2017. "Climate Change and Human Rights" accessed on 24 March 2018: http://international.gc.ca/world-monde/issues_development-enjeux_developpement/human_rights-droits_homme/climate_rights-droits_climat.aspx?lang=eng; Government of Canada. 2018. "Canada's Action on Climate Change" accessed on 24 March 2018: https://www.canada.ca/en/services/environment/weather/climatechange/climate-action.html
[109] Government of Canada (2017), *ibid*.
[110] *Ibid*.
[111] *Ibid*.
[112] Government of Canada (2018), *supra* note 107.

The Canadian government and its officials have stated, on numerous occasions, that "change must be addressed to achieve sustainable development."[113] So what has been done to address climate change and foster innovation?

6.1.1 The Kyoto Protocol

The Kyoto Protocol was the first binding international climate treaty and was adopted in 1997.[114] It stemmed from the 1992 UNFCCC to address worldwide climate issues through the reduction of global greenhouse gas emissions.[115] Canada officially ratified the Kyoto Protocol in December 2002, under Chrétien's Liberal government.[116]

In 2004, the new Liberal minority government led by Paul Martin, planned to honour the Kyoto Protocol targets through Project Green.[117] The plan consisted of buying all sorts of emissions reductions costing an estimated $10 billion.[118] The plan never went into fruition as Stephen Harper and a minority Conservative government were elected in 2006.[119] Stephen Harper had publicly opposed the Kyoto Protocol since it's development and once elected into office, he slowed or cancelled actions to meet the Kyoto Protocol targets including Project Green.[120]

With many years of climate inaction from the federal government, Canada officially withdrew from the Kyoto Protocol in December 2011.[121] Announced by then-Environment Minister Peter Kent, "the government would save $14 billion in penalties by pulling out of the agreement."[122]

6.1.2. The Paris Agreement

In 2015, Canada and 194 other countries adopted the Paris Agreement under the UNFCCC.[123] Under the Paris Agreement, all 195 countries agreed to work together to strengthen their efforts and lead the transformation towards a low-carbon, climate resilient global economy including by setting targets to reduce greenhouse gas emissions, report on their progress and increase their ambition every five years.[124] Under the Paris Agreement, a global stock will take place every five years which will consider mitigation and adaptation actions undertaken by all countries.[125] This is an ambitious and balanced agreement to fight against climate change; it aims to strengthen

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[113] *Ibid*.
[114] Environment and Climate Change Canada. 2013. "A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act 2012: Canada's Withdrawal from the Kyoto Protocol" *The Government of Canada*, accessed on 03 April 2018: http://www.ec.gc.ca/Publications/default.asp?lang=En&n=EE4F06AE-1&xml=EE4F06AE-13EF-453B-B633-FCB3BAECEB4F&offset=3&toc=hide.
[115] *Ibid*.
[116] *Ibid*.
[117] Environment and Climate Change Canada. 2013. "A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act 2012: Canada's Domestic Climate Change Approach" *The Government of Canada*, accessed on 03 April 2018: http://www.ec.gc.ca/Publications/default.asp?lang=En&n=EE4F06AE-1&xml=EE4F06AE-13EF-453B-B633-FCB3BAECEB4F&offset=4&toc=hide.
[118] *Ibid*.
[119] *Ibid*.
[120] *Ibid*.
[121] Environment and Climate Change Canada. 2013. "A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act 2012: Measures to Address Climate Change" *The Government of Canada*, accessed on 03 April 2018: http://www.ec.gc.ca/Publications/default.asp?lang=En&n=EE4F06AE-1&xml=EE4F06AE-13EF-453B-B633-FCB3BAECEB4F&offset=5&toc=hide.
[122] *Ibid*.
[123] Government of Canada. 2017. "United Nations Framework Convention on Climate Change: The Paris Agreement" accessed on 03 April 2018: https://www.canada.ca/en/environment-climate-change/corporate/international-affairs/partnerships-organizations/united-nations-framework-climate-change.html.
[124] *Ibid*.
[125] *Ibid*.

efforts to limit the global average temperature rise to well below 2℃ and to limit the increase to 1.5℃.[126]

