Envisioning a Sustainable Future:

Recommendations for a Canadian Energy Transformation

University of Western Ontario
International Relations Capstone Project

To our esteemed professor, the late Col. Brock Millman.

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Land Acknowledgement

The International Relations Class of 2020 acknowledges that Western University is located on the traditional lands of the Anishinaabek, Haudenosaunee, Lūnaapéewak and Attawandaron peoples, on lands connected with the London Township and Sombra Treaties of 1796 and the Dish with One Spoon Covenant Wampum. We, as a collective, recognize the distinct relationship that the Indigenous communities have with the land, being its first caretakers. We are focused on highlighting the voices of Indigenous communities, activists, and hereditary leaders in this report.

Our report is founded on the belief that open dialogue and a genuine understanding of Indigenous communities' rights and concerns will allow us to create policies that are focused on reconciliation and collaboration with the original stewards bearing rights to the land we inhabit. We recognize the longstanding injustices that Indigenous peoples face in Canada and aim to listen and create partnerships with communities to promote reconciliation.

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Executive Summary

Canada is currently presented with a major opportunity to diversify its economy while mitigating the negative impacts of climate change, by embarking on an ambitious energy transition. The transition proposed in this report involves significant decreases in Canada's reliance on non-renewable energy sources, accompanied by increases in Canada's usage of renewable and nuclear energy. The ultimate goal presented in this report is for Canada to reach net-zero carbon emissions while leading by example on the world stage as an international energy innovator.

Every Canadian province and territory varies in its energy consumption, policies, and capabilities, each of which require careful consideration in designing an effective energy transition plan for Canada. For example, British Columbia's energy production comes almost entirely from renewable energy, whereas almost half of Alberta's energy comes from coal, and most of Nunavut is powered by diesel fuel. Due to this variation in energy consumption patterns across the country, each province and territory requires individually-tailored policy recommendations for how to accomplish an energy transition. These will be outlined in this report.

Transitioning to a carbon-neutral economy will present Canada with political, economic, social, and environmental obstacles that may produce apprehension about the change. Energy transitions are costly and time-consuming, which does not appeal to politicians who are looking for short-term gains in time for the next election. On the other hand, individuals may become fearful of their livelihoods being disrupted by drastic change, Indigenous communities may be at risk of being oppressed and ignored, all while a rapid transition may initially increase greenhouse gas emissions. These concerns are all relevant considerations in crafting energy transition policies. Accordingly, this report will thoroughly consider each concern in its recommendations for a transition.

Canada's energy transition requires change in several different sectors including transportation, technology, trade, financial policy, and labour policy. Particular care must be taken to ensure that the transition is just; no one group should unfairly bear the cost of a national energy transition. In embarking on this transition, the government must also be sure to communicate the change in a way that emphasizes both the short- and long-term benefits to stakeholders.

This report will demonstrate that a transition to sustainable energy is not only possible, but is in Canada's best interest. Ultimately, the recommendations provided herein seek to offer the Government of Canada a blueprint outlining how to seize this opportunity, while carefully considering the diverse interests of all stakeholders involved, and positioning Canada as a global leader in sustainable energy.

Introduction

Vision

Climate science demands swift reductions in carbon emissions. Western University's International Relations Class of 2020 see this challenge as an opportunity for Canada to seize a moment of transition; to transform our economy, futurize our energy, create a more just society, and become a world leader in global energy innovation. Our mission is to initiate action through federal, provincial, and municipal governments in order to reach net-zero carbon emissions by rapidly shifting away from the use and production of fossil fuels, while developing greater renewable and nuclear energy infrastructure. We propose that these domestic advances intertwine with the international sphere as we invest in and share technology on a global scale and work with like-minded states to decarbonize the world economy. We envision Canada as an international leader in building a green and just economy for the future, rooted in bold action now.

Principles

While current policies are moving towards a low-carbon future, they lack a shared vision of what the energy transition will entail, and fail to engage those members of society most impacted; current policies are fragmented and lack capacity, accountability, and enforcement. In order to adapt to a carbon-neutral sustainable energy economy, sustainable infrastructure, along with institutional and public support, will be required to adjust to potential damage, capitalize on opportunities, and respond to consequences. Drawing on the need for sustainable infrastructure, transformation to new institutions able to withstand the physical consequences of climate change, such as rising sea levels and intensified storms, would strengthen remote and Indigenous populations, as well as the developed energy sources that are vulnerable to climate change. We aim to offer solutions to implement an equitable transition to sustainable sources of carbon-neutral energy while addressing economic and social inequalities. The solutions we offer are therefore aimed at protecting working class individuals and Indigenous peoples from shouldering the burden of the shift to renewables. We aim to encourage various stakeholders to invest in sustainable energy sources and increase the number of sustainable energy projects undertaken at the national, provincial and local levels, ensuring collaboration with Indigenous peoples and other impacted groups along the way.

Targets

The 2015 Paris Agreement under the United Nations Framework Convention on Climate Change (henceforth "Paris Agreement"), is an international treaty that aims to reduce global emissions in an effort to combat climate change.[1] Canada has ratified this agreement which sets forth a target to limit the global average temperature rise to below 2°C. The targets set by the Paris Agreement have informed our recommendations, however, the basis of this report is not simply to adhere to the targets set by the treaty. Rather, we propose that Canada immediately pursue a more ambitious energy transition and globally lead by example as an international energy innovator.

To this end, we propose that Canada reduce its use and production of fossil fuels to the lowest possible extent, reach net-zero carbon emissions, replace fossil fuels with renewable and nuclear energy, convene an international coalition of like-minded states committed to taking action to fulfil this vision, and ensure the transition is just and equitable in its distribution of costs and benefits to all stakeholders. Considering the wide array of moving parts in an energy transition, it is difficult to project a strict timeline for completion - what is crucial is that the starting point is now. The Canadian government must embark upon this ambitious transition immediately.

Audience

Governments

Why are we aiming this policy at the Canadian federal, provincial, and territorial governments? We believe that Canada, as the sixth largest energy producer in the world, can and should take up the role of an energy innovator, both at home and abroad. In 2018, Canada's energy exports were valued at $132.2 billion, and in total the energy sector accounted for $230 billion of Canada's nominal gross domestic product (GDP).[2]

Nonetheless, we believe that the climate change we see today is anthropogenic, particularly due to the use of non-renewable, greenhouse gas-emitting fossil fuels. Canada is also one of the largest consumers of energy per capita in the world. Thus, we address this report to the Canadian governments at the federal and provincial levels so that they can lead the way to a transition towards renewable and nuclear energy. We propose incentivizing the pursuit of sustainable energy sources, sharing of technological discoveries and implementation methods, ensuring an equitable transition to all stakeholders, and leading by example on the global stage.

Although the provincial governments have constitutional jurisdiction over most of their energy resources, the federal government is in charge of building and operating international power transmission lines, oil and gas pipelines, international energy trade, as well as providing general national oversight and mitigating the adverse effects of climate change. Thus, the federal government plays a critical role in coordinating energy communications and trade across the provinces, and must be active in leading the energy transition domestically and internationally.[3] One example of how the federal government has been facilitating the transition is through the Emerging Renewable Power Program, which "provides up to $200 million to expand the portfolio of commercially viable renewable energy sources available to provinces and territories as they work to reduce greenhouse gas emissions from their electricity sectors."[4]

Several provinces and territories have also taken up the call to an energy transition. Manitoba, for example, has developed a Climate Change and Green Economy Action Plan, which outlines its goal to be completely carbon neutral by 2080.[5] Northwest Territories is a leader in terms of solar electricity sources installed per person, and it reduced its greenhouse gas emissions from electricity by 25% in 2017.[6] Yukon Territory and British Columbia are both at approximately 94% renewable electricity.[7, 8] This highlights a few of the many ways in which some of the provinces are already embarking on an energy transition. We believe that each of these regions are well equipped to continue with the energy transition at both the provincial and national levels.

However, there is more work to be done. We are petitioning all levels of government to take on sustainable energy projects that will prevent further climate change, achieve emissions targets, and take on an equitable approach to the energy transition.[9]

The Public

How can the public benefit from the information contained in this policy? We understand that there are concerns about the transition to renewable and nuclear energy, including but not limited to the loss of jobs in the non-renewable sector, fears of nuclear energy, and skepticism about renewable energy projects such as hydroelectric dams and wind farms. We also understand that some people are more concerned about the effects of climate change and the shifts to renewable and nuclear energy than others, and that this concern depends on a variety of factors, such as their ties to the fossil fuels sector.[10]

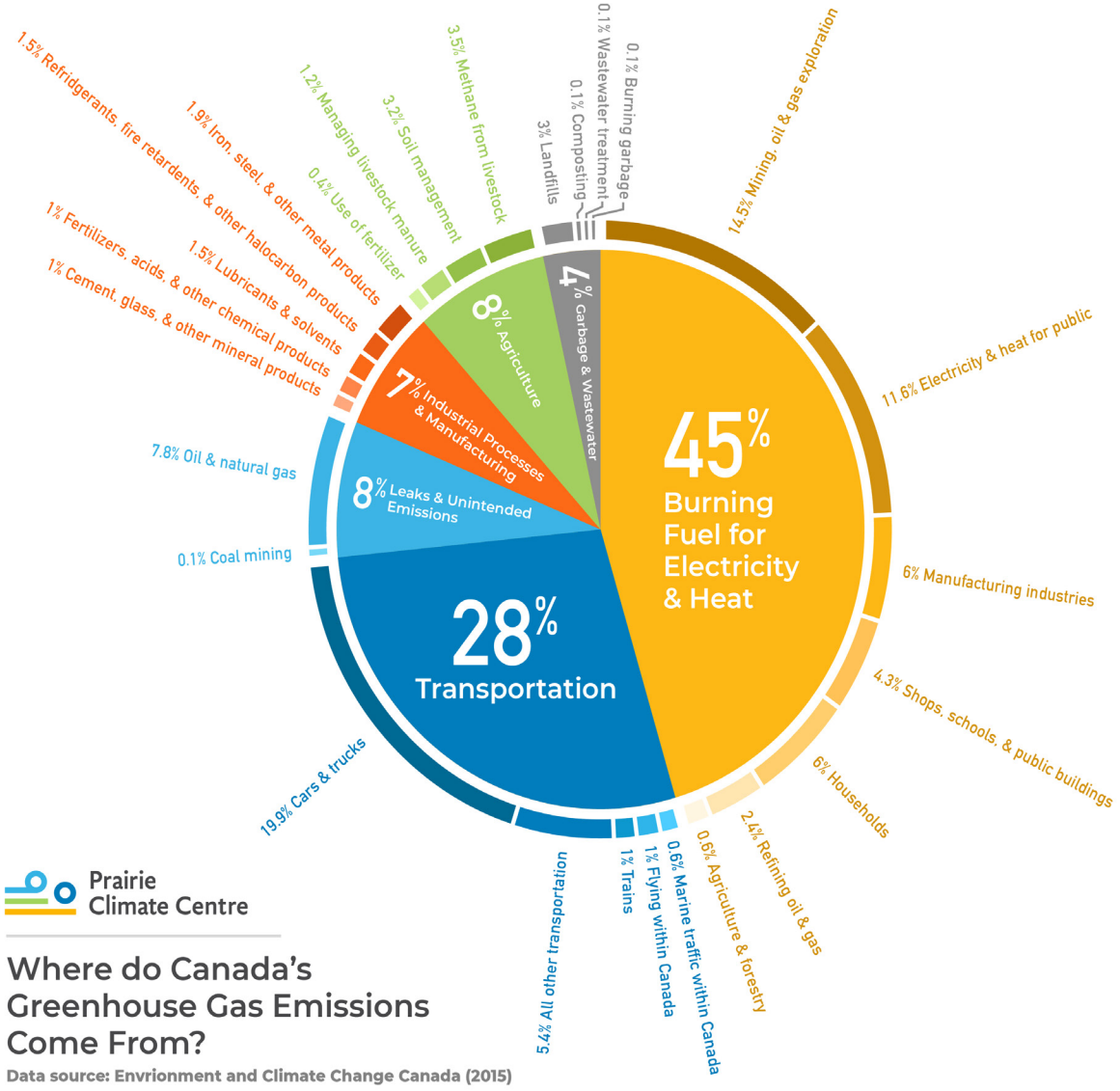
Furthermore, it is critical that we acknowledge the impacts the transition could have on Indigenous peoples. On one hand, the fossil fuels industry has destroyed and built pipelines across First Nations territory without adequate consultation, and sometimes in violation of the United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP). As per Section 35 of the 1982 Constitution, Indigenous people must be "consulted" if their land is predicted to be affected by any kind of project. However, "consulted" has many different interpretations, which can complicate an already ambiguous criterion.[11] This, of course, is an oversimplification of the complex process of consultation and the disappointing history of government and corporate violations of Indigenous rights. On the other hand, major renewable projects such as hydroelectric dams can have similar effects on Indigenous peoples and territories.[12] Thus, our report has taken indigenous rights into consideration at every step of the drafting process.

Overall, our report seeks to address and mitigate these concerns in order to ensure an equitable transition for those parties that have a stake in the issue. We do not want to diminish the importance of the oil and gas sector in the Canadian economy and leave oil and gas workers feeling as if they are disposable; rather, we want to promote the need to strengthen our economy through diversification that also addresses the issue of carbon emissions from burning fossil fuels. We believe our proposal is non-partisan and for the benefit of Canada as a whole.

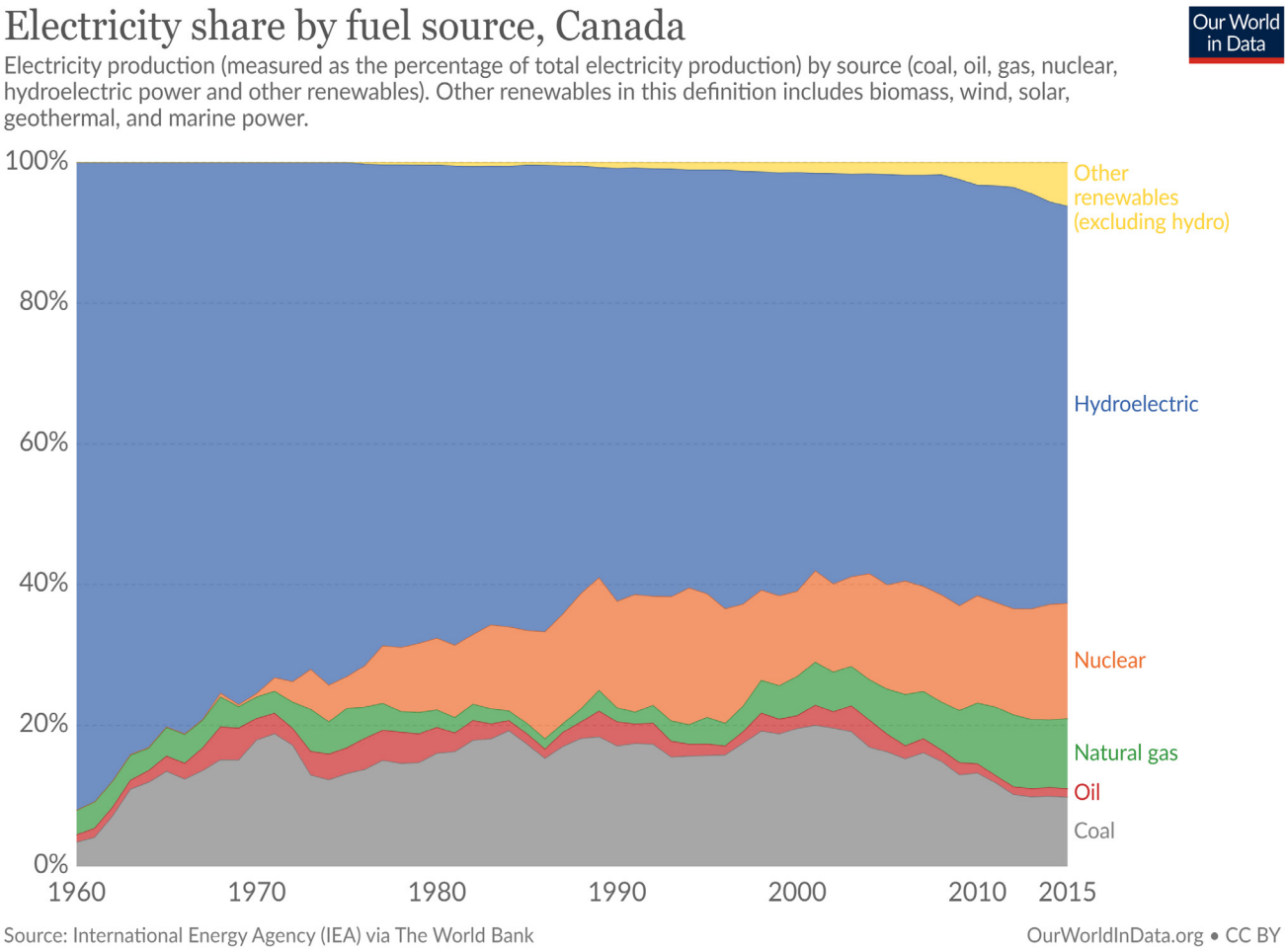
Corporate

How can Canadian businesses benefit from the information contained in this policy? A large amount of the country's greenhouse gas emissions are industry-based – in fact, industry emissions comprise 42% of Canada's total greenhouse gas emissions.[13] As a result, the energy transition that we are advocating for in this report cannot be accomplished without the transformation of key industry players. Key sectors include corporate transportation, industrial processes and manufacturing, as well as agriculture.

In the following report, industry leaders will find innovative policy proposals that can be adopted in order to contribute to Canada's energy transition, and thus elevate the country to be a leader in sustainable energy. Through in-depth analyses and research, we have demonstrated that despite the mainstream narrative, industries will benefit economically from the transition to sustainable energy. We hope that this report will encourage industry leaders to recognize the urgent need to reduce greenhouse gas emissions and contribute to Canada's energy transition towards a more sustainable future for all.



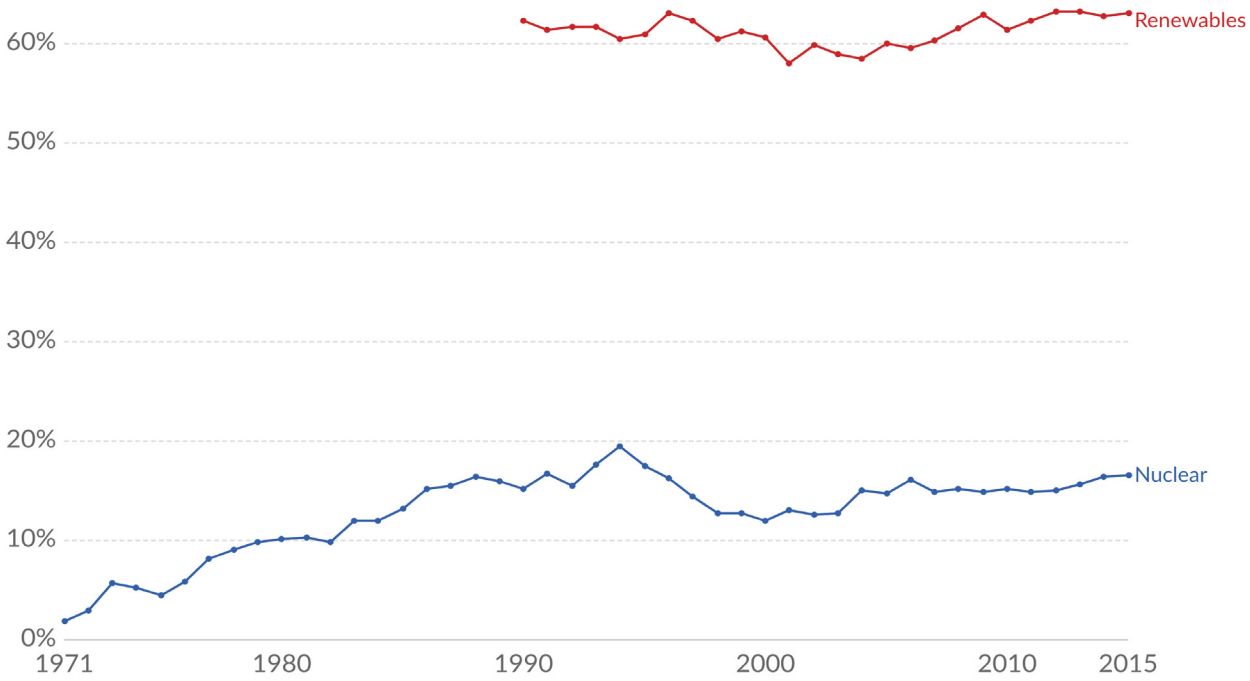
ENERGY 101
Overarching Graphs



The share of nuclear and renewables in total electricity production, Canada

Our World in Data

Percentage contribution by nuclear, and contribution of non-nuclear renewable sources to global electricity production.
In this case, 'renewable electricity' includes hydropower, biomass, wind, solar, geothermal and marine production; it does not include nuclear.