In relation to this obligation, the Government of Canada pledged $2.65 billion over five years to help developing countries adapt to climate change, to deploy renewable energy technologies, and to manage risks related to severe weather events.[127]

Demonstrating its commitment to equality, Canada advocated that language on human rights, and specifically the rights of Indigenous peoples, be included in the Paris Agreement.[128] The federal government will "build on the efforts of provinces and territories, local governments, Indigenous organizations, businesses, youth, the academic community, and non-governmental organizations."[129]

6.2. *National Convention*

6.2.1. Pan-Canadian Framework on Clean Growth and Climate Change

The Government of Canada is working with the provinces and territories to establish a Pan-Canadian Framework on Clean Growth and Climate Change ("The Framework").[130] The Framework is Canada's plan – developed with the provinces and territories and in consultation with Indigenous peoples – to meet Canada's emissions reduction targets, grow the economy, and build resilience to a changing climate.[131] The plan includes a Pan-Canadian approach to pricing carbon pollution, and measures to achieve reductions across all sectors of the economy.[132] It aims to drive innovation and growth by increasing technology development and adoption to ensure Canadian businesses are competitive in the global low-carbon economy.[133] It also includes actions to advance climate change adaptation and build resilience to climate impacts across the country.[134]

The Framework promotes the idea that a low-carbon economy can and will be a strong and thriving economy.[135] The Canadian government states that "taking action now, to position Canada as a global leader on clean technology innovation, will help ensure that Canada remains internationally competitive and will lead to the creation of new good jobs across the country."[136] The Government ensures that investing in clean technology, innovation, and jobs will bring new and in-demand Canadian technologies to expanding global markets, which, as a result, will help improve the efficiency and cost-effectiveness of mitigation and adaptation measures and will equip Canada's workforce with the knowledge and skills to succeed.[137]

Under the Framework, the Canadian governments will support new approaches to early-stage technology development, including breakthrough technologies, to advance research in areas

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[126] *Ibid*.
[127] Environment and Climate Change Canada. 2017. "Compendium of Canada's Engagement in International Environmental Agreements" *The Government of Canada* at 1, accessed on 03 April 2018: https://www.canada.ca/content/dam/eccc/migration/main/international/045000d9-a222-4322-99d3-573e14884196/a43-202017-20iea-20factsheet-20unfccc-20en-20final.pdf.
[128] *Ibid*.
[129] *Ibid*.
[130] Government of Canada (2018), *Pan-Canadian Framework on Clean Growth and Climate Change*, Cat No: En4-294/2016E at 1.
[131] *Ibid*.
[132] *Ibid* at 2-3.
[133] *Ibid* at 3.
[134] *Ibid*.
[135] *Supra* note 118 at 7.
[136] *Supra* note 105.
[137] *Supra* note 118 at 37-39.

that have the potential to substantially reduce emissions and other pollutants. Innovative partnerships with the private sector will also make an important contribution to this effort.[138] The federal and provincial governments will encourage new "mission-oriented" research approaches to focus research and development facilities, programs, and supports on clean technology and environmental performance issues.[139]

Additionally, the Framework states that the Canadian federal and provincial governments will continue to recognize, respect and safeguard the rights of Indigenous Peoples as actions are taken to mitigate climate change.[140]

7. OPPORTUNITIES FOR AI TECHNOLOGY

As Earth-observing satellites become more plentiful and climate models more powerful, researchers who study global warming are facing a flood of data. Some are now turning to the latest trend in AI to help search through all the information, in the hope of discovering new climate patterns and improving forecasts.

Claire Monteleoni, a computer scientist at George Washington University in Washington DC who has helped to pioneer the marriage of machine-learning techniques with climate science, aptly situates technology within the context of climate change when she says that "Climate is now a data problem".[141] In machine learning, AI systems improve in performance as the amount of data that they analyze grows.[142] This approach is a natural fit for climate science: "a single run of a high-resolution climate model can produce a petabyte of data, and the archive of climate data maintained by the national weather service, now holds about 45 petabytes of information."[143]

Work in this area has grown rapidly. In the past several years, researchers have used AI systems to help them to rank climate models, spot cyclones and other extreme weather events — in both real and modelled climate data — and identify new climate patterns.[144]

7.1. *Climate Study: A Big-Data Problem*

Machines can analyze the flood of data that is generated every day from sensors, gauges and monitors to spot patterns quickly and automatically.[145] By looking at data about the changing conditions of the world's land surfaces that is gathered by NASA, these technologies provide a very accurate picture of how the world is changing.[146] The more accurate information available, the better climate models will be. This information can be used to identify the biggest vulnerabilities and risk zones.[147] This knowledge from climate scientists must be shared with decision-makers so they are better equipped to respond to physical, social and cultural impacts of climate change.

7.2. *Developing Better Solutions*

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[138] *Ibid*.
[139] *Ibid*.
[140] *Ibid* at 8.
[141] Bernard Marr. "Amazing Ways we can use AI to Tackle Climate Change" (21 February 2018) *Forbes Magazine* at 1, accessed on 08 March 2018: https://www.forbes.com/sites/bernardmarr/2018/02/21/the-amazing-ways-we-can-use-ai-to-tackle-climate-change/#72068dbd4a35.
[142] *Supra* note 7.
[143] *Supra* note 129.
[144] *Ibid* at 2.
[145] Trexler, Mark C. "An Artificial Intelligence for Climate Progress?" (2017) *The Climatographers* at 2.
[146] *Ibid*.
[147] *Ibid*.

AI and "deep learning"[148] can help climate researchers and innovators test out their theories and solutions about how to reduce air pollution and other climate-friendly innovations.[149] One example of this is the Green Horizon Project from IBM that analyzes environmental data and predicts pollution as well as tests "what-if" scenarios that involve pollution-reducing tactics.[150] Another example includes the "Deep Learning for Climate" project. This program has been using AI to find patterns of extreme weather such as hurricanes and cyclones for the last three years.[151] By looking at known weather patterns, the group at Deep Learning for Climate will train a neural network — a computer program inspired by the human brain and designed to continuously improve itself through machine learning — to be able to quantify how climate might change in the future.[152]

Another example includes Microsoft's "AI for Earth" Program. This investment is part of Microsoft's expansion of its environmental policies, which center around the concept of democratizing AI so that both scientists and business owners can easily utilize the technology to analyze climate data and provide information to help them take strategic action.[153] Microsoft's AI for Earth builds on Microsoft's commitment to use AI technology to amplify human ingenuity and advance sustainability around the globe.[154]

7.3. *Green Initiatives*

While businesses and manufacturing might contribute significantly to greenhouse gas levels, it's still imperative that each citizen commits to reducing their impact as well. The easier it is to implement green initiatives for each person, the higher the adoption rate and the more progress is made to save the environment. AI and machine learning innovations can help create products and services that make it easier to take care of the planet.[155] There are several consumer-facing AI devices such as "smart thermostats (which could save up to 15% on cooling annually for each household) and irrigation systems (which could save up to 8,800 gallons of water per home per year) that help conserve resources."[156]

7.4. *Better Weather Event Predictions*

The damage to human lives and property can be reduced if there are earlier warning signs of a catastrophic weather event.[157] There has been significant progress in using algorithms that were trained on data from other extreme weather events to identify tropical cyclones and atmospheric rivers.[158] The earlier warning that governments and citizens can get about severe weather, the

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[148] Deep Learning focuses even more narrowly on a subset of machine learning tools and techniques, and applies them to solving just about any problem which requires "thought" – human or artificial; Bernard Marr. "What Is the Difference Between Deep Learning, Machine Learning and AI?" *Forbes Magazine* at 1, accessed on 08 March 2018: https://www.forbes.com/sites/bernardmarr/2016/12/08/what-is-the-difference-between-deep-learning-machine-learning-and-ai/#35f2b3d326cf.
[149] *Supra* note 133 at 5.
[150] *Ibid*.
[151] *Supra* note 129.
[152] *Ibid*.
[153] Smith, Brad. "'AI for Earth' can be a game-changer for our planet" (11 December 2017) *Microsoft Blog*, accessed on 17 February 2018: https://blogs.microsoft.com/on-the-issues/2017/12/11/ai-for-earth-can-be-a-game-changer-for-our-planet/.
[154] *Ibid*.
[155] *Supra* note 129.
[156] *Ibid*.
[157] Reilly, Michael. "Climate Change is getting a big dose of AI" (23 August 2017) *MIT Technology Review*, accessed on 08 March 2018: https://www.technologyreview.com/the-download/608726/climate-change-research-is-getting-a-big-dose-of-ai/.
[158] *Ibid*.