Source: International Energy Agency (IEA) via The World Bank

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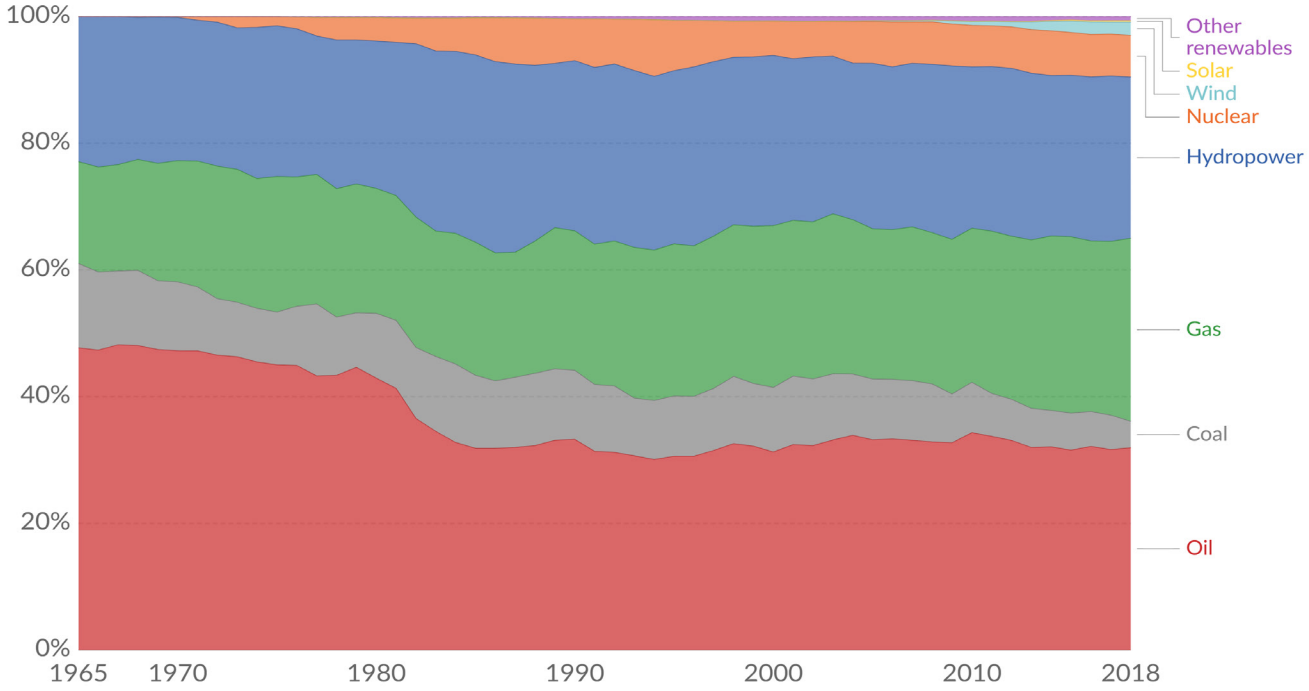
Energy consumption by source, Canada

Our World in Data

Energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.



Source: BP Statistical Review of World Energy (2019)
Note: 'Other renewables' includes geothermal, biomass and waste energy.

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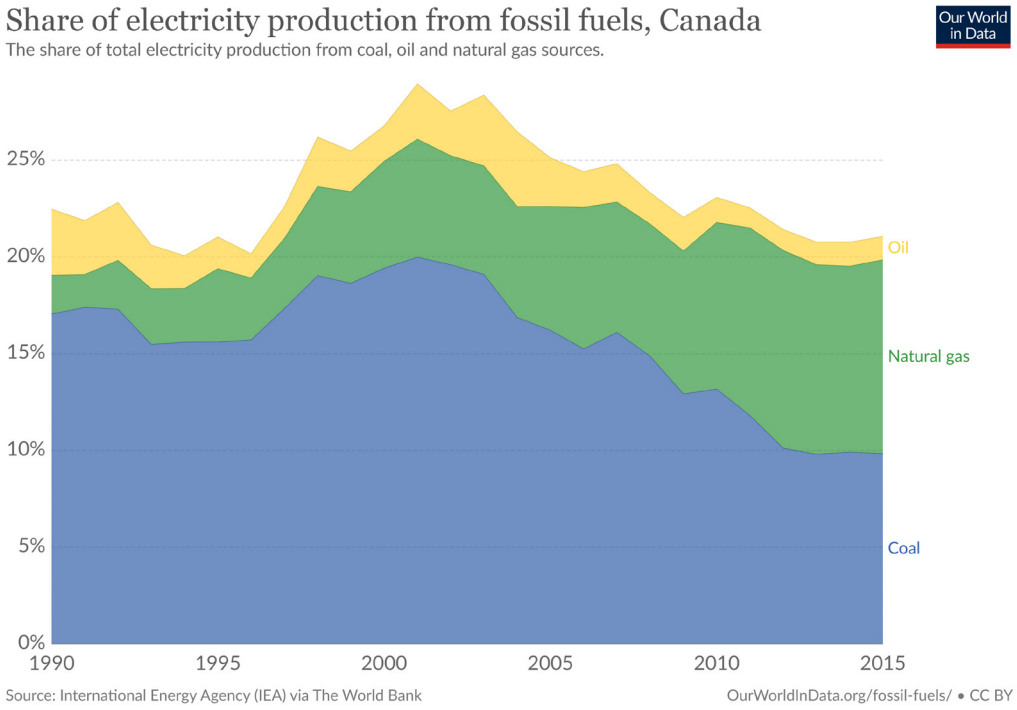
Non-Renewable Energy

Non-renewable energy sources are those sources that once depleted cannot be regenerated. While there is a finite amount of non-renewable energy available for human extraction, the greater concern is how these sources, the largest being the burning of fossil fuels, have lasting impacts on the climate due to their carbon emissions.



Canada's Non-Renewable Energy Production and Consumption: Oil

Crude oil is a thick, flammable, yellow-black liquid that is a "mixture of gaseous, liquid, and solid hydrocarbons that occurs naturally beneath the earth's surface."[14] It is a type of petroleum product. When referring to crude oil, "petroleum" and "oil" are often used interchangeably.[15]

Crude oil is refined to make a variety of petroleum products. Canada's oil sands contain a form of petroleum called bitumen, which is mixed with sulfur, heavy metals, and sand.[16] One barrel of petroleum produces about 19 gallons (72 litres) of gasoline.[17] Other petroleum products include transportation fuels, heating oil, gases like propane and butane, lubricating oils, greases, waxes, and asphalt. Transportation fuels (gasoline, diesel, aviation fuels) accounted for 80% of petroleum products sold in Canada in 2017.[18] Canada is the world's fourth largest exporter (3.7 MMb/d in 2018) and producer (4.55 MMb/d in 2018) of oil. In 2018, Canadians consumed 100 billion litres of refined petroleum products, of which transportation fuels accounted for 80%.[19]

Coal

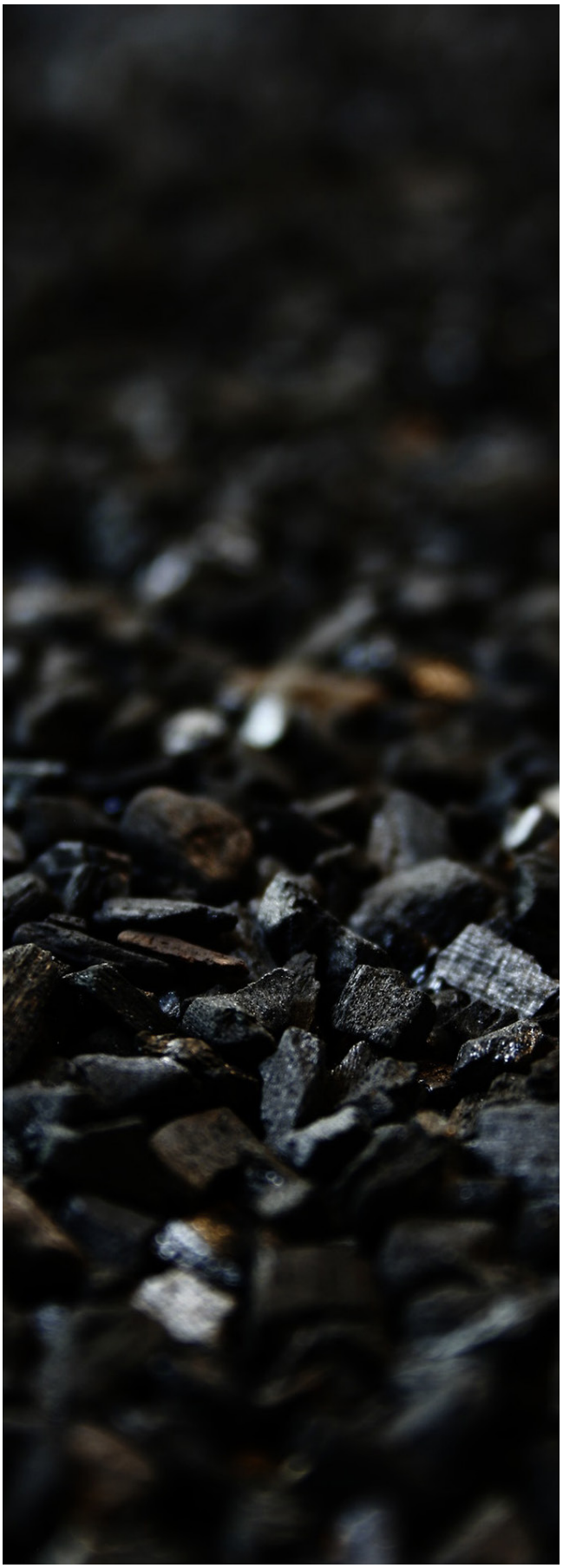
Coal is an altered form of prehistoric vegetation that is processed to release the stored energy found in this vegetation. Essentially, "the energy we get from coal today comes from the energy that plants absorbed from the sun millions of years ago."[20]

The main use of coal in Canada is electricity generation, as Canada is the world's fourth-largest exporter of metallurgical coal.[21] Alberta and British Columbia produce 85% of Canada's coal. Moreover, Canada is home to 24 permitted coal mines – 19 of which are currently in operation.[22] Coal plays a large part in creating new forms of sustainable energy, as it is used to produce steel. Steel has a critical role to play in building green energy infrastructure as the world transitions to a low-carbon economy. Steel is needed to build wind turbines, solar panels, tidal power systems, and bioenergy infrastructure.[23]

Natural Gas

Natural gas is formed from methane, other hydrocarbons, and non-hydrocarbon gas liquids. Similarly to oil and coal, methane based natural gas comes from the remains of plants and animals built up in thick layers on the earth's surface and ocean floors, sometimes mixed with sand, silt, and calcium carbonate from millions, to hundreds of millions years ago. Over time, pressure and heat change this material into coal, oil or natural gas.

Natural gas is abundant in Canada, particularly in British Columbia, Alberta, and the Northwest Territories, along with some areas of Québec and New Brunswick.[24] Natural gas is used for about 13% of Canada's electricity generation, mostly in household use such as heating, powering appliances, and in some cases being combined with traditional petroleum as transportation fuel.[25]



Nuclear

Nuclear energy is a form of power generation derived from nuclear fission. This process takes place in nuclear reactors, utilizing radioactive elements to produce steam that in turn generates electricity. Nuclear energy can be powered by a limited range of fuel sources, primarily uranium. Canada boasts extensive reserves of high-grade uranium, and is the second largest exporter of uranium in the world.[26] Currently, all Canadian uranium production is located in northern Saskatchewan. However, there are deposits of uranium located in several other provinces.[27] There are also plans in place for the potential expansion of Canada's uranium production into provinces such as Ontario, where uranium mines have previously existed, despite the higher cost of extraction.[28] Thorium is also a potential fuel source for nuclear energy that Canada has significant access to, specifically in Northern Ontario. Previous geological surveys dating back decades affirm the breadth of Canada's access to the uranium and thorium resources.[29]

Nuclear power contributes around 15% of Canada's electricity, with 19 reactions located across the country.[30] The majority of reactors are located in Ontario, where they produce around 60% of the province's electricity.[31] Meanwhile, almost none of Québec's electricity is powered by nuclear energy.[32] Energy generated from nuclear reactors is primarily used for electricity in households and businesses. Nuclear energy is also heavily subsidized by the Canadian government, with the industry receiving nearly $14 billion in investments between 1952 and 2006.[33]

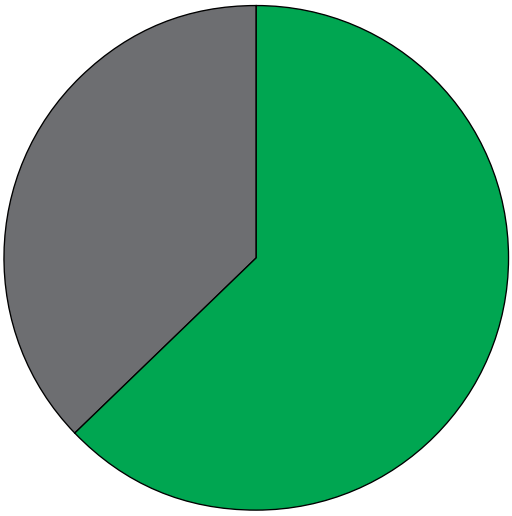
Renewable Energy

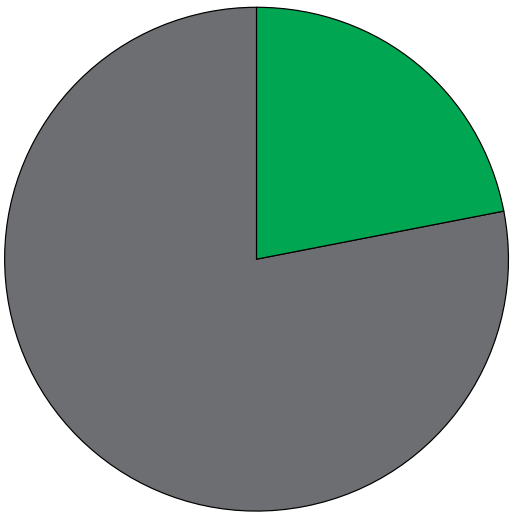
According to Natural Resources Canada, renewable energy is "energy derived from natural processes that are replenished at a rate that is equal to or faster than the rate at which they are consumed." Implementing sustainable energy systems requires the existence of natural resources, technology, and infrastructure, to harness the energy from these renewable sources.[34] Examples of renewable energy sources include solar, hydroelectricity, wind, tidal, geothermal, and biomass. These examples are relevant to Canada's energy transition as they address the need for carbon-neutral, or at least carbon-reduced, sources of energy, when compared to the current leading source of energy-burning fossil fuels.

Canadian Share of Electricity Production from Renewables:
62.8% (2014)

VS

Canadian Share of Final Energy Consumption from Renewables:
22.02% (2014)





Wind

Wind energy is derived from turbines that convert the kinetic energy from wind into electricity.[35] It is common that onshore wind turbines are grouped together to form a "wind farm," which then powers local regions or communities beyond the immediate locality via electric grids.[36] On average, 40-50% of potential kinetic energy from wind can be successfully converted into electricity via wind turbines, so the strategic construction of wind turbines to ensure "maximum energy capture," while prioritizing affordable prices, is crucial.[37]

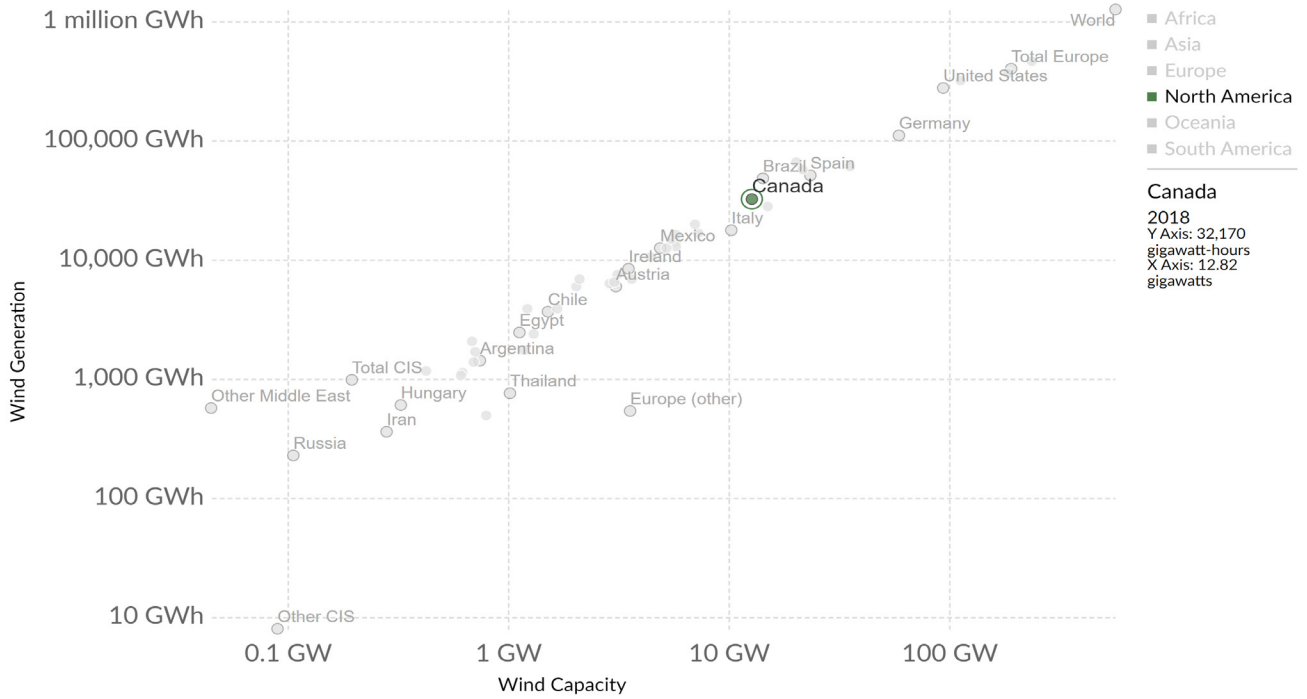
The geography across Canada presents a substantial potential for wind energy development. As of 2018, approximately 4% of Canada's electricity generation is derived from wind energy, however it is one of the most rapidly developing sources of renewable energy across the country.[38] The provinces that are home to the largest capacity of wind energy are Ontario and Québec, respectively.[39]

Tidal

Tidal energy refers to the harnessing of the movement of tides and converting it into electricity, making it an important source of renewable energy, given its predictability.[40] The conversion of tidal movements into electricity is made possible through tidal barrages, which are constructed as dams, to capture the energy of the tide at the "estuary" as it moves from high to low tide, or vice versa.[41] In addition to tidal barrages, tidal fences have also been developed, which consist of turbines constructed across bodies of water with rapidly moving currents, in ways which seek to mitigate any disruptions to marine biodiversity.[42]

Wind energy generation vs. installed capacity, 2018

Wind energy generation, measured in gigawatt-hours (GWh) versus cumulative installed wind energy capacity, measured in gigawatts (GW). Data includes energy from both onshore and offshore wind sources.



Source: BP Statistical Review of Global Energy (2019)

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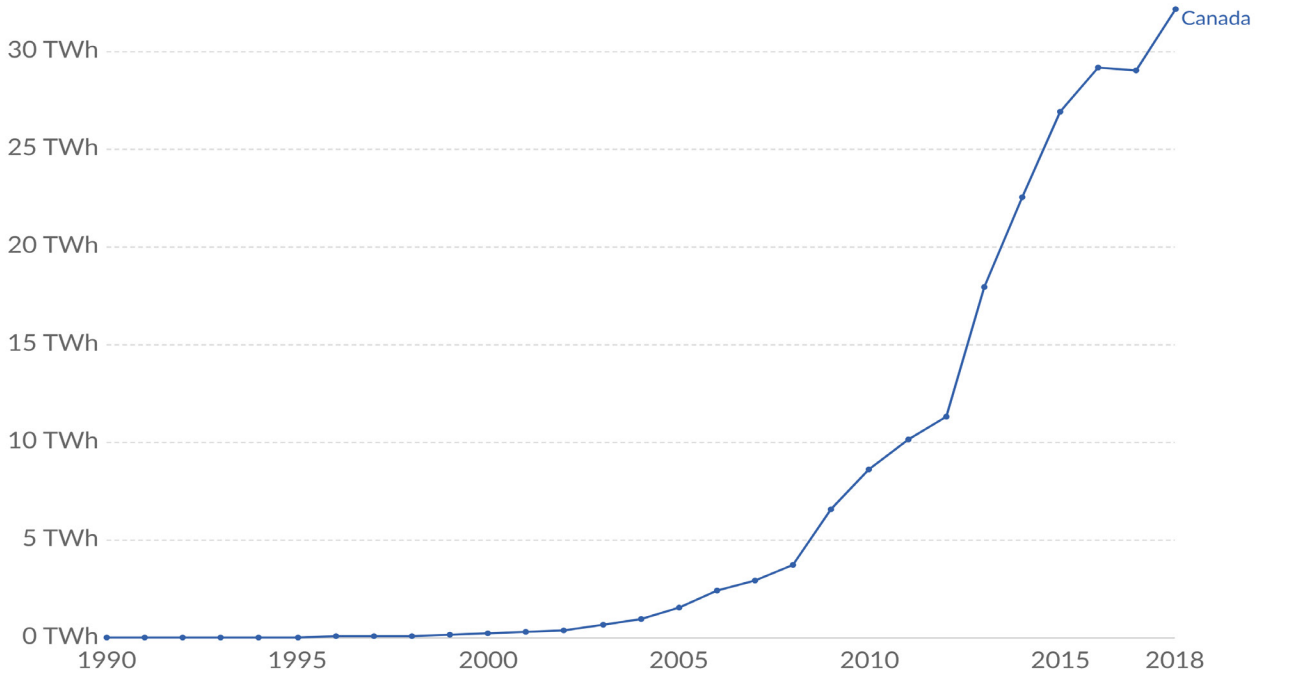
Wind energy generation

Annual wind energy generation is measured in terawatt-hours (TWh) per year. This includes both onshore and offshore wind sources.



Source: BP Statistical Review of Global Energy (2019)

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Tidal energy remains a largely unexplored source of renewable energy, with many uncertainties inhibiting its development in regards to environmental impacts, financial costs, and long-term outlook.[43] It currently accounts for a very small amount of Canada's total renewable energy generation, compromising 0.002%, with there only being one tidal power station residing in Nova Scotia.[44] However, due to Canada's geographic position of being surrounded by three oceans, there is massive potential for the development of tidal energy, especially in the Bay of Fundy.[45]

Geothermal

Geothermal energy refers to the energy generated from capturing the heat below the earth's surface. Heat can be generated in two ways: firstly from natural heat generated by underground steam, and secondly, from manipulating the "temperature differential between outside air and the ground or groundwater." Canada has only undertaken a few pilot projects in Alberta, Saskatchewan, and British Columbia for developing geothermal energy, generating 1,045 MW of installed capacity, and producing approximately 1,420 GW hours equivalent annually.[46]

As previously mentioned, there are only a few pilot projects involving geothermal energy in Canada right now, although there is potential for more to be undertaken.[47] Typically, these projects require a temperature of at least 150°C, which is usually reached 4 km below the earth's surface.[48] One of the biggest obstacles to geothermal energy is its economic feasibility, especially if projects are undertaken in more rural locations. However, as drilling technology advances, this may change.[49] Furthermore, there have been fears that geothermal power facilities may be correlated with increased seismic activity. According to a 2013 study on a Californian geothermal power plant by geophysicist Emily Brodsky, in theory, geothermal projects withdraw vast amounts of water from the ground, leading to net fluid extraction, and thus the shifting of the earth. However, as Brodsky concluded, it may be difficult to extrapolate data from California and apply it to Canadian geography.[50] The main benefit to geothermal energy is its complete lack of emissions upon completion of the geothermal project, although there have also been concerns with methane and carbon dioxide emissions in open-loop systems.[51] However, one geothermal energy site in the US has introduced carbon dioxide injection in order to enhance energy recovery and store CO2 simultaneously, potentially limiting the greenhouse gases emitted from the development of the initial geothermal project.[52]

Hydropower

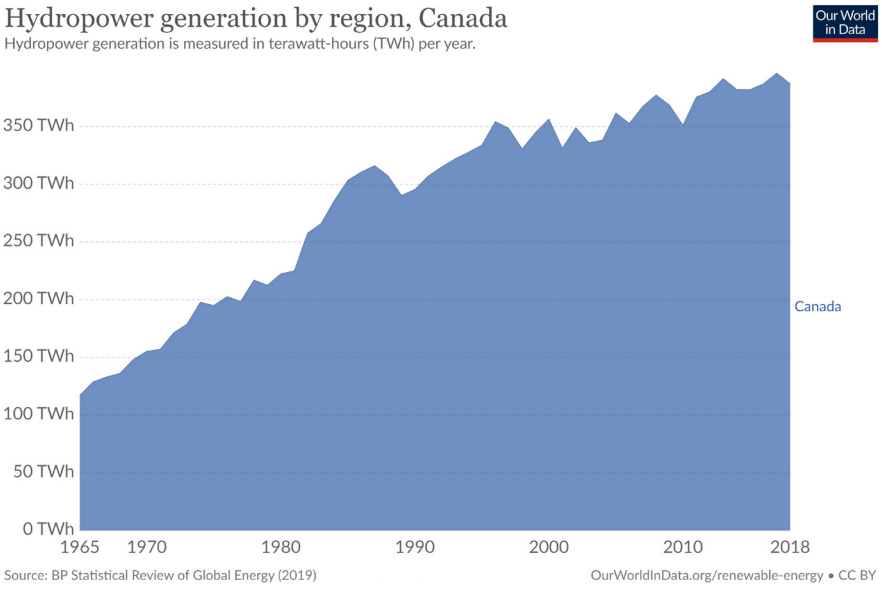
Hydropower refers to a broad category of energy. In this case, our report refers to river hydrokinetic energy and small hydropower, also called "run-of-river" energy. Hydrokinetic energy is harnessed by taking the energy produced by constantly flowing water in rivers, usually through the construction of hydroelectric stations with turbines that are spun by the running water. Dams may also be constructed to manipulate the flow of water. Canada's total potential energy production from river hydrokinetic energy stands at 340 GW.[53] Small hydropower is similar but refers to projects that have between 1-50 MW of capacity. Such projects are more suitable for rural areas and have the potential to produce 15,000 MW of power nationwide.[54]

Hydropower makes up nearly 60% of Canadian electricity generation and is a notable source of energy in provinces such as British Columbia, Manitoba, Québec, Ontario, and Newfoundland and Labrador. Furthermore, Canada produced 378.8 TW of electricity in 2014, making it the second largest producer of hydroelectricity in the world.[55] Thus, hydroelectricity has played and will continue to play a crucial part in Canada's energy transition.

Biofuel

Biofuel is mainly found in two forms: biodiesel and ethanol. Biodiesel is treated as a substitute form of fuel for diesel powered engines.[56] It is made up of renewable materials such as plant oils like canola, waste cooking oil, and animal fats.[57] There are many environmental benefits to the use of biodiesel. It is both renewable and biodegradable, and it has the potential to reduce greenhouse gas emissions by over 80% on a lifecycle basis. Lastly, it can be produced locally within Canada, which provides both environmental and economic benefits.[58]

Ethanol is another type of biofuel that can be produced in Canada. It is an alcohol-based liquid that is obtained through the fermentation of sugar or converted starch in grains.[59] In Canada, ethanol comes from corn or wheat.[60] It is considered to be biomass and it burns cleaner than non-renewable fuels. It is also able to reduce greenhouse gas emissions, as it absorbs carbon dioxide as it grows.[61]



Solar

Solar Power is a renewable energy source that is created through the harnessing of energy from the sun to make it usable.[62] In Canada, solar energy is used to power lighting, heat buildings, and produce electricity.[63] Solar energy power plants absorb solar power to create heat. The heat is then in turn used to move turbines that generate electricity.[64] The benefits of this renewable energy source is that it is pollution-free. Solar power is growing increasingly popular in its usage. Namely, in Canada, the usage of solar power has increased at a growth rate of 13.8% since 2004.[65]

Obstacles to Transition

The current federal Government of Canada has promised to take "real, ambitious action" to address the climate crisis.[66] Canada has agreed to meet the Paris Agreement's goal of limiting the rising global temperature to 2°C by 2030, and has established a Pan-Canadian Framework (PCF) dedicated to meeting this target.[67] An energy transition – from non-renewable energy sources to nuclear and renewable energy sources – is essential to meet this target and to avoid the worst impacts of climate change. The federal government is addressing this energy transition through various proposed policies, such as decreasing oil and gas emissions by 40-45% by 2025, investing in renewable energy infrastructure, and introducing a carbon tax.[68] However, the government's self-portrayal as an environmental steward is concealing inaction, as well as contradictory actions. On one hand, the government is committed to net-zero carbon emissions by 2050, but on the other, it continues to subsidize the fossil fuel industry and approve new pipelines, while falling short of meeting the Paris Agreement's commitments by a 20% margin.[69] The technology and infrastructure exist to make this transition, so one might ask why has it not yet been achieved. In order to show that a socially just energy transition is possible, it is necessary to understand what the biggest challenges are and how they inhibit the actions needed to mitigate the negative consequences of climate change.

First, the government proclaims its interest in combating climate change while simultaneously fixating on economic growth and short-term profits in the fossil fuel industry. When policies are proposed to increase investment into renewable energy and public transportation, concerns about cost inhibits change. Short-term mentalities intersect with concerns of funding that result in inertia and support for the status quo: why invest billions of dollars into renewable energy when there is already "adequate" infrastructure to provide energy for Canadians?

Moreover, there are regions of Canada, particularly Alberta, whose economies are highly dependent on fossil fuels. A substantial amount of the government's revenue is derived from Canada's fossil fuel industry ($8 billion annually on average), therefore divesting from this source of economic growth is not a

priority for governments that typically focus on short-term horizons shaped by the election cycle.[70] Prime Minister Justin Trudeau has shown he is interested in continuing to develop non-renewable energy, given his approval of the Trans Mountain and Coastal GasLink pipelines. He has stated that "there isn't a country in the world that would find billions of barrels of oil and leave it in the ground while there is a market for it."[71] Transferring from fossil fuels will not only deprive the Canadian government of potential profits, but it will also be costly to invest in non-renewables. The cost associated with a transition from non-renewables is the most evident and widely publicized barrier.

With a fixation on re-election, it may be challenging to find a politician willing to be responsible for the massive spending required to reengineer the grid and to build required infrastructure - especially when only 60% of Canadians think that the earth is warming due to human activity.[72] Investing in non-renewables will not only be costly, as a part of the transition CO2 emissions will initially increase. However, a long term perspective justifies this byproduct. When the alternative is irreversible environmental damage as a result of current rates of emission, the costs of upfront investments and brief surge in emissions is a small price to pay. The key obstacle here is that many politicians are more focused on short-term economic stability from the non-renewable sector, rather than investing in green energy that will help future generations and their economy. When government decisions privilege short-term considerations, both economic and political, instead of a just transition focusing on people and their environment in the long term, bold initiatives are undermined.

Another major challenge to an energy transition is existing public opinion regarding fossil fuels. To minimize negative effects that would prolong the process for an energy transition, greenhouse gases are expected to be driven down to nearly zero over the span of a few decades. To many, this implies drastic and disruptive transformation that necessitates global cooperation, technological innovation, and funding that is inconceivable. Yet, a global energy transition is not only possible, it is necessary. Canada must work to implement this transition by making sincere efforts to reduce CO2 emissions. However, a successful, just transition requires public opinion in Canada to transform alongside it. Canadians are the single highest per capita consumers of energy in the world; on average each Canadian produces 22 tonnes of greenhouse gas per year.[73] Therefore, many Canadians will be forced to adjust their lifestyles and habits of overconsumption. While many people support this energy transition, there are also those who are comfortable in their current lifestyles and resist any policies combating climate change which threaten the current status quo.

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Communities directly impacted by energy policies often lack the power to influence the narrative propagated by the government. If Canada seeks a just transition, the voices emerging from minority communities must be included. Canada has systematically excluded indigenous input on land-use decisions and energy policy, effectively perpetuating a settler colonial form of governance. In this way, environmental law in Canada has been colonized in a manner that impedes indigenous efforts for environmental justice.[74] Indigenous land, culture, and practices are protected by federal legislation and treaty laws, yet, governments consistently take illegal actions with regard to the development of energy, despite the lawful protests of Indigenous communities[75]. Over the course of February this year, Indigenous groups across the country have made their voice on environmental matters impossible to ignore. Frustrated by the lack of meaningful consideration of their opinions and the disregard for their traditional lands, Indigenous and non-Indigenous protesters have blocked ports, railways and roads in opposition to the Coastal GasLink pipeline.[76] These protests mark the end of acquiescence to the government's hollow rhetoric of green climate policy and of reconciliation. The steps that have been taken towards an energy transition in Canada have already failed to protect Indigenous communities; and thus, the recommendations in this report stress the need for indigenous consultation at every stage of nuclear and renewable energy development. Not only must these communities be recognized as victims of global climate change, they must also be acknowledged as active agents in climate politics.[77]

Though not traditionally conceptualized as victims in environmental transitions, communities dependent on the fossil-fuel industry for economic stability and group identity will be greatly impacted by an energy transition. A narrative of resistance to the abandonment of non-renewables has been emerging from regions of Canada closely tied to resource extraction, namely the Alberta oil sands. The political narrative effectively equates decarbonization with the loss of jobs in the non-renewable sector.[78] Due to the often emotional relation between a community and the land on which they live, material changes in the energy sector may translate to feelings of loss.[79]

A dominant narrative surrounding climate change calls for immediate, meaningful change. This has been illustrated by the climate marches currently occurring on a global scale. However, this narrative is perceived as threatening to communities whose livelihood and identity are built on the fossil-fuel industry. Altruistic pleas for an energy transition fail to convince these communities that it is worth sacrificing their status quo for the greater good. So, many resist taking the action or participating in the shift needed to bring about an energy transition. Therefore, the recommendations in this report stress the need for federal and provincial action to address communities directly connected to the fossil fuel energy sector.

An energy transition is imperative to mitigating the negative consequences of climate change, and a just transition is entirely achievable in this aim, so why has it not been realized? Despite the existence of technologies required for an energy transition, there are significant barriers preventing their implementation. This is the consequence of competing narratives across Canada. The government has been fixated on the short term costs, and as such, has failed to provide sincere political will in order to facilitate an energy transition. Additionally, a social shift is necessary for a transition to occur; however, this would require the general public to sacrifice their practices of overconsumption. Finally, climate change discourses must address the impacts of transition on Indigenous communities and groups reliant on the fossil fuel industry for their identity and income. These narratives complicating, and sometimes preventing, a transition have informed the recommendations throughout our report.

Life Cycle Assessment: Environmental Cost of Transition

While "it is possible to achieve improved energy access, air quality, and energy security simultaneously, while avoiding dangerous climate change" the transition to renewable energy is still highly susceptible to certain environmental costs.[80] Riahi et. al. argue that the energy cost will be reduced as a whole, "when multiple economic benefits… are properly accounted for", but a case study in Southeast Asia suggests otherwise.[81] In an observation of Singapore, Malaysia, and Brunei, a life cycle assessment showed multiple environmental repercussions, "expected from transitioning to high shares of renewables'' for electricity.[82] The study looked at projected impacts from 2015 to 2050, finding that the construction of renewable infrastructure – such as solar photovoltaic systems – present a great negative impact through the current manufacturing process.[83] Although mitigating greenhouse gas emissions when implemented, solar PV construction contributes heavily to "localized impacts" through the use of toxic-heavy and rare earth metals.[84] The transition study of Singapore, Malaysia, and Brunei concluded that while renewables replace fossil fuels, some environmental impacts decrease while others will increase. "Unless managed in the right perspective," renewables are not a guaranteed path to sustainability as there will always be a potential of harm to the environment.[85] It is ultimately in the hands of policymakers to assess the environmental impacts of renewable energy implementations, and using the life cycle assessment would present a more holistic view of the effects.

Energy Spike

Transitioning towards a sustainable economy will certainly present the Canadian government with considerable challenges. The fossil fuel industry is mainly opex-intensive, meaning the majority of investments are spent on operational costs that give instant returns. Renewable energy projects have been gaining momentum in the past couple of years. The development of turbines, solar panels, and other instruments of renewable energy is only one piece of the puzzle; countries must also look into engineering sustainable infrastructure tailored towards renewable energy sources. Since there is no large-scale infrastructure for renewable energy, they are considered capex-intensive, in other words they require significant capital expenditure and need greater sums of upfront investments.[86] Large investments are required to reinforce or replace the energy grid infrastructure in any country seeking to transition to a sustainable economy. The traditional energy infrastructure must be connected to local, renewable power generation resources, and smart grids must be installed in order to accommodate small scale residential and commercial energy generation. In addition to renewable energy sources, there is also the need for infrastructure in the development of electric vehicles, which is far less advanced than that of renewable energy.[87] During the period of transition, countries must take into consideration both the capital and energy investments needed to move towards a sustainable economy. Germany, for example, has increased its renewables to almost 30% of the country's power mix. However, this initiative has not made much of a reduction in their total carbon emissions.[88] Given the intermittent nature of renewable energy, Germany found that it must also use fossil fuels, such as coal, to buffer the intermittency of renewables, and as a result, their coal consumption increased by 30% in this time period.[89]

Generally speaking, the term "energy spike" refers to the idea that in the process of pushing towards sustainable carbon-neutral energy sources, a great deal of carbon emitting energy sources will be put into action to allow for a transition. There is not extensive research on the idea of an energy spike in the duration of transitioning towards sustainable energy, due mainly to what scientists refer to as "emissions uncertainty," referring to the idea that we cannot predict how human beings will behave in the future with regard to carbon emissions. However, it should be one of the main areas of concern in transitioning towards a sustainable energy system since we cannot afford to increase our carbon emissions any further. The Intergovernmental Panel on Climate Change (IPCC) has reported that if the current carbon emission trends continue, in the next 11 years global temperatures will rise by 1.5-2°C, having a far greater impact on the planet than expected.[90]

There is no question as to whether we should transition towards carbon-neutrality or not, given the sheer magnitude of consequences for humankind, as well as biodiversity, if our current trend of anthropogenic climate change continues. However, countries undertaking this initiative must be aware of the impacts that it will have on the economy and the environment, as well as on Canadian society. Before starting the process, there must be extensive research done to know roughly how much energy needs to be invested into the energy transition process in order to mitigate its effects, by other means such as reforestation, carbon capturing technology, and so on.

Carbon Capture

Principle: Countries and companies alike should place more emphasis on new methods to negate the effects of climate change.

Principle: Countries and companies must diversify their investment to find new ways to tackle climate change.

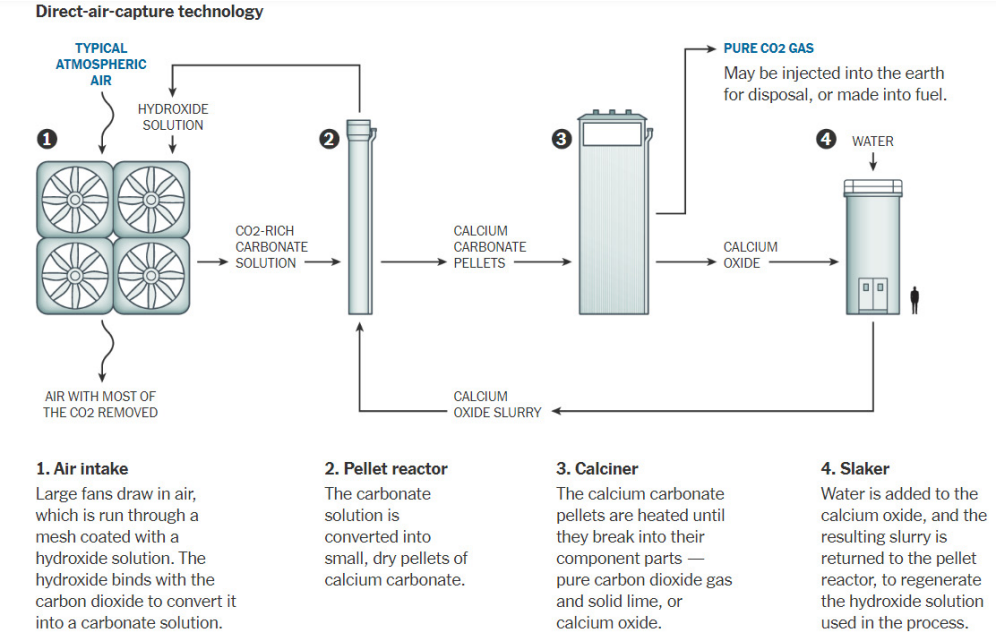
Concern: Transitioning away from non-renewable infrastructure will have immense political, economic, and social consequences

Recommendation: Countries and companies alike must explore new methods such as carbon capturing that would allow the existence with the current infrastructure while also negating the effects of climate change.

A complete transition away from fossil fuel-based infrastructures, such as energy grids, will have various consequences. Workers will be forced to shift industries or retire early, and there may be an economic disruption if the transition does not put measures in place to ensure the safety of all the workers in the non-renewable sector Rather than undergoing a radical infrastructure change, non-renewable companies have started investing in new ways to tackle climate change, to maintain the current infrastructure energy grid.

Major fossil fuel companies have started diversifying their investments as a result of lawsuits, pressure from shareholders. Companies have invested in carbon capture technology. Carbon Capture and Storage (CCS) is a method in which carbon dioxide emissions from fossil fuel use at large point sources can be safely captured and stored to be used as a synthetic fuel.[91] Captured CO_2 is converted into a clean burning synthetic fuel which can be used by traditional cars and planes.[92]

Chevron, Occidental Petroleum, and Australian mining giant, BHP, have all invested in CCS; specifically, in a small company in Alberta that claims to be on the verge of breakthrough in making this technology.[93] Canada is currently a world leader in this technology, committed to exploring it further. There are currently more than 11 projects being funded directly by the federal Government of Canada.



Canada's Energy Production and Consumption

Canada's Energy Production

The energy production section of this paper will examine Canada's natural resources, energy generation, and exports.

Non-renewable

Globally, Canada is the fourth largest producer (4.55 MMb/d in 2018) and exporter (3.7 MMb/d in 2018) of oil. 96% of its proven reserves are oil sands, which accounts for 64% of total oil production. Most of its oil exports (96%) go to the US, while 65% of American oil is imported by Canada. The production of crude oil contributed to 2.8% of Canadian GDP in 2018, while it constituted 32% of the country's share of primary energy production. Between 2013 and 2017 the oil and gas industry alone contributed roughly $14.8 billion annually to government revenues. Most of the employment benefits of oil production are concentrated in the provinces that host oil operations, particularly Alberta. In terms of labour, this industry was responsible for 0.3% of employment in 2018.[94]

Canada is the fourth largest exporter of metallurgical coal and the twelfth producer globally. As estimated in 2018, Canada exported 34 million tonnes of coal worldwide and produced 62.3 million tonnes, with 85% of its industry being in Alberta and British Columbia. The majority of Canadian coal is exported to Asia, where there is still a significant market. The Government of Canada has approved regulations to phase out traditional coal-fired electricity by 2030, according to the Pan Canadian Framework on Clean Growth and Climate Change.[95]

As for natural gas, Canada is the fourth largest producer and the fifth largest exporter in the world. The country owns 1% of proven reserves globally (equivalent to 69 trillion cubic feet) and 8% of shale oil resources. Canadian marketable resources (meaning natural gas that is free from impurities and hence marketable), could sustain current production level for 300 more years. Due to the location of supply basins, demand centres, availability of transportation infrastructure, and the existence of trade agreements, the Canadian and the US' natural gas markets are extremely integrated.[96]

Nuclear Energy

In the international context, Canada is ranked as the second largest producer and exporter of nuclear uranium, compromising 22% of the global uranium production in 2017. In the same year, the country accounted for 4% of the world's share of nuclear power production. Most nuclear power stations are in Ontario and New Brunswick, while industries for uranium mining, refining, and fuel fabrication are situated in Saskatchewan and Ontario. According to estimates from 2016, the facilities of McArthur River mine and Key Lake mill produced 6928 tonnes of uranium, with an additional 17 tonnes from recycling of uranium refineries waste. These two facilities alone are responsible for 49.4% of domestic production, followed by Cigar Lake (47.5%) and Rabbit Lake (3.1%).

Of all the uranium produced, 76% is exported, mainly to Asia and to the rest of the American continent; 16% is also exported to Europe. The remaining 24% of uranium produced is used domestically by CANDU reactors in Ontario and New Brunswick to provide 15% of the country's electricity.[97]

Renewable

Renewable forms of energy currently contribute 17% of Canadian total primary energy supply. Globally, Canada is ranked seventh for renewable production, generating 1878 Mtoe (megatonne of oil equivalent) in 2016. The majority of renewable energy comes from hydro, which constitutes 67.1% of total green energy production; hydro generating capacity has grown steadily since 2006, arriving at 80764 in 2017, making Canada the second largest producer of hydroelectricity in the world after China.

The second major energy industry in the renewable sector is solid biomass, which compromises 23.1% of total production, being approximately between 504 and 610 petajoules since 2000. Of the total biomass energy, between 66% and 76% of it comes from solid and liquid wood waste.