better they are able to respond and protect themselves.[159] Machines are also being deployed to assess the strengths of such models by reviewing the dozens of them that are in use and extracting intelligence from them.[160] They also help predict how long a storm will last and its severity.[161]

The Canadian government must begin to utilize AI and machine learning technology to help them understand the current reality, predict future weather events and create new products and services to minimize the human impact on the environment. This direction will only increase our chances of improving and saving lives, creating a healthier world and making businesses more efficient.

8. FROM DISCUSSION TO IMPLEMENTATION

8.1 *Policy Actions*

8.1.1. National

Human rights can be integrated in climate-change related actions by applying a rights-based approach to policy and development. The essential attributes of this approach are the following: As policies and programs are formulated, the main objective should be to fulfil human rights; the rights-holders and their entitlements must be identified as well as the corresponding duty-bearers and their obligations in order to find ways for strengthening the capacities of rights-holders to make their claims and of duty-bearers to meet their obligations; and principles and standards derived from international human rights law – especially the HR Declaration and the core universal human rights treaties, should guide all policies and programming in all phases of the process.

Critically, it is not enough to simply focus on ensuring that climate actions respect human rights. A rights-based approach requires Canada to take affirmative actions to respect, protect, promote and fulfil all human rights for all persons. Failure to prevent foreseeable human rights harms caused by climate change, or at the very least to mobilize maximum available resources in an effort to do so, constitutes a breach of this obligation. Human rights obligations apply to the goals and commitments of Canada in the area of climate change and require that climate actions should focus on protecting the rights of all those vulnerable to climate change starting with those most affected. Human rights principles articulated in the Development Declaration and other instruments call for such climate action to be both individual and collective and for it to benefit all persons, particularly the most marginalized.[162] The UNFCCC further elaborates upon the need for equitable climate action calling for states, such as Canada, to address climate change in accordance with their common but differentiated responsibilities and respective capabilities in order to benefit present and future generations.[163]

Canadian commitments therefore require international cooperation, including financial, technological and capacity-building support, to realize low-carbon, climate-resilient, and sustainable development, while also rapidly reducing greenhouse gas emissions. Only by integrating human rights in climate actions and policies, and empowering people to participate in policy formulation, can Canada promote sustainability and ensure the accountability of all duty-bearers for their actions. This, in turn, will promote consistency, policy coherence and the enjoyment of all human rights.

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[159] *Ibid*.
[160] *Ibid*.
[161] *Ibid*.
[162] *Supra* note 43.
[163] *Supra* note 22.

8.1.1.1. A "Permissionless Innovation" approach to technology policy in Canada

Those involved in the development of technology have often advocated for a "permissionless innovation" approach to AI research and development. This tenet proposes that experimentation with new technologies and business models should generally be permitted by default.[164] In other words, unless a compelling case can be made that a new invention will bring serious harm to society, innovation should be allowed to continue unabated and problems, if any develop, can be addressed later.[165] Where policy interventions are deemed needed, proponents of permissionless innovation "advocate for flexible, bottom-up solutions of an *ex post* (responsive) nature as always preferable to rigid, top-down controls of an *ex ante* (anticipatory) nature."[166]

This approach will facilitate innovation and creativity, whereas a proactive approach to technology policy will stifle creativity and hinder the technology industry from progressing; the result of the "precautionary" or proactive approach will be fewer services, lower-quality goods, higher prices, diminished economic growth, and a decline in the overall standard of living.[167] The principle of permissionless innovation, however, has fueled the success of the Internet and much of the modern technology economy in recent years, and it is set to power the next great industrial revolution of AI technology.[168]

While it would seem self-evident that pro-innovation attitudes matter and that a general embrace of risk-taking and commercial pursuits is crucial to unlocking entrepreneurial creativity and opportunities, scholars have typically failed to put a name on this disposition. "Permissionless innovation" is a phrase of recent (but uncertain) origin that nicely summarizes that vision.