Following are wind and solar industries, which are growing steadily, making respectively 5.3% and 0.6% of total renewable energy production.[98]

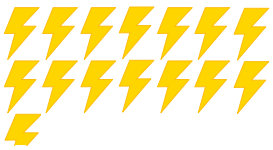
Canada as an International Energy Innovator

Canada has demonstrated willingness to move towards more sustainable energy through the Pan-Canadian Framework on Clean Growth and Climate Change, which imposes carbon pricing at the federal level, proposes sustainable efficiency standards for transportation and edifices, and promotes renewable forms of energy.[99] At the international level, Canada has already taken actions to limit climate change by signing the Paris Agreement in 2016, and is a leader in innovative technologies that are designed to create a more efficient and sustainable environment. The development of companies specialized in green technology (Greentech) demonstrates Canada's commitment to sustainable forms of energy, and is attracting investments from other countries and multinational enterprises. Exemplary of this is the promising industry for hydrogen and fuel technologies based in British Columbia that has recently received an investment of $53 million dollars from Mercedes-Benz,[100] and the research on Carbon Capture and Storage technologies that are currently being financed by companies such as Chevron, Occidental Petroleum, and BHP.[101]

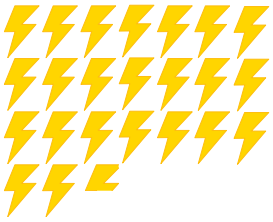
Energy Consumption per Capita

Canada is the 9th largest consumer of energy per capita surpassing all major developed countries such as the US, France, and Germany.[102] In 2015 alone, Canadians used 1.5 million terajoules of energy in their households.[103] Households with a total income of over $150,000 use more than twice the energy than other households in Canada.[104] Natural Gas accounted for 51% of their consumption, electricity for 45.2% and heating oil for 3.8%.[105] Looking at it from a provincial level, Québec has the lowest average electricity consumption, followed by New Brunswick. On the other side of the spectrum, Alberta and Saskatchewan have the highest reported electricity consumption in Canada.[106] Canada is ranked higher than the eight most industrialized countries in terms of per capita energy consumption.[107] From the G8 countries, the US comes the closest to Canada's per capita annual energy usage.[108] Transportation sector in Canada consumes 60% of the Canadian oil, this puts the country as the 3rd largest consumer of oil per capita in the world.[109] In 2010, the average Canadian household used about 20 times more en-

Households in **Quebec** consumed the **least** energy per capita while those in **Alberta** consumed the **most**.



73.4 gigajoules
(**Quebec** 2015)



117.7 gigajoules
(**Alberta** 2015)

 = 5 gigajoules

ergy than a Nigerian household, and three times more than a typical European household.[110] The massive per capita energy consumption by Canadians can be caused by multiple factors such as the harsh Canadian winters, the high income in Canada which leads to less conservation in energy usage, and larger average home size as compared to other countries.

To be able to be leaders in energy transition, Canadians must realize their excessive usage of energy and start cutting down on it on a personal level. The Government of Canada will be able to transition to a sustainable economy, however, the citizens of the country make the real change, as the biggest consumer of energy in the world, Canadians must change their lifestyle in order to set an example for other countries to follow.

1. Province-based Energy Transformations

Summary

British Colombia

Renewable energy sources supply nearly 95% of British Columbia's electricity, representing about 16,000 MW of power. In particular, British Columbia relies heavily on hydropower for its electricity, much of which is generated from large-scale hydroelectricity projects. However, there have been concerns over violations of indigenous rights, emissions of greenhouse gases, and overblown costs when it comes to the construction and operations of massive dams. Furthermore, with ongoing protests against plans to extend pipelines in BC, the need to consider and protect indigenous land when developing energy projects is more pressing than ever.

Alberta

Alberta's electricity generation is composed of 47.4% coal, 40.3% natural gas, and 12.3% renewables, 6.9% of which is wind. The province established the Climate Leadership Plan which aims to phase out coal-fired electrical generation by 2030 and replace two-thirds with renewable energy and one-third with natural gas. However, since such a rapid transition is taking place, it is recommended that the well-being of workers and their communities is prioritized. Nevertheless, the economic environment in Alberta makes renewable energy cost-competitive, setting an example for the rest of the country to deregulate and allow deals to be struck between energy generators and customers. All in all, renewable energy will improve the health of Albertans in metropolitan regions and create new opportunities and incentives in an industry previously dominated by coal.

Saskatchewan

In Saskatchewan, coal is the province's main power production source. However, this power source is currently near the end of its useful life and the province has set a goal of doubling the percentage of renewable electricity generation capacity by 2030. Furthermore, billions are spent annually to upkeep transmission lines in one of the most dispersed electricity distribution in the world and sources of power such as solar can be installed near the site of energy demand. Renewable energy power provides opportunity to expand the production of zero-emissions, upend the need for a centralized grid controlled by a monopoly utility and provide a long-lasting energy solution in a resource-intensive economy with its main source of power nearing the end of its life.

Ontario

Coal power plants and nuclear plants are a large source of energy across Ontario currently. While these are highly polluting forms of energy, they also contribute to poor air-quality and cost a lot to manage their unresolved toxic waste issues. Nuclear power that is highly subsidized in Ontario creates radioactive waste that is very difficult to manage. Wind, solar, hydro, refurbished nuclear and natural gas-fired resources have replaced Ontario's coal fleet. Currently, nuclear energy takes up the largest percentage of installed energy capacity in Ontario.

Québec

Québec generates a large amount of its energy through hydroelectricity. Québec's per-capita energy consumption is high compared to global averages. This is connected to its high standard of living because energy is central to the quality of life of people living in Québec. Several daily activities ranging from travelling, exporting, distributing products, running electrical devices, heating homes and many others require energy. In order to achieve energy transition targets as set in Québec's energy transition master plan, all forms of raw energy resources such as crude oil, sunlight, running water and coal are not exploited and are converted to useful secondary energy products such that they can be transported and distributed to consumers.

Manitoba

Manitoba generates 99% of its electricity from renewable resources, almost entirely from hydropower, and the province has detailed its strategies to lead the energy transition through its 2015 Climate Change and Green Economy Action Plan. As a net exporter of electricity, Manitoba has found a way to make renewable energy both profitable and a major source of employment. Overall, it seems as if Manitoba has been skillfully following its plan to "lead by example" in ensuring that the energy transition happens quickly, profitably, and with consideration to all stakeholders.

Prince Edward Island

Prince Edward Island generates approximately 19% of its own energy, 18% of which comes from wind energy. However, PEI imports 81% of its electricity from other provinces, which predominantly comes from coal. In order to ensure PEI completely divests from non-renewable energy, it is recommended to invest in more wind energy on its northern coast. In regard to the potential intermittency of wind power, it is also recommended that PEI invests in solar energy and/or limited biomass to meet any energy shortages that may occur. The government should develop funding for community co-ownership of these renewable energy projects, so communities have the opportunity to possess more autonomy over the profits and projects themselves, rather than private companies.

Newfoundland and Labrador

Newfoundland already generates approximately 96% of its energy from hydroelectricity. However, it is recommended that Newfoundland divests from large-scale hydroelectricity projects given their poor environmental impacts upon communities, including Indigenous communities. It is therefore recommended that Newfoundland transitions to become 100% renewable through other means, using wind and solar energy. However, this is complicated by Bill-61 which ensures Nalcor has a monopoly over all renewable energy projects in Newfoundland, and only develops hydroelectricity. As such, where it is not possible to develop wind and solar energy, it is crucial to invest in sustainable hydroelectric projects. Moreover, the government should consider withdrawing from the non-renewable energy projects that have been proposed by Newfoundland's Oil and Gas Industry Development Council.

Nova Scotia

Nova Scotia's generation of renewable energy as of 2015 was 24%, predominantly coming from wind and hydroelectricity. In order to divest from the province's reliance on coal and natural gas, it is recommended that Nova Scotia becomes 100% renewable through investments in wind, solar, and tidal energy. Tidal energy is especially significant given the immense potential from the Bay of Fundy, and the ways in which it can allow for more indigenous collaboration and empowerment. As for wind and solar energy, it is recommended to develop more community initiatives such as the Community Buildings Solar PV Pilot Program, particularly for wind energy, given Nova Scotia's potential to reap the benefits from a higher amount of wind farms.

New Brunswick

As of 2016, New Brunswick generated 30% of its energy from renewable sources, and 30% from nuclear energy. In order for New Brunswick to generate 70% renewable energy, it is recommended to invest in tidal, wind, and solar energy. New Brunswick should develop a plan to facilitate the development and construction of tidal energy, similar to Nova Scotia's Marine Renewable Energy Strategy, given the massive potential of the Bay of Fundy. Community co-ownership of renewable energy projects is also recommended in order to bolster positive public opinion, divest some profits away from private companies, and potentially allow for more indigenous collaboration and empowerment.

The Northwest Territories

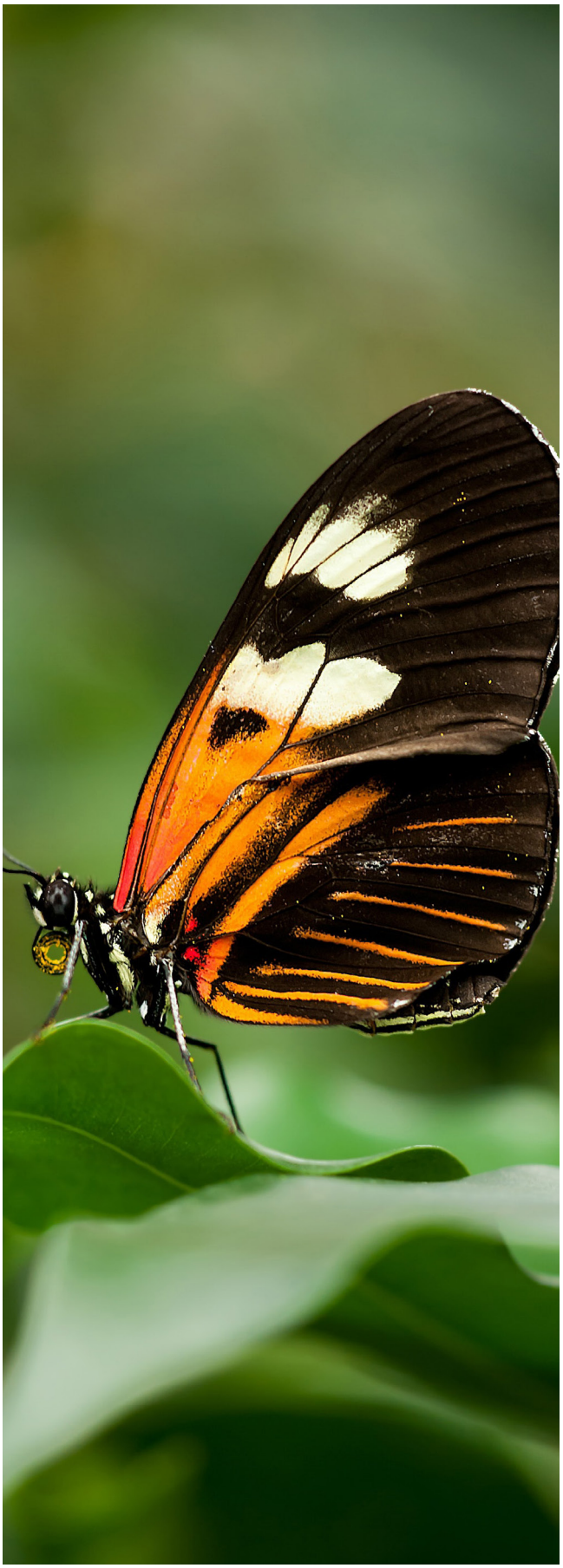
The Northwest Territories has made great advancements in terms of the installed solar electricity per individual. However, there must be a further push for commercial, government, and non-personal uses of this energy, since it has proven itself useful in the region. Some renewable energy sources are specific to certain times and places. The long hours of sunlight in spring and summer in the NWT can provide usable heat and electricity for up to eight months of the year. The annual solar resource in Fort Simpson for example, is greater than Berlin and Tokyo, and comparable to most of Ontario – all locations where large investments in solar technology have taken place. Wind energy provides an intermittent renewable power resource that is increasingly being deployed in remote northern locations.

Nunavut

The greenhouse gas emissions in the territory have increased by 58% since 2000, the first full year after Nunavut was created. The Qulliq Energy Corporation (QEC) is a government-owned corporation that is responsible for running the 25 power plants that operate in each of Nunavut's 25 communities. These plants run solely on diesel fuel to produce electricity. These power plants are spread out all around the country and not all connected by roads of power lines. Nunavut is currently very dependent on fossil fuels. Each year, diesel fuel is purchased and shipped in bulk during the short summer season and stored in tank facilities in each community. Fuel is then used to power generator sets that convert energy into electricity to provide power to the territory. The largest sector for energy in Nunavut is transportation at 57% of total demand in the entire province. Industrial energy takes 35% of energy, commercial industries taking 4%, and residential at 4%.

Yukon

Current strategies in Yukon outline an increase in carbon-neutral renewable energy supplies, specifically hydroelectricity, which would push Yukon's energy to 97% by 2030. It is necessary that this is pushed further and diversified to include more than just hydroelectricity in order to move to 100% renewable energy. It must also account for off the grid communities as well as the reliance on wood across the territory. In such communities, it is necessary to replace fossil fuels with cleaner, renewable energy sources, such as repurposing retired gold mines under the city of Yellowknife for geothermal energy. These mine tunnels and shafts are filled with water heated as high as 50°C and could provide a thermal reservoir for a district heat system that serves buildings in the downtown core. Another potential source of energy is both solar and wind for those areas that are at risk of potential earthquakes resulting from sources of geothermal energy.



Overarching Recommendations

While many of our policy recommendations are targeted to the federal government, it is important to recognize that provincial governments have significant autonomy over the development of their energy projects. As such, the following section outlines each province's current energy landscape, and our subsequent policy recommendations to divest from non-renewable energy. These recommendations outline which renewable energy sources should be used according to each province, and address the concerns which must be considered in order to ensure a socially just, environmentally-conscious energy transition. The overarching principles inform our recommendations for each province:

Principle: All provinces should be accounted for in Canada's energy transition.

Principle: Renewable energy projects should be developed as quickly as possible, while mitigating costs and collaborating with Indigenous communities, especially when the projects encroach on, or have the potential to affect their lands and resources.

Principle: Provinces should communicate their innovations and developments within the renewable sector to ensure that all of Canada can benefit from the energy transition.

Principle: A fair and reasonable climate policy agenda must be created to prioritize the well-being of both workers and their communities while addressing existing inequalities.

Concern: The intermittency of renewable energy forces policy makers to find solutions that involve other less-sustainable forms of energy to efficiently meet demands.

Concern: Large-scale projects may encroach on the territories of Indigenous communities and strip them of their agency over such projects.

Concern: A lack of communication and drastically different geological terrains could inhibit cross-national innovation and implementation methods.

Recommendation: Divest from non-renewable sources and towards 100% renewable energy as quickly as possible.

Recommendation: Implement gender audits of energy sector policy in order to construct more gender-inclusive policy frameworks and provide incentives to increase gender equity.

Recommendation: Ensure Indigenous communities have prior, and ongoing consent with the planning, development and production of energy projects.

Recommendation: All renewable energy projects must be subject to rigorous environmental assessment to mitigate any potential harm to local biodiversity.

1.1 British Colombia

Principle: Consultation with environmental and Indigenous groups on the ethics and health concerns of the projects is crucial to the promotion of sustainable energy.

Principle: Canada should halt the construction and development of pipelines.

Concern: Large-scale projects, particularly hydroelectric dams, may take years, if not decades, to undergo construction and can cost millions of dollars. Site C Dam in Peace River, British Columbia, for example, is estimated to cost nearly three billion dollars over budget.

Concern: Site C Dam proceeded despite there having been no consultation with Indigenous groups, until after a major report on the project was issued in May 2014. Additionally, Indigenous groups' proposals for alternative approaches of evaluating the cumulative effects of the project were rejected in favor of using BC Hydro's evaluation method.

Recommendation: The British Columbian government should prioritize small-scale, localized "run-of-river" projects rather than large-scale projects.

Recommendation: The British Columbian government should make the last 6% of its electricity that comes from non-renewable sources come from renewable sources.

Hydroelectric Power Generation in British Columbia

British Columbia, the picturesque Western-most province in Canada, has an abundance of natural resources. The province's numerous rivers and other waterways have been critical in facilitating BC's transition to renewable energy; as of 2019, the province derives almost 95% of its electricity from renewable sources, almost all of which comes from hydropower. A much smaller portion of BC's electricity comes from wind and biomass fuels.[111] In 2002, the provincial government banned the use of nuclear energy as part of its Clean Energy Act and because of this high proportion of electricity it generates from renewable sources, it will likely remain committed to the ban.[112]

About 80% of British Columbia's electricity capacity is owned and operated by two Crown corporations: British Columbia Hydro and Power Authority, or BC Hydro; and the Columbia Power Corporation. The last 20% is owned and maintained by FortisBC, independent municipal groups, and First Nations groups.[113] BC Hydro alone runs 82 dams at 40 different locations,[114] and the provincial government notes that there are currently 1500 active dams under its regulation.[115]

Case Study: Site C and the Need for Run-of-River Hydro Power

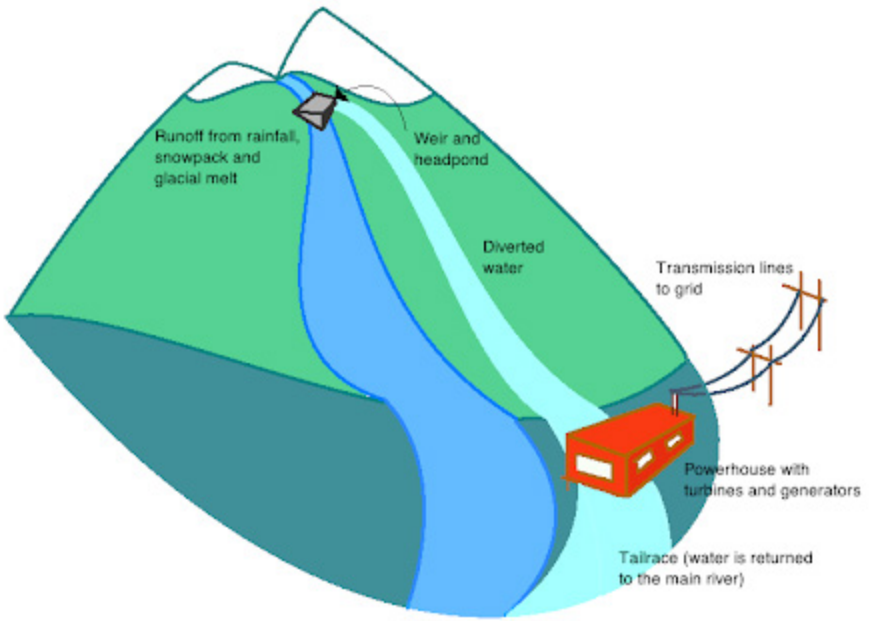
BC Hydro's latest large-scale hydroelectric project is Site C, on Peace River in northern BC.[116] When completed, Site C will generate an estimated 1,100 MW of electricity – almost as much as all wind sources in BC.[117] The initial idea to place a major dam on Peace River arose in the 1950s, and the BC Utilities Commission, which is responsible for regulating BC Hydro, issued its first report in the early 1980s, citing inadequate demand.[118]

However, the project was picked up again in 2012, with the federal and provincial government creating a Joint Review Panel to investigate Site C's potential environmental impacts and to conduct hearings and consultations with the public and Indigenous groups. The Panel issued its report in May 2014, and construction of Site C began in July 2015.[119]

In November 2017, the BC Utilities Commission Inquiry issued a report stating that the project was "unlikely to remain on schedule or on budget" The Panel's 2014 report claimed that construction would take 9 years, with a 2011 estimated budget of $7.9 billion.[120] Despite the current estimated budget of $10.7 billion, the project is ongoing.

Several concerns arise here. Firstly, Indigenous communities, who are often vocal about such large-scale projects but too frequently ignored by relevant decision-makers, have expressed concern over the potential for environmental and cultural damages.[121] In this case, BC Hydro alleged that there was not enough data available to conduct a "cumulative effects" assessment of Site C and its potential for damage despite the Panel's contention that there was indeed enough information to conduct such a study.[122]

Secondly, although proponents of Site C claim that the project will reduce greenhouse gas emissions, BC Hydro has acknowledged that there will indeed be anywhere from 5.3 and 7.3 million metric tons of CO2 emitted over the first 100 years of the project's operations.[123] So pressing was the issue that the provincial government tasked the BC Utilities Commission Inquiry of finding an alternative project that could produce similar benefits in terms of electricity generated by Site C with minimal greenhouse gas



How run-of-river projects work.

Source: energybc.ca

emissions.[124] The C.D. Howe Institute even suggested that Site C was a sunk cost and that a carefully planned cancellation of the project - with potential alternatives - would save money for electricity ratepayers.[125]

If large-scale hydroelectric projects are so controversial, what are some of the possible alternatives? The Clean Energy Association of British Columbia has highlighted the potential for smaller-scale projects, or run-of-river hydro power. As of 2015, there were 56 independently owned run-of-river projects in BC, most of them in rural areas. This is a key benefit of small projects: they require less funding and work well in rural areas; thus, run-of-river projects are more likely to be owned and operated by independent and Indigenous groups than massive sites. In fact, each run-of-river project requires over 50 permits and extensive consultations with First Nations before the project can proceed.[126]

Furthermore, run-of-river sites have smaller environmental impacts than large projects like Site C because run-of-river projects do not hoard massive amounts of water. This in turn means that less land needs to be flooded, although the drawback of this is that run-of-river generators rely on constant flows of water. Each site also generates significantly less greenhouse gases than one large-scale project.[127]

The expensive and potentially damaging construction of Site C demonstrates the need to prioritize small, run-of-river hydro projects in BC. While run-of-river projects alone cannot meet all of the province's demands for electricity, these small-scale hydro projects include more independent, rural, and indigenous ownership while emitting fewer greenhouse gases than traditional large-scale hydro projects.

Economic Growth, Pipeline Protests, and First Nations Rights

It is vital that British Columbia make the transition towards 100% renewable energy sources rather than take a step backward. Twice in the past decade, there were attempts to build pipelines in British Columbia. The Enbridge Northern Gate Pipelines, which would have linked Alberta and BC by transporting oil across the two provinces, was struck down by the federal government in 2016, citing environmental concerns and the protestations of Indigenous groups.[128]

However, there is an ongoing attempt to extend the existing Kinder Morgan Trans Mountain Pipeline by erecting the Coastal GasLink pipeline, which will carry natural gas. Coastal GasLink has signed agreements with 20 elected band councils, but Wet'suwet'en hereditary chiefs have argued that they have claim to 22,000km2 of land over which the pipeline would infringe. To sum it up briefly, this has led to several weeks of protests across the country, blockades of railways, political debates on appropriate responses, and police action and surveillance of Indigenous communities, which at the time of writing are ongoing.[129] In the early stages of the protests, the federal government has begun consultation processes with 129 Indigenous communities to ensure that they can benefit from the pipeline extensions. However, because such non-renewable projects have drawn national ire, is there a need to extend the pipeline? The federal government stands to gain $500 million/year in taxes from the extension, but who stands to lose from its construction?[130] Should the Canadian government be expanding non-renewable projects when Canada is falling behind in terms of taking an active stance against climate change?[131]

As previously stated, British Columbia derives nearly 95% of its electricity from renewable resources[132] – a remarkable number – and should not seek to dilute this number with non-renewables and pipeline expansions. While the Coastal GasLink pipeline is not a purely provincial project, BC could take a stronger stance against its construction. Instead, the money could be diverted into, as but one example, low-carbon "transition experiments," which are small-scale projects with renewable energy sources that involve learning, capacity building, de-risking, and public engagement.[133]

Finally, pipelines are not the only or even the best way for the provincial and federal governments to generate revenue. Rubin challenges the oil industry's claim that pipelines are an essential part of economic growth, both domestically and with overseas markets, stating instead that there is no demand for fossil fuels from Alberta.[134] According to Rubin, the economic and environmental drawbacks of extending pipelines greatly outweighs any potential benefits of extending or building new pipelines.[135] Given all this, is there truly a need to construct more pipelines across the provinces? Because of British Columbia's massive share of renewable electricity, the groundwork is already laid for experiments and eventually the full transition towards renewable energy. Additionally, as with small-scale hydroelectricity projects, smaller renewable projects create more opportunities for indigenous and independent ownership, which fossil fuel pipelines – as clearly shown by the current protests – do not provide. Thus, renewable electricity projects are critical for engaging Indigenous groups in the energy transition, and the construction of new pipelines would be a hurdle in the path towards Canada's energy transition.

1.2 Alberta

Concern: Alberta's self-imposed goal from 2015 was to phase out coal by 2030, but the share of renewable energy is far too small. While Alberta may indeed phase out coal by 2030, it could still supplement the 47.4% of electricity generated from coal with other fossil fuels, replacing one problem with another.

Recommendation: The government of Alberta should capitalize on the windy southern region of Alberta when developing wind farms.

Recommendation: The government of Alberta should follow Manitoba's lead in creating an emissions tax for certain fossil fuels (in Manitoba's case, on coal and petroleum coke) and use the money to fund developments in the renewable sector, including job retraining for those who may lose their jobs in the fossil fuel industry.

Recommendation: The current government of Alberta should follow the previous government's Climate Leadership Plan in order to make the energy transition economically feasible.

The province of Alberta proposes transforming its electricity sector by 2030 as part of a more comprehensive plan to reduce greenhouse gas emissions. Alberta currently generates its electricity from 47.4% coal, 40.3% natural gas, and 12.3% renewables – 6.9% of which is wind power.[136] Although other jurisdictions around the world have adopted more ambitious targets and acted earlier, by emulating this course of action, the province has the opportunity to learn from the successes and failures of others. The Climate Leadership Plan established by the previous NDP leadership aims to phase out coal-fired electrical generation by 2030. As part of this plan, the government vies to replace two-thirds of this electrical generation capacity with renewable energy and one-third with natural gas.[137]

The rapid retirement of coal-fired plants without introducing sufficient and reliable energy generation leads to unintended risks. Therefore, without a coordinated and deliberate framework of action, the workers and communities most dependent on coal extraction will bear a disproportionate amount of financial and economic issues caused by this ambitious energy transition.[138] In this process, the costs of climate change must be distributed equally, stressing the importance of provincial and national renewable energy programs as part of a job creation strategy that guides the transition to a low carbon economy.[139] Furthermore, a comprehensive industrial strategy that would absorb and introduce laid-off coal power workers into the renewable energy and low-carbon sectors must be established to support workers and their families.

Additionally, Alberta residents, particularly those in highly populated metropolitan regions, will have cleaner air quality with the coal phase-out set to conclude by the end of 2029. Not only would the retirement of coal-powered energy units improve the health of Albertans, the transition away from coal could also save Alberta's public health care system an estimated $300 million per year related to poor air quality.[140] A cost-benefit analysis published by Environment Canada found that regulations in Alberta resulting in a 298,000 GWh reduction in coal-fired electricity generation would lead to an avoidance of 900 premature deaths and 800 emergency room visits and hospitalizations between 2015 and 2035.[141]

To date, most of Alberta's wind power is located in the same part of the province, the windy southwest, so at any given time the assets are either all generating power or producing little to no power.[142] However, the NDP's renewable electricity program demonstrated that renewable energy could be cost-competitive by offering guaranteed minimum power prices that attracted bids lower than competing power sources.[143] Furthermore, the open market in Alberta allows deals to be struck between renewable energy generators and customers that are generally prevented by regulations in the rest of Canada.

An imperative element to consider in the plan to phase-out coal is the proposed $30 per tonne carbon tax on emissions above the cleanest natural gas-fired plant producing the same amount of electricity.[144] The money produced through this tax should be invested in energy efficiency initiatives and sustainable microgeneration. This can only be established through creating the appropriate regulatory and policy environment to ensure that the energy security needs of the province can still be met notwithstanding partisan forces and interests.[145]

Therefore the provincial government can provide support for the deployment of renewable generation in many ways, including tax breaks on investments in renewable projects, forms of credit support, direct grants, and the facilitation of projects by transferring part of the costs and risks typically associated with a power project away from the project developer.[146]

1.3 Saskatchewan

Principle: Countries and companies alike should place more emphasis on new methods to negate the effects of climate change.

Concern: Saskatchewan's share of electricity derived from renewable energy remained fairly stagnant from 2005-2015 and its over-reliance on carbon capture and storage technology (CCS) may prevent innovation or developments in the renewable sector.

Concern: The goal of doubling the percentage of renewable electricity generation capacity by 2030 is set too far into the future while other provinces are accomplishing similar goals within a shorter time frame.

Recommendation: The government of Saskatchewan should phase out coal completely by 2030, like Alberta is planning to do.

Recommendation: During the early phases of the energy transition, SaskPower should consider using carbon capture and storage (CCS) technologies.

Recommendation: Saskatchewan should follow Manitoba's lead in creating an emissions tax for certain fossil fuels (in Manitoba's case, on coal and petroleum coke) and use the money to fund developments in the renewable sector, including job training for those who may lose their jobs in the fossil fuel industry.

Saskatchewan depends mostly on a single resource – coal – for its energy generation. The industry is dominated by Crown corporation SaskPower, which works within this resource and mining-based economy. The province's context provides a unique and somewhat straightforward case for understanding the rapid transition to renewable energy in a province which is almost entirely dependent on fossil fuels.

Most of the province's power production source, which is coal, is currently near the end of its useful life. Hence, the province's energy system is at a critical transition juncture. Affordability and reliability of power are vital in defining Saskatchewan's approach to power generation, meaning Saskatchewan's energy plans need to not only be environmentally sustainable but also reliable and affordable.[147] Heavy investment and subsidization of the solar and wind industries would promise energy independence, income generation, community development, and reductions in greenhouse gas emissions.[148] In the meantime, Saskatchewan could potentially look to CCS technology, which can reduce sulfur dioxide emissions by 100% and carbon dioxide emissions by up to 90%. In 2014, SaskPower created the world's first successful CCS power station on Boundary Dam, near Estevan.[149] However, we caution Saskatchewan from becoming over-reliant on CCS tech, because simply capturing and storing greenhouse gases produced by burning fossil fuels may prevent innovations in the renewable sector.

Although nearly half of Saskatchewan is powered by coal, SaskPower is making progress on its path towards a more sustainable future and its goal of doubling the percentage of renewable electricity generation capacity by 2030.[150] This plan involves increasing renewable energy generation including natural gas, wind, solar and hydro, but there is still a hovering question about the deployment of CCS to keep coal in the mix to sustain a base-load source of electricity. Nonetheless, current base-load sources are still supplied by coal power plants which, as stated earlier, are nearing the end of their life. Another option would be the implementation of nuclear Small Modular Reactors (SMR) which would be a clean and reliable option to retire coal completely from the province's energy sector.[151] SMR technology is said to be under consideration in Saskatchewan, but the historical objection to nuclear technology based on its perceived risks continues to hinder its advancement.

With a population of 1.17 million spread over a landmass of 650,000 km^2, Saskatchewan possesses one of the most dispersed electricity distribution in the world. Billions are spent annually to maintain and upgrade the transmission lines that are interspersed around the province.[152] Yet, solar and wind power provide opportunity to expand the production of zero-emissions, renewable energy in the province, and a disruptive threat to the SaskPower business model.[153] They can be installed on homes, businesses, farms, and in fields on or near the site of energy demand. This distribut-

ed energy potential upends the need for a centralized grid controlled by a monopoly utility.

Similarly, Saskatchewan could share some of its high potential for wind resources with its neighbors in British Columbia and Alberta. Already, the Saskatchewan Environment Minister Dustin Duncan is requesting proposals to add 300 MW of wind power generation capacity and says the process will help the province quadruple its wind power when they come online in late 2023 or 2024.[154] This would certainly prevent Saskatchewan's renewable sector from remaining stagnant, like it was from 2005-2015.[155]

A carbon tax can create a powerful incentive to reduce carbon emissions by means of conservation, substitution, and innovation. This measure has been proposed or applied in many countries and regions around the world, including Australia, Sweden, and Alberta.[156] However, in a resource-intense economy such as Saskatchewan's, it is no surprise that the provincial government is vehemently opposed to a federal carbon tax to reduce greenhouse gas emissions. In a study published by the University of Regina, it was found that a carbon tax would reduce greenhouse gas emissions while contracting Saskatchewan's economy.[157] What this indicates is that in an economy where there is little opportunity to switch to a different energy source, a carbon tax will simply result in decisions to contract economic activity. Therefore, a generous carbon tax rebate program must be implemented by the federal government to aid Saskatchewan in its rapid energy transition goals. Furthermore, money gained from the carbon tax must be used in a productive manner in order to stimulate the provincial economy and create new jobs.

1.4 Ontario

Principle: Greenhouse gas emissions must be reduced by 80% by 2050 by using renewable resources such as wind energy, which is well suited to Ontario's environment.

Concern: Ontario relies on a limited number of huge generators for electricity instead of using efficient strategies and a diverse generation portfolio.

Concern: The electricity sector of Ontario does not have a long-term plan which is much needed to manage the electrical system and eliminate ideological disparities.

Recommendation: The Government of Ontario should implement a sustainable energy standard offer program for cogeneration and recycled energy.

Recommendations: The Government of Ontario should invest in wind energy by collaborating with interest groups such as the Ontario Clean Air Alliance to reduce carbon emissions in Ontario.

Recommendation: Wind energy companies should work with the Independent Electricity System Operator (IESO) and other stakeholders to determine the supply capability of wind generators to be included within Ontario power system plans.

Recommendation: Incentivize companies and individuals to increase their reliance on electric vehicles instead of non-electric vehicles that have high carbon emission rates.

Canada's renewable energy sector employs over 200,000 people and can extend and strengthen partnerships with Indigenous communities in order to bring sustainable energy to their communities at affordable rates. This can be done by using infrastructure efficiently and managing networks with the diverse populations living in Canada. Improving distribution and storage networks can also help provide consumers with energy at good prices, while being efficient and ensuring reliability in the renewable energy sector.

Wind energy has high potential to provide cost-effective and environmentally friendly sources of electricity generation in Ontario. The wind industry of Ontario has allowed for the creation of well-paying jobs in manufacturing, construction and other services. While it provides property tax revenue to municipalities, it also provides sustained revenue for Indigenous partners.

Ontario has the potential to lead Canada's transition to a low-carbon economy by ensuring investment in wind energy that reduces carbon emissions and other air pollutants. In order to reach greenhouse gas emission reduction targets, Ontario will need to focus on generating emissions-free electricity while also increasing the electricity generation supply in the upcoming decade in order to make sure that there is enough power since the Darlington and Bruce nuclear-generating stations will be reaching the end of their availability to supply energy.

Ontario's carbon-emissions can further be reduced through encouraging and vouching for non-emitting and reduced carbon emitting electricity through wind energy generation. The wind energy industry can benefit by creating partnerships with the Independent Electricity System Operator (IESO) in order to support cost-effective development and maintenance of resources. The partnership is important to establish rules of IESO that will result in more accurate methodologies to calculate capacity value from variable generation and to allow for market-based opportunities for participation and investment by stakeholders.

1.5 Québec

Principle: Québec can take the lead in energy efficiency by 2030 by building a strong low-carbon economy.[158]

Concern: The costs associated with electric vehicles are a roadblock to incentivizing people to purchase carbon-neutral vehicles.

Recommendation: Enable the public to make green choices through discounts on the purchase of electric vehicles.[159]

Recommendation: Strengthening and establishing Québec's Energy Transition Master Plan as the single, accessible gateway to administer to coordinate the implementation of all energy efficiency and energy innovation programs.[160]

Recommendation: Fully eliminate the use of thermal coal in Québec by 2030.

Recommendation: Increase the number of renewable energy sources around Indigenous communities.

As per the Generation Energy Council Report, the first electric vehicle charging network, the Electric Circuit, was made in Québec and this establishment has now extended to include 1,500 stations in Québec and Eastern Ontario to serve more than 23,000 electric vehicles. This model has prevented over 4,000 tons of carbon dioxide emissions. Québec's EV charging network is a model for utility-led infrastructure projects and has prevented more than 4,000 tons of CO2 emissions. The expansion and establishment of this project can significantly reduce carbon emissions.

Québec has the potential to take the lead in North America in the realm of renewable energy. Québec's ambitious targets of improving energy efficiency by 1% per year can be achieved through strategically ensuring that there are alternative choices for Québecers in their daily activities. Cooperation and forming alliances are central to achieving a low-carbon economy in Québec because a collective effort by all actors; the government, individuals and experts in the field, is required to create and maintain measurable steps in the energy transition of Québec.

1.6 Manitoba

Principle: Promote governmental investment in community co-ownership or community ownership of energy projects

Concern: Manitoba has the ability to lead by example in the region, but lack of communication and drastically different geological terrains could inhibit cross-national innovation and implementation methods.

Recommendation: Manitoba, which currently derives about 99% of its electricity from renewable sources, should act as a leader by exporting its renewable electricity and sharing technology and implementation methods.

Recommendation: Manitoba itself should complete the full transition to renewable energy for all electricity.

Almost 100% Renewable Electricity

Manitoba is truly a stellar example when it comes to renewable electricity. The province derives 99% of its electricity from renewable resources, mostly from hydropower generators controlled by Manitoba Hydro, which is the largest employer of electrical, civil, and mechanical engineers in the province and whose workforce is comprised of 20% Indigenous employees.[161] There are currently major hydroelectricity generating stations across the province, although Manitoba also derives about 2.1% of its electricity from wind and biomass fuels.[162]

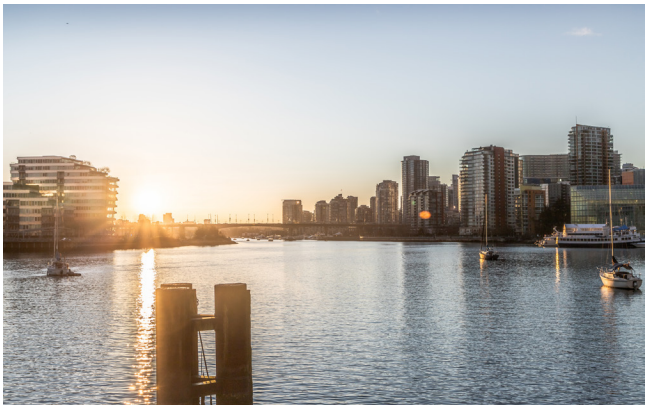
With consideration to the environmental impact of large-scale hydropower generators, Manitoba plans to curb its greenhouse gas emissions by one-third by 2030 compared to 2005 levels, down to one-half by 2050, and ultimately completely carbon neutral by 2080.[163] However, given Manitoba's nearly 100% renewable electricity rate, this timeline could be shortened. The province's Climate Change and Green Economy Action Plan, published in December 2015, allotted $5 million for a Climate Change Action Fund that will spur innovation in green transportation, community partnerships and education, and indigenous-owned energy projects.[164] The amount of funding could certainly be expanded in addition to federal government grants. For example, the Emerging Renewable Power Program (ERPP) "provides up to $200 million to expand the portfolio of commercially viable renewable energy sources available to provinces and territories as they work to reduce greenhouse gas emissions from their electricity sectors."[165] Manitoba is also considering non-hydro renewable energy sources, such as geothermal, biomass, and wind energy.[166]

Manitoba as a National Leader

Manitoba, with its abundance of natural resources, is already undertaking an ambitious energy transition. With all of its aforementioned goals, Manitoba would make for an excellent leader in the national shift towards renewable energy. Already in its Climate Change and Green Economy Action Plan, Manitoba has stated that it will "lead by example," not just in terms of electricity but through investing in clean energy sources, protecting special areas in complete collaboration with Indigenous groups, promoting sustainable agricultural practices, and developing efficient green and public transportation systems.[167]

One example of how Manitoba has managed to reduce its use of non-renewable electricity is by implementing a 2012 emissions tax and eventually a 2017 complete ban on coal and petroleum coke. Revenue generated from the emissions tax was used to fund the Biomass Energy Support Program, which assists coal users in the transition to renewable energy.[168] Arguably the most important feature of this project is that the province funnels the money generated from the emissions tax into supporting coal users and not leaving them behind. Manitoba has purposefully sought to ensure the inclusion of all in this energy transition.

Other provinces and territories could stand to learn from Manitoba to ensure an equitable and just transition. However, Manitoba could also emerge as an exporter of renewable electricity, which would ultimately reduce national greenhouse gas emissions and draw more revenue for the province. In 2015, for example, "Manitoba Hydro's exports reduced net global greenhouse gas emissions by approximately 7.5 million tonnes of CO2," exporting to both the Midwestern US and Saskatchewan.[169] Rubin also points out that Québec is a notable exporter of renewable electricity, particularly to the Eastern US. Combining Manitoba's and Québec's transmission lines, which has been in discussion since 2017, could significantly boost exports and generate even more revenue for Manitoba.[170] Thus, in addition to "leading by example," Manitoba could also share its vast amount of renewable electricity with neighboring regions.



1.7 Prince Edward Island

Concern: PEI imports 81% of its electricity from other provinces, namely New Brunswick, when wind energy is intermittent. 62% of this imported electricity is generated from non-renewable sources, mainly coal.

Concern: Electricity prices are very high in PEI; 20% higher than the national average.

Recommendation: Invest in more wind energy, specifically on its northern coast which is a particularly good location for wind.

Recommendation: Invest in solar and biomass energy to ensure PEI is not just relying on a non-renewable power supply from other provinces when wind is intermittent.

Recommendation: The government should develop funding for community co-ownership of these renewable energy projects so communities can have more autonomy and reap the benefits from its profits, rather than private companies.

As of 2014, Prince Edward Island generated 19% of its own energy, the vast majority (18%) coming from wind energy.[171] However, PEI imports 81% of its electricity from other provinces (namely New Brunswick) when wind energy is intermittent; 62% of this imported electricity is generated from non-renewable sources, mainly coal.[172] As such, in order for Prince Edward Island to divest from its utilization of non-renewable energy to combat climate change, it is necessary for PEI to become autonomous in its energy and become 100% renewable by 2035.

Investing in more wind energy is recommended since PEI's coastline on the Atlantic Ocean makes the province, particularly the northern coast, well-situated for wind energy generation.[173] However, there must be adequate environmental assessments to mitigate bird and bat deaths who can potentially collide into the wind turbines.[174] There has been innovation in turbine construction, however, as analysis of avian patterns have substantially mitigated wildlife deaths from turbines in recent years.[175] Another concern surrounding wind energy is how greenhouse gas emissions are still emitted in the construction of wind turbines, particularly its steel and concrete foundations.[176] However, research has shown that the scale of these emissions pale in comparison to emissions from burning fossil fuels.[177] While negative public opinion surrounding wind energy is also a common concern, professor Matthew Hall ensures that public opinion in PEI is generally open to the construction of wind farms, therefore backlash is not a huge issue.[178] Even so, community (co)ownership is advisable to entice people to be even more supportive of more wind farms, as a case study from Germany demonstrated how community co-ownership of energy projects suggests it is more likely that local populations will be welcoming to shifts in renewable energy.[179] Community (co)ownership also ensures that some of the profits from renewable energy will be able to fund other community projects, instead of the entirety of profits being funneled to private companies.

Moreover, there is the issue of wind not being 100% reliable, and how PEI is currently relying on non-renewable energy from other provinces to make ends meet. Professor Hall suggests that the least expensive option would be to also invest in biomass to balance out the wind energy to ensure a reliable renewable power supply, without having to rely so heavily on coal.[180] Biomass is advantageous due to its "dispatchability," and thus would only be necessary to meet the occasional energy shortfalls from intermittent wind energy.[181] Environmental assessments will be needed to ensure biomass development is not harmful to the environment, given concerns regarding potential air pollution and

water resource depletion.[182] Hall also suggests utilizing solar energy for local residences and businesses, noting how the cost of solar energy is declining, making it a reasonable option for inhabitants who already live in a province which has electricity costs 20% higher than the national average.[183] As such, consideration for lower-income families must be at the forefront of this shift towards renewable energy, to ensure higher prices will not be forced upon those with lower socioeconomic statuses.

Given PEI's coastline along the Atlantic Ocean, tidal energy could also be a viable option. However, it is not currently recommended for PEI due to uncertainties surrounding financing, technology, and its inability to be constructed at a local scale that PEI needs.[184] As such, a mixture of wind, solar, and biomass renewable energy presents the most sustainable, reliable, and affordable mix of renewable energy for Prince Edward Island.

1.8 Newfoundland

Concern: Bill-61 ensures Nalcor has a monopoly over renewable energy projects in Newfoundland, who have thus been criticized for stifling innovation in wind energy.

Concern: The current hydroelectricity projects in Newfoundland (e.g. Muskrat Falls) have been criticized for causing high risk of methylmercury as well as inadequate consideration of Indigenous communities.

Concern: Plans for growth and development of Newfoundland's oil and gas industry for 2030 through the establishment of the Oil and Gas Industry Development Council.