8.1.2. International

A key question to which answers are far from clear, is how much of this effort could benefit from direct international cooperation. In order to foster policy coherence and help ensure that climate change mitigation and adaptation efforts are adequate, sufficiently ambitious, non-discriminatory and otherwise compliant with human rights obligations, the following considerations should be reflected in all climate action policy plans:

Under core human rights treaties, States acting individually and collectively are obligated to mobilize and allocate the maximum available resources for the progressive realization of economic, social and cultural rights, as well as for the advancement of civil and political rights and the right to development.[169] The failure to adopt reasonable measures to mobilize available resources to prevent foreseeable human rights harms caused by climate change breaches this obligation. Innovative measures such as carbon taxes, with appropriate safeguards to minimize negative impacts on the poor, can be designed to internalize environmental externalities and mobilize additional resources to finance mitigation and adaptation efforts that benefit the poorest and most marginalized.

The UN Charter, the ICESCR, and other human rights instruments impose upon States the duty to cooperate to ensure the realization of all human rights.[170] Climate change is a human rights

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[164] Grubb, Michael. "Technology Innovation and Climate Change Policy" (2004) 41:2 KEIO Econ St 103 at 129.
[165] *Ibid*.
[166] *Ibid* at 130-131.
[167] *Ibid* at 142.
[168] *Ibid* at 144.
[169] United Nations. "Charter of the United Nations" (1945) at art 55(b); ICESCR, *supra* note 42 at art 2.1; HR Declaration, *supra* note 41 at art 22; ICCPR, *supra* note 49 at art 1.2; Development Declaration, *supra* note 46 at art 3.3.
[170] *Ibid*.

threat with causes and consequences that cross borders; thus, it requires a global response, underpinned by international solidarity. States should share resources, knowledge and technology in order to address climate change. Pursuant to relevant human rights principles, climate assistance must be adequate, effective and transparent, it must be administered through participatory, accountable and nondiscriminatory processes, and it must be targeted toward persons, groups, and peoples most in need. States should engage in cooperative efforts to respond to climate-related displacement and migration and to address climate-related conflicts and security risks.

Finally, the ICESCR also states that everyone has the right to enjoy the benefits of science and its applications.[171] All States must actively support the development and dissemination of new climate mitigation and adaptation technologies including technologies for sustainable production and consumption. Environmentally clean and sound technologies should be accessibly priced, the cost of their development should be equitably shared, and their benefits should be fairly distributed between and within countries. Technology transfers between States should take place as needed and appropriate to ensure a just, comprehensive and effective international response to climate change. States should also take steps to ensure that global intellectual property regimes do not obstruct the dissemination of mitigation and adaptation technologies while at the same time ensuring that these regimes create appropriate incentives to help meet sustainable development objectives.

8.2 *Institutional Actions in Support of Policy Actions*

8.2.1 National

To become a leader in the development and deployment of clean technologies, Canada needs a strong flow of innovative ideas. Government investments in clean technology research, development, and demonstration will create the largest benefit where coordinated and focused in areas that will most effectively help Canada to meet its climate change goals, create economic opportunities, and expand global-market opportunities.[172] One of Canada's commitments under the Framework is to facilitate efforts to coordinate and focus investment beyond governments and involve the collaboration of industry, stakeholders, academia, and Indigenous Peoples in the innovation process.[173] It also has the goal of developing international partnerships which will create new economic opportunities, build areas of shared expertise, and foster stronger bilateral relations.[174]

These goals can be achieved through the establishment of a National AI Research and Development Centre. This Centre will aid in the establishment of a set of objectives for federally funded AI research, both within and outside of government, such as in academia. The ultimate goal of this research is to produce new AI knowledge and technologies based on the work and input of participants from various fields such as computer science, law, engineering, business, medicine, etc. that provide a range of positive benefits to societ. A plan for a similar Centre has been established by the National Science and Technology Council in the United States.[175] They