Recommendation: Complete transition to 100% renewable energy by 2030 using a combination of wind and solar energy. Where this is not possible due to Bill-61, invest in hydroelectricity that is sustainable, and takes environment assessments and indigenous consent into consideration.

Recommendation: Work with Oil and Gas Industry Development Council to withdraw from any upcoming oil and gas projects.

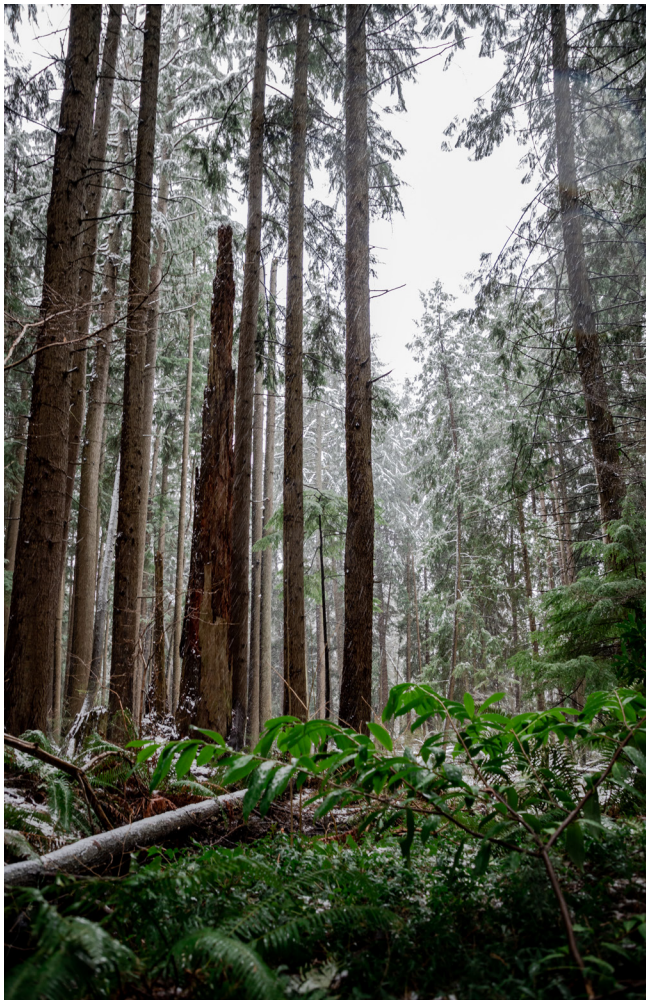
Recommendation: Continue to work around Bill-61 by constructing energy projects using wind and solar energy within communities that currently rely on diesel-powered facilities.

Newfoundland already generates nearly 96% of its energy from hydroelectricity.[185] At first glance, it would make the most sense to merely complete this transition also using hydroelectricity. However, it is recommended that Newfoundland divests from large-scale hydroelectricity such as the current Muskrat Falls project. It did not involve proper consultations with Indigenous communities nor adequate environmental assessments; studies have suggested that Muskrat Falls will yield higher methylmercury levels into Lake Melville,

increasing by 50%-100% if highly-carbonized soil is not taken away before flooding.[186] Methylmercury is a neurotoxin which can induce harmful effects on humans, including kidney and liver failure, memory loss, blurry vision and dizziness.[187] Moreover, higher methylmercury concentrations will disproportionately affect Inuit communities who rely on the lake for hunting and fishing. Studies suggest that 10-20% of Inuit peoples surrounding Lake Melville will surpass the daily intake limit as per Health Canada guidelines if Muskrat Falls continues to be constructed.[188] As such, any development in renewable energy projects in Newfoundland must include free, prior, and ongoing consent from Indigenous communities.

The multitude of negative environmental and health impacts associated with hydroelectricity is why it is recommended to invest in more environmentally sustainable options, such as wind and solar energy. Given Bill-61 ensuring Nalcor has a monopoly over renewable energy projects in Newfoundland, any innovation in renewable energy sources other than hydroelectricity is complicated.[189] Since Bill-61 does not include smaller communities dependent on diesel, other renewables such as wind could be an option given Newfoundland's high potential for wind, and solar energy for residences and businesses.[190] Like always, rigorous environmental assessments must also be undertaken to mitigate wildlife deaths from wind turbines, and any hazardous waste that is produced which could contaminate water resources from the production of photo-volatic (PV) cells for solar energy.[191] In areas where Bill-61 applies, the utilization of sustainable hydroelectric development with robust environmental assessment and Indigenous communities' consent must be undertaken. Community co-ownership is recommended which would yield more autonomy for locals and Indigenous communities over these energy projects, rather than having private companies like Nalcor reap all the benefits.

Moreover, there is the issue of the establishment of Newfoundland's Oil and Gas Industry Development Council. Through their "Advance 2030" policy report, the council pledges to drastically increase oil and gas projects by 2030 to create jobs and economic growth for Newfoundland.[192] They envision: "over 100 new exploration wells drilled, employment for more than 7,500 people, and multiple basins producing over 650,000 barrels of oil equivalent per day."[193] However, the development of this council directly conflicts with the goal of completely divesting from non-renewables and combating climate change. Instead of focusing on the economic potential of oil and gas, the government should instead focus its resources on creating jobs and a development council within the renewable industry, and withdraw from any upcoming projects involving oil and gas development.



1.9 Nova Scotia

Concern: Nova Scotia's geography and shortage of a major river system, as well as concerns over biodiversity, make large-scale hydroelectric power stations unfeasible.

Concern: Uncertainties as well as lack of investment and technology surrounding the implementation of large-scale marine energy.

Concern: Disruptions to wildlife due to the construction of certain renewable energy structures, such as wind and tidal turbines.

Concern: Negative public opinion surrounding wind turbines in local communities creates tension surrounding the implementation of this energy source.

Concern: As per the Provincial Government's Electricity Plan 2015-2040, the need for a renewable energy form with more reliability and less cost than biomass is necessary for Nova Scotia

Recommendation: Divest completely from coal and natural gas, and transition into 100% renewable energy by 2035 through investing in a mixture of wind, solar and tidal energy. Invest heavily in tidal energy due to the massive potential from the Bay of Fundy.

Recommendation: For tidal energy specifically, ensure that slow-moving turbines and fences are engineered so fish and other wildlife can pass through unharmed.

Recommendation: Continue and develop more community ownership initiatives such as the Community Buildings Solar PV Pilot Program, and for wind energy as well, so communities can have more autonomy over energy projects and reap the profits as opposed to private companies.

Nova Scotia's current generation of renewable energy as of 2015 was 24%, the rest of which predominantly comes from coal and natural gas.[194] The lack of a major river system makes it infeasible for hydroelectricity to make a substantial impact on generating energy; therefore, wind, solar, and tidal energy are the areas in which Nova Scotia can thrive to ensure their transition to renewable energy is sustainable and feasible.[195] The 2012 Marine Renewable Energy Strategy ensures action will be taken to construct and develop tidal energy as a priority in Nova Scotia's shift from fossil fuels, as the Bay of Fundy possesses immense potential for energy (60,000 MW).[196] Although there is currently a lack of guidance and investment surrounding tidal energy, as well as uncertainties concerning environmental effects, this gives Nova Scotia the potential to become a global innovator in tidal energy and a model for other countries around the world in the shift to renewable energy. Tidal energy is a highly recommended renewable energy for Nova Scotia due to the predictability of tides, lack of carbon emissions, and huge potential of the Bay of Fundy.[197] That being said, there are environmental concerns pertaining to wildlife deaths from tidal turbines and fences. However, there has been innovation to engineer these structures in particular ways, such as constructing slowly moving turbines, that would mitigate deaths substantially.[198]

There are also concerns from Indigenous communities regarding how the development of tidal energy may affect activities essential to their daily life, such as fishing. Freely given, ongoing, and prior consent from Indigenous groups must be at the forefront of these energy projects, especially given the uncertainty of environmental impacts of tidal energy. Development of tidal energy also brings opportunities for indigenous empowerment and collaboration, as the Mi'kmaq Ecological Study currently is dedicated to addressing any anticipated issues with tidal energy devel-

opment on their use of the Bay of Fundy.[199] Moreover, indigenous (co)-ownership of tidal energy is recommended to ensure autonomy over the planning and development of such projects. These co-ownership projects with Indigenous communities have already drawn considerable success, such as Pic River First Nation in northern Ontario co-owning a 13.5 MW hydroelectric system.[200] While financing these renewable energy projects is often a concern, Pic River has cultivated positive public opinion for this investment, through a variety of strategies: education programs, broadening town council to the general public so community members can offer advice, using the local newspaper as an outlet to maintain transparency, and working with other Indigenous groups around the region.[201] Pic River First Nation could potentially provide a framework for indigenous ownership of tidal energy projects in Nova Scotia as well.

As per the Provincial Government's Electricity Plan for 2015-2040, it was clear that the need for renewable energy forms that are more reliable and less costly than biomass is necessary to compliment tidal energy in Nova Scotia as well.[202] Solar energy is a promising option, since Nova Scotia already has developed a Community Buildings Solar PV Pilot Program that invests in solar panels for community buildings from which they can reap the profits.[203] While solar energy is one of the cleanest renewable energies given that it does not expend natural resources nor emit greenhouse gases, any potential hazardous waste from the production of PV cells must be considered.[204] Community initiatives should also be implemented for wind energy, as there is huge potential for it in Nova Scotia given its coastline along the Atlantic Ocean. Noise pollution is a common concern regarding the implementation of wind energy; however, a case study from Germany has suggested that community co-ownership of wind energy allowed for more positive public opinion towards wind turbine development.[205] This also gives communities the chance, similar to the Community Buildings Solar PV Pilot Program, to receive some of the profits from the energy projects to invest in further community initiatives.

1.10 New Brunswick

Concern: Negative public opinion towards wind energy.

Concern: Disruptions to wildlife as a cause of constructing certain renewable energy structures, such as wind and tidal turbines.

Concern: Uncertainty as well as lack of investment and planning surrounding the implementation of marine energy.

Recommendation: Invest in tidal, solar, and wind energy to ensure New Brunswick is 70% renewable by 2035 (the other 30% comes from nuclear energy).

Recommendation: Develop a framework to plan for future development and construction of tidal energy for New Brunswick, similar to Nova Scotia's Marine Renewable Energy Strategy.

Recommendation: Develop funding for community ownership of energy projects to keep the profits within the communities, and to sustain positive public opinion - similar to Nova Scotia's Community Buildings Solar PV Pilot Program.

In 2016, hydropower was the main source of renewable energy in New Brunswick, accounting for 20.6% of generation, with wind accounting for 5.6% of generation. [206] On January 10, The Canadian Press reported the extension of a deal between Hydro-Québec and New Brunswick that will see Québec export 47 TW of electricity into New Brunswick until 2040. [207] New Brunswick Premier Blaine Higgs says the agreement shows the province's willingness to import green

electricity and reduce its carbon footprint. Currently, the majority of New Brunswick's renewable energy is sourced from hydroelectric facilities, mostly from the 668 MW Mactaquac Hydroelectric Generating Station.[208]

A report published by the Pan-Canadian Integrated Wind Survey evaluated the potential for additional wind development across Canada and identified that in the Maritimes 50% of the demand for electricity could be met using wind energy.[209] Wind energy would also serve as a suitable complement to hydroelectricity, which can provide energy when wind speeds are not slow. This is ideal for a climate such as New Brunswick's which produces winds feasible for commercial energy generation.

Although tidal energy is still in its infancy, it is difficult to estimate how much energy can be feasibly generated from tidal sources. Tidal turbine technology is being tested and upgraded by private companies who are attempting to determine how animals interact with tidal equipment, how to launch and recover turbines, anchor equipment and deploy subsea cables in the Bay of Fundy — a difficult environment to work in due to its very strong currents.[210] The ultimate goal for developers is to test, refine and de-risk tidal electricity production and prove the bay's tides can be harnessed to generate electricity at commercially acceptable prices and output.[211] There are numerous challenges to developing working tidal energy technology since the research efforts are severely under-funded and the technology can be easily damaged due to the strength of the currents. The Pic River First Nation in northern Ontario which co-owns a 13.5 MW hydroelectric system is a stellar example of a co-ownership project with an Indigenous community.[212] Harnessing the power of public opinion, the community was able to draw investments into the project and make a substantial impact on production of sustainable energy in the community. Strategies such as education programs, the involvement of the town council and local newspaper to reach the broader community and maintain transparency, Pic River First Nation created an example of effective Indigenous ownership of tidal energy projects which communities of New Brunswick can successfully emulate.[213]

Community ownership of energy projects has been successful on a small scale before with three rural communities joining forces on a proposal to generate more wind energy in New Brunswick. Saint John Energy and smaller utilities in Edmundston, and Perth-Andover submitted joint proposals to develop two wind energy projects, the Charlotte County Community Wind Farm, near South Oromocto Lake, and Chapman Community Wind Farm in Chapmanville in Carleton County.[214] Furthermore, projects such as Community Renewable Energy, that are small scale programs are regulated through the Electricity from Renewable Resources Regulation and allow NB Power to endeavor to obtain up to 40 MW of renewable energy from First Nations and an additional 40 MW of renewable energy from local entities as defined in the Regulation.[215]

1.11 Northwest Territories

Concern: The NWT is warming at roughly three times the global rate, as highlighted in Canada's Changing Climate Report (2019), which is causing significant changes in the natural environment.

Recommendation: Invest in solar energy in the Northwest Territories, and for the times and places where this is not suitable, invest in wind and tidal energy, in order to meet 100% of the energy demand. This will allow for a diverse source of carbon-neutral renewable energies by 2030.

Out of all of Canada's provinces and territories, the Northwest Territories is a leader in terms of per person installed solar electricity: they reduced their greenhouse gas emissions from electricity by 25% in 2017.[216] Yet, despite its abundant natural resources, the NWT depends heavily on imported fossil fuels to meet its energy needs. This results in significant per-capita greenhouse gas emissions and high costs in independent communities.[217]

The NWT is warming at approximately triple the global rate, which has been highlighted in Canada's Changing Climate Report (2019); this is causing significant changes in the biodiversity and environments across the region.[218] These impacts include, but are not limited to, greater coastal and river erosion; increasing permafrost thaw; new mammal, bird, insect and fish species moving north; increasing risk of wildfires; changing ice conditions and longer ice-free seasons.[219] There is a need for large scale action in the NWT, in the form of reducing CO2 emissions by meeting energy needs with carbon-neutral renewable energy sources. This is perhaps the most significant, if not the only, way to combat the risks associated with rising CO2 emissions.

Currently the NWT draws its energy as 37% from hydro, 46% from oil and gas, and the remainder from other carbon-neutral renewables, such as wind and solar energy. Developments in solar and wind should be prioritized to shift the NWT to 100% renewable energy within the agreed-upon timeframe, as this would maximize the diverse potential of the NWT. In particular, tidal energy. Tidal energy, at a glance, operates through the rise and fall of the sea in places of high tides, providing energy that can be used to generate electricity. There are few places that can support such a source of energy, one being the NWT, where there could be built 35 MW of generation capacity from four particular sites. As with many sources of environmentally dependent renewable energies, there are significant technical challenges to the implementation of these emerging technologies, such as isolation and very harsh ice conditions.[220]

In addition to a promise for diversified renewable energy development, the government of the NWTs has made a number of commitments to reach the 2030 Paris Agreement in order to avoid a 2°C increase in global temperatures. The six commitments are as follows:

1. Work together to find solutions: community engagement, participation and empowerment
2. Reduce greenhouse gases from electricity generation in diesel powered communities by an average of 25%
3. Reduce greenhouse gas emissions from transportation by 10% per capita
4. Increase the share of renewable energy used for space heating to 40%
5. Increase residential, commercial, and government building energy efficiency by 15%
6. A longer-term vision: developing the NWT's energy potential, address industry emissions, and do our part to meet national climate change objectives.[221]

Unfortunately, 2°C will not mitigate all the consequences of climate change, and further increased heating will occur even if we reduce CO2 emissions globally down to zero by yesterday. This is because much of the earth's CO2 is stored in soil and permafrost, as well as the ocean, and when these storages heat up they release more of that CO2, sending the climate into a self-perpetuating greenhouse effect. Consequently, there is far more to be done than meeting the Paris Agreement. The NWT and Canada at large, must commit to carbon-neutral production and consumption as soon as possible, as we are both in a privileged position to do so and committed to an international promise set out by the Paris Agreement to transition to carbon neutrality.

1.12 Nunavut

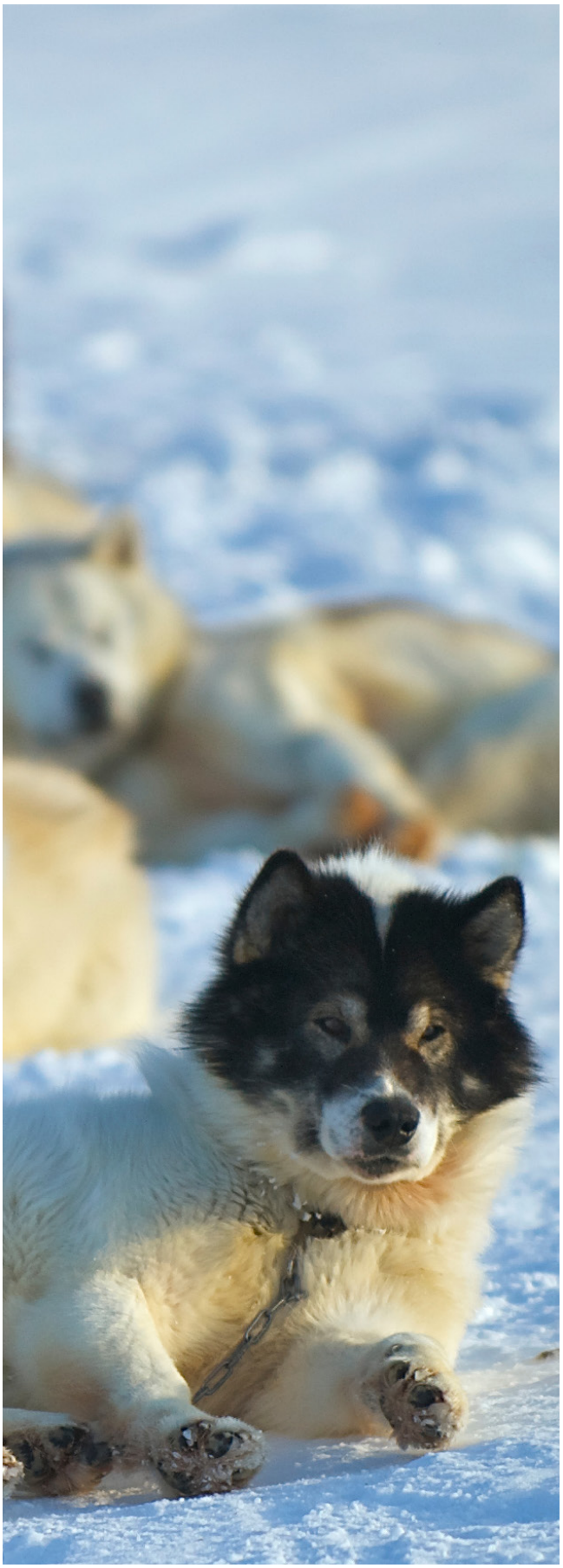
Concern: There are significant technical challenges to implementing emerging technologies in the North, including very harsh ice conditions and isolation.

Concern: Nunavut relies almost exclusively on imported diesel to run generators throughout individual communities.

Recommendation: Focus should be placed on reaching individual communities and supporting them in implementing renewable energy sources.

Recommendation: The South Baffin region of Nunavut is one of the world-class sites for tidal change and this area should be utilized.

Recommendation: More research surrounding energy transitions in Nunavut should be conducted in order to ensure that this region is adequately incorporated into Canada's energy transition.



Residents of Nunavut consume on average 2.9 MWh of energy, which is 80% less than the Canadian national average, however, it does not produce much.[222] Nunavut does not currently produce any crude oil or natural gas, but its reserves are estimated at 181.4 trillion cubic feet of natural gas and 18.3 billion barrels of oil. Recently, Qulliq Energy Corporation has invested in solar panels in Iqaluit as part of a pilot project.[223] This shows that there is a willingness to convert to renewable energy in the territory, though this transition may be slow. Solar panels are only usable for certain times of the year, as Nunavut has less daytime in the winter months and almost constant daytime in the summer. This means their solar power use could only be seasonal, however, the extra energy created in the summer may be economically beneficial to the area. Tidal energy also shows promise in the territory, as the long coastline and constant waves create great conditions for tidal energy generation.

Currently, Nunavut has no plans to pursue nuclear energy. The Territory has endorsed the extraction of Uranium in its land on the condition that it is used for peaceful and environmentally responsible purposes.[224] There are proposals to build a Uranium mine in Nunavut, however the projects have been stalled for many years.

Nunavut faces specific challenges in our energy transition, as this Territory does not have an existing energy grid unlike the Yukon and Northwest Territories.[225] Harsh ice conditions, a vast territory and the large amount of islands in the northern part of Nunavut are a hindrance to the creation of a cohesive energy grid. This means that each individual community across Nunavut relies on independent power sources and cannot have power transported to them and will make the construction of any energy infrastructure difficult.[226]

Nunavut relies almost exclusively on imported diesel to run generators in individual communities.[227] Reliance on diesel adds significantly to the high cost of living, meaning that other forms of energy have great potential in Nunavut. For these reasons, Canada's energy transition should focus on reaching local communities and supplementing renewable energy sources in them. Furthermore, the market size of communities makes this transition difficult, as markets are small and transportation to other markets is costly.[228] However, finding a way to create an effective energy transition in Canada means utilizing geographic areas that would offer advantages for energy production.

Tidal energy is created through the rise and fall of sea levels where the size of the difference in the ocean waves is several meters. This can be used to provide a source of energy and can be harnessed Nunavut offers one of the most prime locations in the world where these changes in tidal height are consistent and reliable.[229] The South Baffin region in Nunavut is a world-class site for tide change. It is estimated that Nunavut has the potential to build 30,000 MW of generation capacity from harnessing tidal energy from 34 sites in the South Baffin region.[230] Though there are ways for Nunavut to be included in Canada's energy transition, research regarding how to effectively integrate the territory is severely lacking. Consequently, more research should be conducted to ensure that Canada is utilizing all of its land to the fullest extent; while ensuring that communities are incorporated in this energy transition. This research should be specifically conducted around tidal energy and its applications in Nunavut.

1.13 Yukon

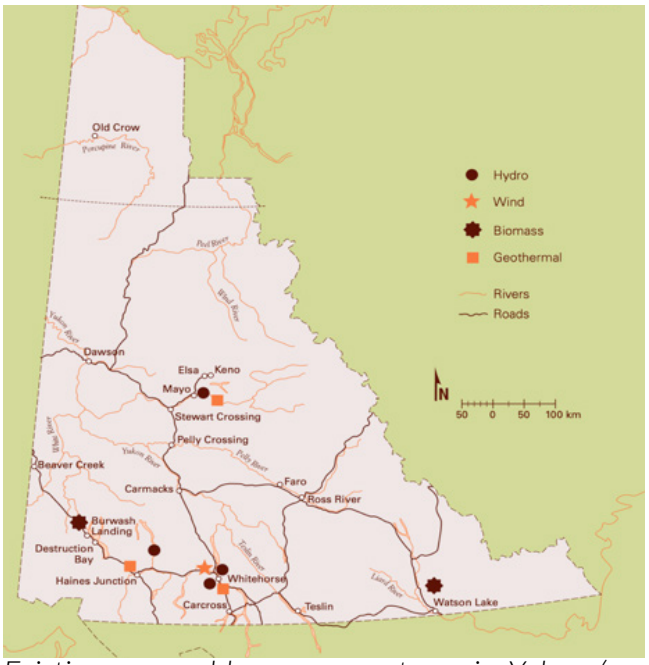
Recommendation: Reduce Yukon's reliance on non-renewables and other energy sources that are not carbon-neutral, while replacing them with a diversified source of renewables which includes hydroelectricity, and potentially solar, wind, and geothermal.

Concern: current plans to increase renewable energy do not do enough to meet the needs of communities off the grid. This brings up as well, the reliance on wood in communities across Yukon, given wood is not a carbon neutral source of renewable energy.

Yukon's approach to renewable energy is both optimistic and inspiring. Currently Yukon is doing incredibly well with supplying renewable sustainable energy to meet the needs of Yukoners, by all standards. Hydro has, and must always, play a key role in Yukon's electricity makeup given its abundant supply and the pre-existing infrastructure to provide it. In 2018, Yukon was able to use hydro to generate just shy of 94% of the electricity needed by those connected to the Yukon grid. The other 6% was drawn from thermal fuel sources like diesel and liquified natural gas (LNG). In 2019, the Yukon government released a draft of its *Our Clean Future* 10-year plan to address climate change, "by building thriving, resilient communities powered by sustainable energy and supported by a sustainable green economy."[231]

So far, things are going well in the Yukon in terms of transitioning to carbon neutral energy. However, there is also a growing demand in the Yukon for renewable energy that must be met with a growing supply. The key goals outlined in the government's draft include reaching the following milestones by 2030:

1. Produce an average of 93% renewable electricity on the Yukon grid.
2. Have 6,000 zero-emission vehicles on the road.
3. Replace fossil fuel heating systems with electric heat pumps in 1,500 buildings.



Existing renewable energy systems in Yukon (excluding smaller systems such roof-top solar panels or wood stoves, which can be found throughout the territory).[232]

The draft also proposes reducing the amount of diesel used to generate electricity in off-grid communities by 30% by 2030.[233] Yukon energy has proposed specifically how this can be accomplished, pushing the 90% to 97% renewable energy by 2030. The 10-year plan focuses on hydroelectric through three primary new projects:

1. Construct a new pumped storage facility on Moon Lake.

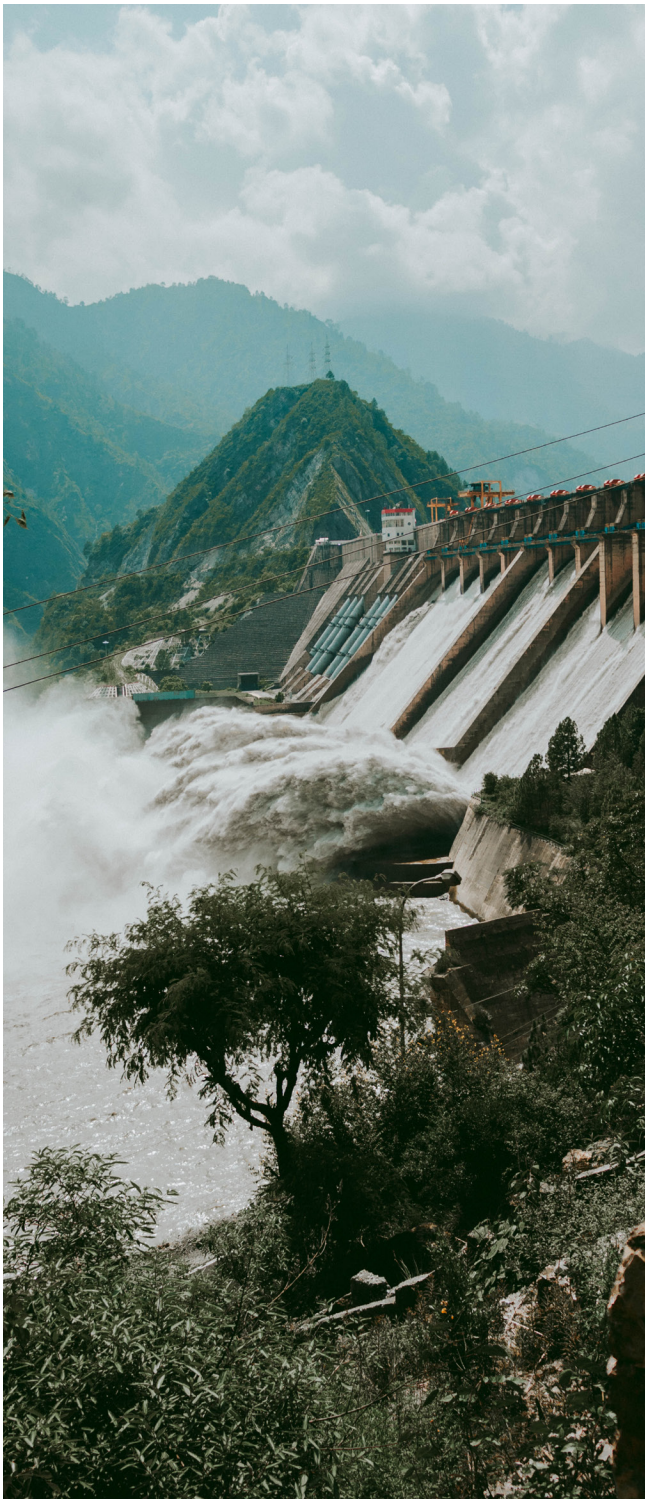
2. Source renewable electricity from the planned expansion of the Atlin hydro plant owned by the Taku River Tlingit First Nation.

3. Expand and upgrade the transmission network in the Southern Lakes region.[234]

This would, as aforementioned, put Yukon's energy source at 97% renewable using only hydroelectricity by 2030. The potential for renewable energy in the Yukon is both possible and practical.

Currently, concerns are raised with the continued reliance on woodfire as a renewable energy source across the territory.[235] Although wood is a renewable source of energy, it is not a sustainable one. In some cases, it is possible that wood-burning furnaces may actually emit more CO2 from their smokestacks per unit of electricity produced than those burning coal or natural gas, due to the higher water content in wood than other fuels.[236] For this reason, it is both recommended that the Yukon's approach involves increasing renewables, an already incredible task, but also meeting the needs of everyday Yukoners that have yet to be integrated into more sustainable sources of renewable energy. However, the current government strategy has favoured wood sources of renewable energy; and while there is much debate around the harms and benefits of wood as a renewable energy, Yukon does not need to use wood when there are other sources of renewable energy, as well as hydroelectricity.

Attention must be paid to communities living off the grid; those who rely on diesel for their source of electricity, who perhaps are not yet integrated into the Yukon's hydroelectric source of energy. These communities include Beaver Creek, Burwash Landing, Destruction Bay, Old Crow, Upper Liard and Watson Lake.[237] The government policy reflects an interest in diversifying the renewable energy sources to tackle this issue, including the adoption of geothermal energy, and the need to develop a policy framework for geothermal energy. As well, it supports the development of a wind, hydro, solar, or geothermal project in diesel-powered communities. In order to test its feasibility, the government will first run a pilot program, which will be followed by further investment, if all goes well.[238]



2. Nation-Wide Energy Transformations

The energy technology currently existing in Canada can be utilized in its energy transition by updating existing infrastructure to support sustainable energy. This includes adapting existing pipelines to support ethanol and biofuels, updating small modular reactor technology, and effectively utilizing uranium reserves.

2.1 Knowledge exchange channels

Recommendation: Create channels through province-sponsored programs where there can be an exchange of knowledge and expertise between the non-renewable and renewable sectors across provinces

The non-renewable sector is accustomed to dealing with new supply chains, working with unfamiliar technical capabilities, or even having to establish different delivery methods.[239] A program that allows for exchanges of core expertise between the renewable and non-renewable industry could be beneficial for both sectors to optimize technologies, reduce emissions during extraction or production methods, and make consumption more efficient. For example, Statoil was able to apply their knowledge of offshore drilling structures to build offshore wind factories.[240] Other oil companies such as Total, Shell, and Eni were able to extend their knowledge of the oil refinery process to the biofuel industry; an easy transition considering the similarities of the fuels and the infrastructures needed to produce it.[241] On the other hand, renewable technologies can be useful to improve non-renewable technologies, making them more efficient and ultimately reducing their emissions. Carbon Engineering for example, is a small Canadian company that helps companies such as Chevron, Occidental Petroleum and Australian BHP to develop carbon-capture technologies to reduce emissions during the extraction process.[242] Canada can create programs at the provincial level that can incentivize the exchange of expertise (mostly technical) between the two industries, by providing tax-cuts and Accelerated Investments Incentives to the companies involved. Through these programs, Canada can transition its energy consumption to a more sustainable one while at the same time providing a platform on which both the renewable and non-renewable sectors can exchange expertise and improve their infrastructure and final products from a sustainable standpoint.

2.2 Existing Infrastructure

Principle: Canada's existing energy infrastructure can be useful in an energy transition.

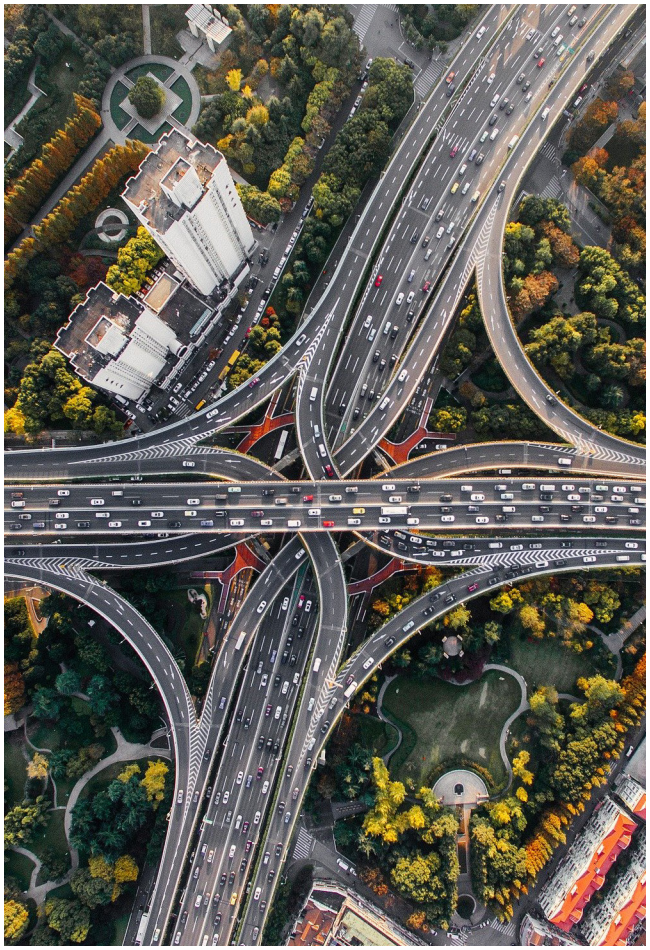
Concern: The adaptation of current infrastructure to accommodate environmentally sustainable alternatives to fossil fuels may present technical difficulties; in addition.

Recommendation: Existing infrastructures that are used for non renewable industries should be mandated by the Canadian government to begin the transition to renewable energy by incorporating biofuel and renewable sources into their operations while reducing non-renewable productions and use.

Canada currently has more than 840,000 km of pipelines throughout the country, moving thousands of barrels of oil and millions of cubic metres of gas per day.[243] To im-

prove the transition towards more sustainable forms of energy, some of these pipelines could be adapted to transport ethanol and biofuels, which can be used to replace petroleum products. The rest of the pipelines will still be used for the transportation of natural gas, since it can contribute to intermittence in renewable sources of energy. Currently, biofuels are transported via rails, trucks, and ships, leaving a substantial environmental impact compared to using these pre-existing pipelines.[244]

Adapting current infrastructure to support these goals presents some technical challenges. A large amount of ethanol present in the pipelines can cause Stress Corrosion Cracking, which can be damaging to its infrastructure.[245] Another challenge in this transition is the fact that biofuel and oil refineries may not be placed close to each other, creating the need to relocate some of the pipelines to accommodate for the transportation of biofuels and ethanol.



2.3 Small Modular Reactors

Principle: A replacement plan for older nuclear generators must be formulated.

Principle: Emerging technology such as Small Modular Reactors (SMRs) should be considered as they have the capabilities of being retrofitted in existing nuclear facilities, and are safer as well as more efficient.

Concern: This technology is being developed through the private sector while the government has monopolized nuclear power.

Concern: The technology, while promising, is still years away from being commercially viable.

Recommendation: The government should take steps to begin a transition process by creating the proper infrastructure so that when the technology is available, it can scale quickly.

Recommendation: The government should work closely with private sector companies associated with SMRs, investing in them and providing subsidies while putting a plan in place for how to intertwine the public and private sectors.

Traditionally, the Canadian government has held a monopoly over nuclear power. Nevertheless, the private sector has been focused on developing a new and improved form of nuclear power in the form of small modular reactors. It is imperative that the public and private spheres cohesively merge their efforts together in order to efficiently carry out and scale this new solution and aid in the fight against climate change. Countries such as the US have already created funding initiatives in order to help the private sector accelerate their ongoing projects.[246] The Office of Nuclear Energy has initiated the "SMR Licensing Technical Sup-

port Program", which reduces problematic barriers and expedites the certification process.[247]

Similarly, Canada has begun merging the public and private spheres by implementing support programs such as the Canadian Nuclear Research Initiative, created for the purpose of aiding private corporations with research grants and connecting them to global vendors in order to accelerate production.[248] This relatively new program released its first round of recipients in November of 2019, which included Kairos Power, Moltex Canada, Terrestrial Energy and Ultra safe Nuclear Corporation.[249] In order to ensure continued success, similar support programs need to continue to be created and implemented by the Government of Canada.

Relative to a conventional reactor, the new technology of a SMR can scale down the size of the reactors to 1%.[250] Having this excess space will allow for a power plant to be made of multiple small reactors and eliminate the risk of having one malfunction and delaying power generation. As with all forms of nuclear power, safety is the primary concern especially after the recent meltdown in 2011 at the Fukushima plant in Japan. To mitigate these concerns, companies such as NuScale Power out of Oregon have created an SMR that is said to be impervious to meltdowns.[251] This is done by eliminating many of the moving parts of conventional reactors such as valves and pumps that can malfunction, and replacing them with increased safeguards.[252]

With the technology at the cusp of being available for mass production and implementation, it should be the onus of the Government of Canada to aid the private sector in developing this technology. By creating and implementing support programs, the government will be able to create the proper infrastructure for an efficient transition into this new wave of nuclear technology.

2.4 Uranium Utilization and Nuclear Regulations

Principle: Canada must effectively utilize its reserves of uranium to support the expansion of nuclear power.

Principle: The environmental impact of extracting uranium should be minimized.

Principle: All communities near uranium mining operations, indigenous or otherwise, should not be negatively affected by the process of extracting uranium.

Concern: The closing of uranium mines throughout various provinces and territories has significantly reduced Canada's production of uranium.

Concern: The ban on uranium exploration and production by the Provinces of British Columbia, Nova Scotia, and Québec harms Canada's ability to develop and utilize its uranium reserves.

Concern: Current practices in mining uranium still have room for improvement in reducing their environmental impact.

Concern: Communities located near uranium mining operations, particularly Indigenous communities, may be suffering from negative impacts associated with the extraction of uranium.

Recommendation: The Intergovernmental Affairs Secretariat and Department of Natural Resources should seek to foster cooperation with provincial governments to better develop and utilize Canada's uranium reserves.

Recommendation: The Ministry of the Environment should conduct a review of the ISO 14001 international environmental certification and create an improved environmental standard if deemed necessary.

Recommendation: The Indigenous Services Canada, Crown-Indigenous Relations and Northern Affairs, and Departments of Natural Resources should collaborate with Indigenous stakeholders to develop enhanced regulations to mitigate the negative impacts of uranium mining on nearby communities.

Canada has a natural abundance of uranium, with over 490,000 tonnes of uranium - roughly 9% of the global total - being found in Canada in 2012.[253] This figure only accounts for uranium that is economically viable to extract at a price of $100 per kilogram, meaning that there is significantly more uranium beyond that, to potentially be exploited should prices rise. Currently, all active and proposed uranium mining operations are located in Northern Saskatchewan.[254]

The foremost concern regarding Canadian production of uranium is therefore not scarcity or an inability to produce, but rather the environmental impacts associated with mining uranium. As is typical of mining operations, there is a disruption of the environment and pollution of both surface and groundwater, as the radioactive minerals are extracted.[255] This was evident in the Saskatchewan government's close decision in the 1990s to nearly close all uranium mines in the province due to environmental concerns.[256] However, the results of a joint Federal-Provincial study panel prevented this by instead advocating for the adoption of the ISO 14001 environmental certification.[257] With the incorporation of an international bodies' environmental certification, including a commitment that all future mines would have a lessened environmental impact, the government took substantial action to meet environmental concerns.

With the goal of transitioning from non-renewable energy, nuclear power offers an opportunity for more sustainable energy production. Any barriers to uranium extraction by provincial governments should be

reduced, if not eliminated, through joint-cooperative efforts by the Federal and Provincial governments. To mitigate the concerns that led to restrictions on uranium mining by provinces such as Nova Scotia and Québec, a review should be undertaken of the ISO 14001 environmental certification to ensure it provides for sufficient protections for the environment by uranium mining operations.[258] If it is found to be insufficient, the Federal Department of the Environment should take the initiative on creating an updated and robust environmental certification for the mining of uranium. Further, the Indigenous Services Canada, Crown-Indigenous Relations and Northern Affairs, and Departments of Natural Resources should engage in a process of consultations and cooperation with nearby communities, including Indigenous groups, located near current or proposed uranium mining sites. This should be done to ensure that any negative impacts associated with uranium mining for local communities are mitigated.

2.5 Natural Gas

Recommendation: Where and when necessary, supplement renewable forms of energy with low-emission fossil fuels, such as natural gas.

Natural gas is considered to be the cleanest of the fossil fuels because it emits a low level of greenhouse emissions. It is also one of the world's fastest growing fossil fuels, by demand.[259] Some other benefits of natural gas are its easy transportability, especially when in the form of LNG, which can be useful to countries experiencing short-term disruption. It is also cheap to produce when compared to coal, since a gas-fired plant has an investment cost of $1,100 per kilowatt, while a coal-fired plant would need $34,000.[260] In the global market for natural gas, Canada is the fourth-largest producer and the fifth-largest exporter,[261] making this specific fossil fuel a perfect candidate for supplying energy to Canadians when and where electricity produced by renewable sources such as wind and solar is simply not available. Indeed, most forms of renewable energy are actually intermittent and need to be complemented by some other types of generated power. Natural gas could be used as a supplement to make the energy grid more reliable while producing low emissions, [262] and can be supplied through a gas power plant, pipelines, and through traditional means of transportation. Natural gas can thus temporarily facilitate the transition to a fully sustainable energy mix while renewable energy production capacities are still under development. Canadian companies that produce natural gas (such as Suncor Energy and Canadian Natural Resources Limited) can be incentivized to invest in renewable energies that are complemented by existing non-renewable sources; this would mitigate the unfavourable effects of transitioning to clean energy on the natural gas sector, by integrating it into the process.

2.6 Transportation

Transportation is one of the largest sectors contributing to greenhouse gas emissions in Canada. Government data has revealed that in 2017, the transportation sector accounted for 27% of all of Canada's greenhouse gases.[263] When broken down, this statistic is comprised of 54% passenger transportation, 41% freight emissions and 5% for off-road emissions.[264] The vastness of Canada's land mass effectively creates the need for relatively long transportation periods, thus rendering transportation as a major contributor to emissions.[265]

Transport-related emissions in Canada have increased steadily over the years. Between 2000 and 2017, emissions rose by 19% per capita due to an increase in the number of vehicles, especially freight trucks and SUVs used in Canada.[266] Because of the immense amount of energy required to transport Canadians, as well as their goods and services, there is clearly a need for innovation in the sector towards more environmentally sustainable means of transport. Transportation in Canada is currently a booming sector, as energy efficiency improvements have saved Canadians 763 PJ of energy, and almost $20.8 billion in energy costs, in 2016 alone.[267] This next section will outline the challenges and proposed solutions for three of Canada's major transportation sectors: buses, cars, and trains in both the public and private sector.