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[171] *Supra* note 39 at art 1(b).
[172] Government of Canada. 2018. "Canada's action on climate change: clean technology, innovation, and jobs" accessed on 05 April 2018: https://www.canada.ca/en/services/environment/weather/climate change/climate-action/clean-technology-innovation-jobs.html.
[173] *Supra* note 118 at p 37.
[174] *Ibid* at p 38.
[175] National Science and Technology Council of the Executive Office of the President of the United States (2016), *Artificial Intelligence Research and Development Strategic Plan*, accessed on 19 February 2018: https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf.

have proposed that Centres such as the one suggested should be established with the following strategies, and Canada's proposed National Centre will benefit from the same:

- Maintain long-term investments in AI research.[176] Prioritize investments in the next generation of AI that will drive discovery and insight and enable the Canada to position itself as a world leader in AI.
- Understand and address the ethical, legal, and societal implications of AI.[177] Research is needed to develop methods for designing AI systems that align with ethical, legal, and societal goals.
- Develop shared public datasets and environments for AI training and testing.[178] The depth, quality, and accuracy of training datasets and resources significantly affect AI performance. Researchers need to develop high quality datasets and environments and enable responsible access to high-quality datasets as well as to testing and training resources.
- Measure and evaluate AI technologies through standards and benchmarks.[179] Research is needed to develop a broad spectrum of evaluative techniques.

Canada is already taking steps in the right direction with it's Sustainable Development Technology Canada (SDTC) program. The SDTC program provides funding support to companies across Canada to develop, demonstrate, and deploy innovative new clean technologies.[180] SDTC has also launched joint funding opportunities in collaboration with Emissions Reduction Alberta and Alberta Innovates and partners with the Ontario Centres of Excellence to enhance Ontario's Greenhouse Gas Innovation Initiative.[181] SDTC estimates its projects "have reduced annual emissions by 6.3 Mt of CO2e, generated $1.4 billion in annual revenue, and supported more than 9200 direct and indirect jobs."[182]

Through its participation in Mission Innovation, the Canadian federal government has also committed to double its investments in clean energy research and technology development over five years, while encouraging greater levels of private sector investment in transformative clean energy technologies.[183] On November 14, 2016, Canada and 21 other Mission Innovation partners launched seven Innovation Challenges aimed at catalyzing global research efforts in areas that could provide significant benefits in reducing GHG emissions, increasing energy security, and creating new opportunities for clean economic growth.[184]

8.2.2. International

National efforts to develop AI policies, should, from the very beginning, be coordinated and supported by an international regulatory framework to avoid the risks stemming from the imperfect interaction of fragmented domestic regulatory approaches. Against this background, it is proposed that the Canadian government help establish a new intergovernmental organization — which could be named the Global Consortium for AI Ethics and Policy ("GCAIEP") — to serve as an international forum for discussion and engage in international standard setting activities. The GCAIEP should unite a diverse group of stakeholders from public sector, industry, and

[176] *Ibid* at 16.
[177] *Ibid* at 26.
[178] *Ibid* at 30.
[179] *Ibid* at 32.
[180] *Supra* note 160.
[181] *Ibid*.
[182] *Ibid*.
[183] *Ibid*.
[184] *Ibid*.

academic organizations, whose interdisciplinary expertise can support policymakers in the overwhelming and crucially important task of regulating this novel, immensely complex, and largely uncharted area. Such a wide-scale, in-depth cooperation among all interested stakeholders at this early stage will put Canadian national and international policymakers in the position to take proactive action instead of lagging behind technological innovation with potentially devastating implications.

Programs facilitated through the GCAIEP will include Technology & Knowledge Transfer between participating countries.

8.2.2.1. Technology and Knowledge Transfer

In the context of climate change, the IPCC defines technology transfer "as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organizations ("NGO"s) and research/education institutions."[185]

The benefits of technology and knowledge transfer to the recipient country depend on the type of transfer. Embodied technology transfer occurs through the importation – or flow – of equipment into a country.[186] In such cases, the technology is embodied in the imported equipment.[187] Disembodied technology transfer involves the flow of know-how or experience, for example, through demonstration projects, training of local staff, and/or local firms hiring staff from multinational firms operating in the recipient country.[188]

Technology transfer may come from public or private sources. Public funding includes aid from governments or non-governmental organizations, typically in the form of Official Developmental Assistance ("ODA").[189] Compared to private investment, ODA flows are low but are important in areas of the world that receive little foreign investment.[190] In the case of climate change, such aid often involves international cooperation. For example, the United Nations Development Program, United Nations Environment Program, and World Bank jointly implement the Global Environment Facility ("GEF"), which provides grants for projects in developing countries that protect the global environment.[191] Although GEF projects are not devoted specifically to climate change, biodiversity and climate change are the categories that receive the most funding.[192] Since 1991, "the GEF has invested almost $2 billion in climate change projects, of which 90% has gone to energy efficiency, renewable energy, GHG reduction, or sustainable transportation."[193]

A country may also acquire new technology via international trade, with the technology embodied in the good being traded. Trade is an increasingly important source of new technologies.[194] Absorptive capacity describes a country's ability to conduct research to

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[185] Goul, Michael. "Artificial intelligence technology transfer in computer information systems: The Arizona State University perspective" 4:2 *Expert Systems with Applications* 203 at 210.
[186] *Ibid* at 208.
[187] *Ibid*.
[188] *Ibid* at 209.
[189] Harris, Larry R. "Experience with INTELLECT: Artificial Intelligence Technology Transfer" (1984) 5:2 *AI Magazine* 43 at 45.
[190] *Ibid*.
[191] Global Environment Facility. 2018. "About Us: Organization" *World Bank Group* accessed on 14 February 2018: https://www.thegef.org/about/organization.
[192] *Ibid*.
[193] *Ibid*.
[194] *Supra* note 177 at 47.

understand, implement, and adapt technologies that arrive in the country.[195] This affects the speed at which a new technology diffuses through a country.[196] Absorptive capacity depends on the technological literacy and skills of the workforce and is influenced by education, the strength of governing institutions, and financial markets.[197]

9. COUNTER-ARGUMENTS & RESPONSE

9.1. *The Precautionary Principle is a better approach to innovation policy*

The concept of permissionless innovation stands in stark contrast to the sort of "precautionary principle" thinking that often governs policy toward emerging technologies. The precautionary principle refers to the belief that new innovations should be curtailed or disallowed "until their developers can prove that they will not cause any harms to individuals, groups, specific entities, cultural norms, or various existing laws, norms, or traditions."[198] Canada has strongly advocated for and applied this principle, as a "better safe than sorry" approach, to developing legislation, regulation and policy for emerging technologies. Through these preemptive constraints, however, opportunities for experimentation are stifled. While some steps to anticipate or control for unforeseen circumstances are sensible, excessive safeguarding forecloses opportunities and experiences that offer valuable lessons for individuals and society.

Permissionless innovation is not an absolutist position that rejects any role for government. Rather, it is an aspirational goal that stresses the benefit of "innovation allowed" as the default position to begin policy debates. It switches the burden of proof to those who favor preemptive regulation and asks them to explain why ongoing trial-and-error experimentation with new technologies should be disallowed. Innovation is more likely in systems that maximize breathing room for ongoing economic and social experimentation, evolution, and adaptation. Societies that appreciate those values-and allow them to influence both social norms and policy decisions-are likely to experience greater economic growth.[199] By contrast, those that deride such values and adopt a more precautionary policy approach are more likely to discourage innovation.

Unlocking long-term growth opportunities, therefore, depends upon a rejection of precautionary principle thinking and an embrace of permissionless innovation as the default policy disposition.

9.2. *Technological Development contributes to Climate Change*

A consistent issue with technological development is industrialization, which has undoubtedly continued to affect the environment in a negative way.[200] This is evidenced by increasing international discussions and consultations through conferences and meetings.[201] A major theme in such meetings is on environmental violations resulting from technology.[202]

Some have argued that technology is not a solution to climate change; instead, it further perpetuates its negative effects.[203] There seem to be three major negative impacts of

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[195] *Ibid* at 48.
[196] *Supra* note 173 at 211.
[197] *Ibid*.
[198] Thierer, A. "Does 'Permissionless Innovation' even mean anything?" (18 May 2017) *Tech Liberation Magazine*, accessed on 10 March 2018: https://techliberation.com/2017/05/18/does-permissionless-innovation-even-mean-anything/.
[199] Foray, Domonique and Arnulf Grubler. 2000. "Technology and the Environment: An Overview" 53 *Technological Forecasting and Social Change* 3 at 5.
[200] *Ibid*.
[201] *Ibid*.
[202] *Ibid*.
[203] *Ibid* at 7-8.

technology on environment discussed in the literature: First, environmental pollution results from waste output contributed by "trial and error" methods, as promoted by permissionless innovation.[204] Second, energy consumption caused by technological development processes contributes to unsustainability.[205] Third, there is a significant depletion of natural resources and ecological imbalances experienced as result from technological development, related to the second point.[206]

A higher percentage of environmental problems is a direct result of technology mismanagement by innovators and users.[207] A small portion of environmental issues relate to economic, social and natural changes resulting from human activities.[208] Environmental pollution, ecological systems disturbances, depletion of natural resources and climatic changes resulting from global warming are only slightly technologically influenced.[209] Technology is significant in development and increased productivity to satisfy human need, but u*ncontrolled* technology impacts environment negatively.[210]

The effects of technology innovation on the environment are already beginning to be mitigated, however. With programs such as CleanTech Canada and funding incentives such as SDTC, the environmental harms caused by technological development can be mitigated effectively. Furthermore, although permissionless innovation promotes a "trial and error" process which can result in unsustainable innovation practices, this is tempered by monetary incentives, such as the ones previously mentioned, to create using more efficient and sustainable methods.

Finally, Canada's commitment under the Paris Agreement and its implementation of the Framework can assist in controlling the environmental effects of technological innovation if the government works toward establishing a National Centre for AI Research and Development. This will ensure that all AI innovation is done in-house and thus complies with emissions and sustainability standards. The GCAIEP will also aid in controlling the potential harms of technological development through it's Technology Transfer program, where Canada can receive information on sustainable technology development practices used in other countries as well as receive the tools to implement those strategies.

10. CONCLUSION

Canada has a national and international obligation to respect, protect, fulfil and promote all human rights for all persons without discrimination. Failure to take affirmative measures to prevent human rights harms caused by climate change, including foreseeable long-term harms, breaches this obligation. Among other impacts, climate change negatively affects people's rights to health, housing, water and food. These negative impacts will increase exponentially according to the degree of climate change that ultimately takes place and will disproportionately affect individuals, groups and peoples in vulnerable situations, such as Indigenous communities. Therefore, Canada must act to mitigate climate change, including through policy and institutional actions, in order to prevent to the greatest extent possible, the current and future negative human rights impacts of climate change.

Innovation is central to tackling climate change, and this article has sought to review the evidence around the innovation processes relevant to AI development, and the implications this may hold for national and international policy and institutional responses to climate change. This

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[204] *Ibid* at 8.
[205] *Ibid*.
[206] *Ibid*.
[207] *Ibid* at 11.
[208] *Ibid*.
[209] *Ibid* at 12.
[210] *Ibid*.

article suggests that understanding and fostering innovation may offer a very important contribution to the development of and compliance with Canada's national and international human rights commitments. The Canadian government, and many other States, have stressed the importance of technology as a response to the effects of climate change. It is time that the government move toward taking actions so that this response can be implemented in an effective and meaningful way.

This article has outlined the opportunities and challenges in considering national and international technology oriented responses to tackle climate change and, in turn, enhance human rights. The main point is a call for clarity: there are many different possible kinds of technology operation, policy plans and institutional responses, and some are more credible, and more useful, than others. Again, these proposed solutions present a starting point for the Canadian government to build on the research presented and take immediate action. There are numerous ways to implement AI technology to address the human rights impacted by climate change, and the options presented are limited to the research capacity of the author, as well as the page-length of this article. It is highly encouraged that further research be conducted in this area, but that actual steps be taken toward consolidating those findings into thorough action plans and direct action. The challenge now is to identify which approaches might offer a realistic, substantive contribution to solving the climate problem.