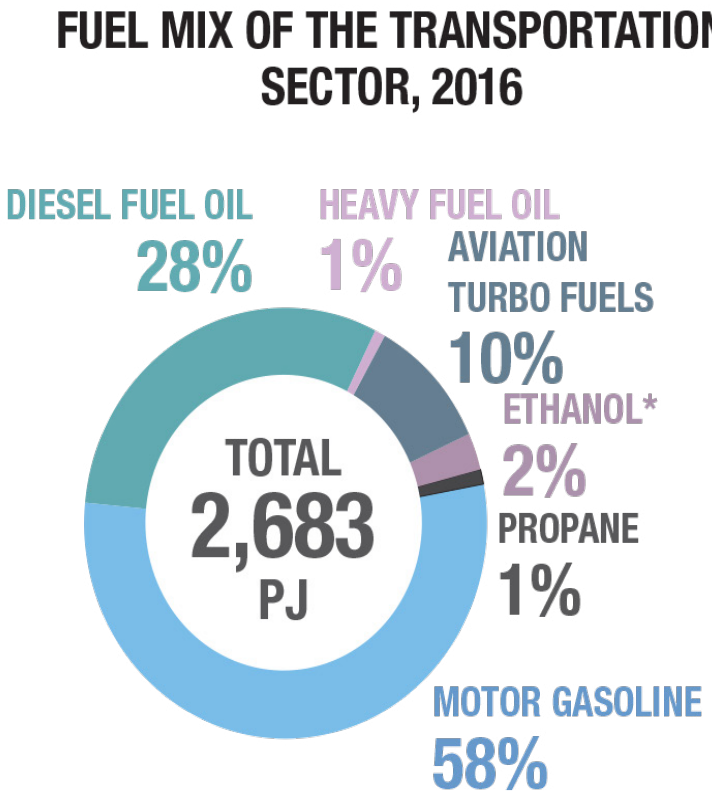
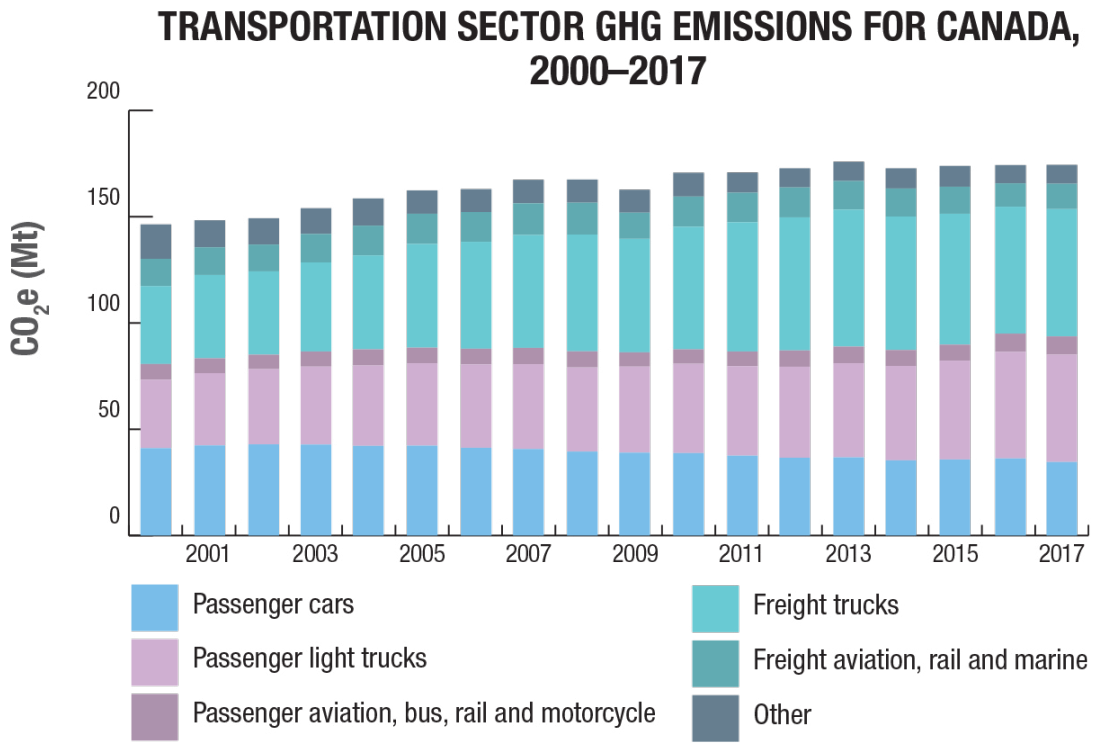


Image from Natural Resources Canada.[268]



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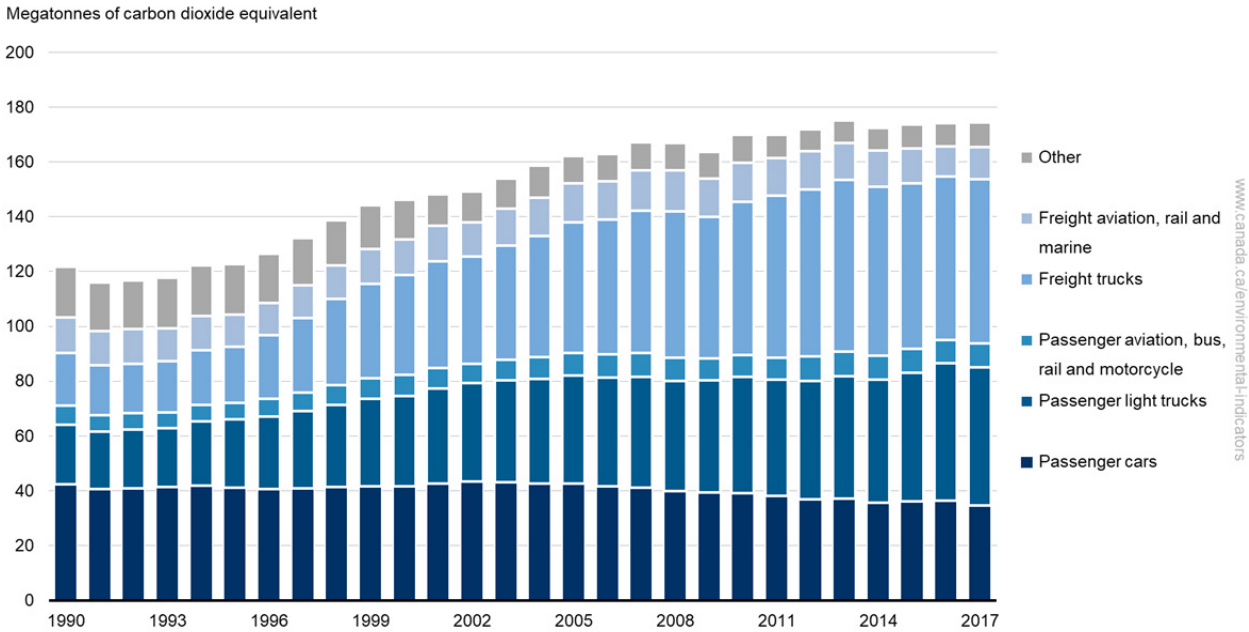


Image from Environment and Climate Change Canada.[270]

2.6.1 Buses

Principle: Electric buses will be an integral part of Canada's energy transition, as they produce 40% fewer greenhouse gases than standard diesel buses produce over the same lifetime.[271]

Concern: Transportation is one of the largest contributors to Canada's carbon emissions.

Concern: Implementing this new infrastructure to support electric buses could be costly.

Recommendation: All publicly funded Canadian bus transportation should have net-zero emissions by 2050.

Recommendation: Each province should ensure that all funding for transit in their respective municipalities is contingent on the implementation of electric buses in their cities.

Recommendation: The Government of Canada should create financial incentives through grants and tax breaks for companies to transition their bus fleets to electric-powered buses.

Most buses currently used in Canada are standard diesel buses. Diesel buses produce carbon emissions, which are harmful to Canada's environment and the health of Canadians. Electric buses are an environmentally friendly alternative to the standard diesel buses that are being used by an increasing number of Canadian municipalities. Even when factoring in the carbon emissions required to create an electric bus, as well as the emissions used to create the electricity to power it, electric buses still produce significantly lower amounts of emissions than diesel buses.[272] Electric buses produce around 40% less greenhouse gasses than standard diesel buses produce over the same lifetime.[273] By investing in electric buses, the Government of Canada will invest in the future of Canadian cities, while actively committing to fighting the climate crisis and improving the health of Canadian citizens.

Though the initial cost of electric buses can be expensive, the savings they will create for the government in the long-run will offset the upfront costs. The average cost of one electric bus is $1.2 million, which is double the cost of the average diesel bus. Though this will appear as a steep initial investment, electric buses produce greater savings over their lifetimes, being around 40% cheaper in repairs and upkeep when compared to standard diesel buses.[274] Furthermore, electric buses are proven better for public health, which will positively impact the Canadian healthcare system. A study done by the City of Chicago revealed an annual cost of $55,000 USD on the health impact of emissions from a single diesel bus in the city, amounting to $660,000 USD during the typical 12-year lifespan of a diesel bus.[275] By investing in electric buses in Canada, the government can offset public health costs, while also creating a more sustainable future.

Today, there is a growing trend in many Canadian municipalities to switch to electric buses. The city of Montréal, for example, has committed to providing zero-emissions transit by 2040.[276] The cities of Edmonton and Toronto have recently purchased between 50 and 60 electric buses that are expected to be fully introduced into their bus fleets by 2020.[277] Following suit, the federal Government of Canada should create financial incentives to encourage every municipality in Canada to make the switch to electric buses.

Though the government has made steps to improve bus sustainability in the public realm, private companies should also be encouraged to transition to sustainable transit. Other common modes of transportation provided by private companies, including greyhound buses and yellow school buses, should be encouraged to transition to electric power. The Government of Canada should encourage

the private sector to transition to electric buses through the provision of envelope funding in order to ensure that these companies are being held to the same account in Canada's sustainable transition as is the public sector.

2.6.2 Cars

Principle: Shifting from private to public transportation will maximize greenhouse gas emissions reduction.

Principle: Canada needs to increase the number of zero-emission vehicles that are produced and sold.

Principle: The private transportation sector of Canada plays a significant role in emitting greenhouse gases.

Concerns: Over 12 million Canadians use their cars to get to work every day.[278] This consumption habit is a large contributor of carbon emissions.

Recommendation: The federal government should encourage and invest in active transportation projects to encourage multiple modes of transportation such as cycling, walking, and transiting, in order to reduce the greenhouse gas emissions produced by Canadians choosing to use their personal cars as their sole mode of transport.

Recommendation: The federal legislation should mandate that a certain percentage of vehicle manufacturers' sales have zero-emissions.[279]

Canada is behind in its achievement of reduced (or zero) emissions in its transportation sector. The transportation sector is responsible for about 23% of Canada's greenhouse gas emissions, leaving it with a lot of scope to improve our policies to reduce this emission.[280] In order to transition to a low-carbon future, a number of changes can, and must, be made. One important shift will be electrifying private transportation, as it accounts for a huge portion of the transportation sector's emissions. Meanwhile, investments to popularize and improve public transit's accessibility will aid the transition to a low-carbon future for Canada. Car-sharing can also help reduce trip distances, while consequently reducing emissions. Cycling and walking have become popular means of transport in some parts of Canada, since it is a healthy and affordable option. However, increased funding for cycling paths and walking infrastructure will be necessary to better establish these options. At a federal level, a zero-emission vehicle legislation should be implemented. As battery-powered electric vehicles emit little to no carbon, this could bring tremendous change to the environmental impacts of private vehicles in Canada. The Government of Ontario has a target of rendering at least 5% of all vehicle sales to be zero-carbon emission by 2020. Although this is still a very small percentage, if Canada would like to be 100% zero-carbon emission by 2040, it is a step in the right direction.[281]

2.6.3 Trains

Principle: Transportation in Canada, specifically commuter transportation, causes the release of significant greenhouse gas emissions and thus must be prioritized in the shift to a less carbon emitting transportation sector.

Concerns: To effectively address the issue of transportation there is a need to offer incentives for individual choice of driving versus using public transportation. Influencing individual choice may be a difficult cultural change to achieve within a population that is comfortable and used to driving private automobiles.

Concerns: The infrastructure changes that are needed to sustainably accommodate the growing population accessing public transit in the next 20 years will require major funding investments from municipal, provincial, and federal governments.

Recommendation: All levels of government should pool funding to support light rail rapid transit on commuter lines across Canada to encourage sustainable and accessible commuter options.

As explored above, transportation in Canada is a major contributor to the nation's greenhouse gas emissions. In 2018 in Ontario, the transportation economic sector was the largest contributor to Ontario's greenhouse gas emissions; contributing 33% of total emissions.[282] Cities in Canada have taken active measures to decrease the amount of greenhouse gas emissions their fleets and transit systems release into the atmosphere.[283] Canada's largest metropolitan areas have expanded outward, resulting in massive increases in the rates of commuter traffic in and out of cities such as Toronto, Vancouver, and Montréal. The most sustainable way to address the emission issues of commuter traffic with relation to major regional growth is to encourage the use of public transit and sustainably powered trains to move people in the regional context of these cities.[284]

For these changes to occur there is a need for municipal, provincial, and federal governments to pool their funds, ensuring that there are light rail rapid transit on commuter lines across Canada, encouraging sustainable and accessible commuter options.[285] Influencing individual choice also plays a role in achieving a shift in the personal lifestyle choices of Canadians driving their cars, to instead using public transportation options, such as light rail. This means that there needs to be accessible options for people to use public transit rails.[286] Creating this shift would require investments from all levels of government, towards both infrastructure and incentives, that will encourage Canadians to continue decreasing their carbon footprint by shifting towards public transit alternatives for their travels.

3. Economy and Financing

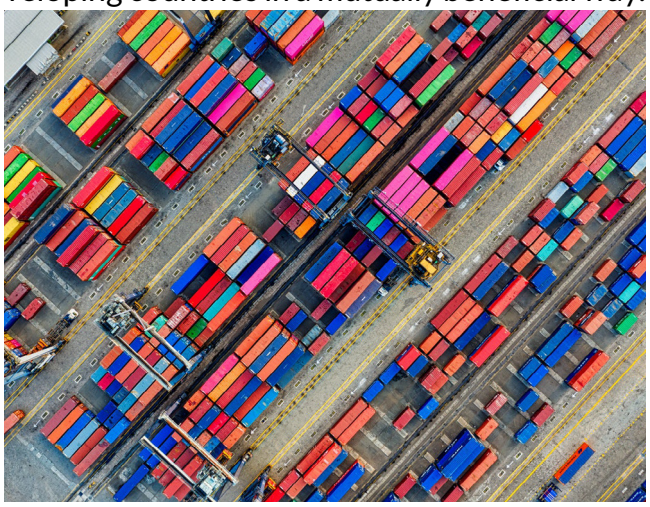
The modern economy is built on energy. Accordingly, it is remiss to discuss an energy transition without considering the economy. Not only will the economy be directly impacted by energy transitions, but it will also be used as a tool to bring about these changes in the first place. This report focuses on bringing Canada's economic policy, spanning trade, taxes and regulation, financing, and labour, in alignment with its proposed energy objectives. For example, more environmentally and socially responsible multilateral trade can cement Canada's status as an energy leader. Furthermore, a combination of different taxation and financing instruments can both discourage traditional energy usage patterns and raise funds for cleaner innovations. Finally, responsible labour policies can lead to a more just transition for all. Through proactively considering economic considerations, Canada can ensure a more effective and equitable energy transition.

3.1 Trade

Principle: Canada should use its energy exports to support sustainable economic development in its most vulnerable trading partners.

If Canada is to become a global energy leader, it must also accept the global responsibility that comes with that leadership and with its advantageous position as a wealthy, industrialized country. The Government of Canada recognizes that "developing countries are the most impacted by climate change and the least able to afford its consequences."[287] Furthermore, energy scarcity and fossil fuel dependence can both inhibit sustainable development. In adopting the UN's Sustainable Development Goals in 2015, Canada committed to support sustainable development globally, and particularly, to work to "ensure access to affordable, reliable, sustainable and modern energy for all," (goal 7) and to "take urgent action to combat climate change and its impacts" (goal 13).[288] As a signatory to the Paris Agreement, Canada has also accepted its "common but differentiated responsibility" as an industrialized country to take the lead in mobilizing finance and facilitating economic conditions conducive to the implementation of climate objectives in developing countries.[289] Among these most vulnerable countries are "African countries, least developed countries, landlocked developing countries, and small island developing states."[290]

Canada's energy trade policy should facilitate and not hinder this objective. It should be guided by the principles of fair trade and the use of best practices in environmental-social impact assessments. Fair trade in energy has the potential to bolster economic development in Canada's trading partners by supplying vital electricity and transport fuels, supporting local commerce and infrastructure creation, and supporting the construction of national energy infrastructure. By making strategic decisions about trade partners, terms of trade, and the types of energy products it chooses to export and import, Canada can exercise its ability to support sustainable energy transitions in developing countries in a mutually beneficial way.



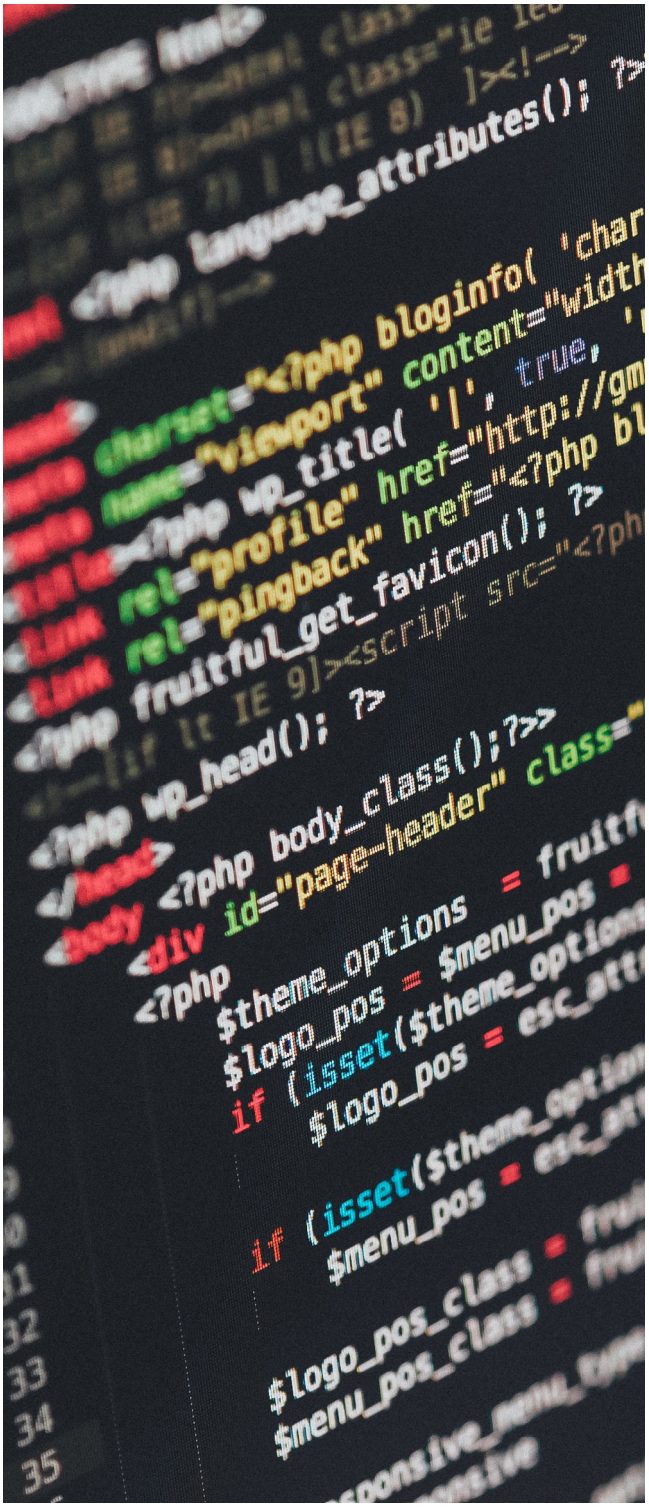
3.1.1 Export renewable tech, limit non-renewable exports

Principle: International agreements are necessary for a globally coordinated effort to stop climate change.

Concern: Existing international climate change agreements have failed to initiate sustained efforts to reduce carbon emissions.

Recommendation: The Canadian government should limit its exports of non-renewable sources of energy, instead focusing on exporting clean, sustainable energy technology. The Canadian government should also include its non-renewable exports as part of its emissions tracking.

Currently, Canada is the fourth largest exporter of oil in the world, exporting over three and a half million barrels of crude oil per day.[291] This trend has continued to increase over the past 15 years, and will need to change in order to combat climate change.[292] Continuing to export non-renewable fuel sources encourages fossil fuel dependency and contributes to environmental degradation. This increases carbon emissions and may cause oil spills, erosion, and habitat destruction. Estimated carbon emissions from Canadian non-renewable exports in 2009 totaled 598 tonnes, totaling more than combustion from domestic use of non-renewables.[293] As such, the Canadian government should seek to limit its exports of non-renewable sources of energy, while simultaneously becoming a leading exporter of clean, sustainable energy technology abroad. Canada's resource wealth provides favourable conditions for developing and testing renewable technologies, making Canada well-positioned to be a leading exporter of renewable technology. Increasing exports of sustainable energy technology will maintain close ties with Canada's trading partners, while also limiting Canada's overall contribution to global fossil fuel dependency. Additionally, the Canadian government should begin including fossil fuel exports in its national emissions tracking. This will not only give a more complete representation of Canada's global emissions contributions, but will also hopefully keep the government accountable in decreasing non-renewable exports.[294]



3.1.2 Increase Uranium and Thorium Exports

Principle: Canada should utilize its extensive reserves of uranium and thorium.

Principle: Canada should seek to leverage the exportation of its energy resources into increased influence on the global stage, specifically with state actors and international institutions.

Concern: Canada has not been fully exploiting its uranium and thorium resources.

Concern: Canada's influence with state actors and international institutions has been challenged in recent years, which poses the risk of suffering a decline.

Recommendation: The Government of Canada should cooperate with provincial governments to increase uranium and thorium exports as a part of both a global energy transition towards increased use of nuclear energy and concentrated effort to increase Canada's influence internationally.

A transition towards increased use of nuclear power would mean a greater reliance on uranium and thorium; two materials that can be used to generate nuclear fission. It has long been established that Canada has significant reserves of both uranium and thorium within its territory.[295] Canada is traditionally the second biggest producer of uranium in the world and exports 85% of the uranium it produces.[296] The export of natural uranium, of which Canada was responsible for 22% in 2017, was valued globally at roughly $4 billion.[297] In 2017, Canada was also the third largest exporter of uranium ore in the world, trailing behind South Africa and Australia.[298] Though it fluctuates annually due to prices, the export of uranium by Canada is valued at roughly $1 billion, making it a valuable energy resource to the Canadian economy.[299] At this time, Canada does not export significant quantities of thorium; although there is a lot of room for potential to do so in the future. Canada's thorium reserves, totaling around 100,000 tonnes, mean that it will remain an opportunity for future economic growth.[300]

Other significant producers of uranium and thorium that would benefit from a transition towards increased utilization of nuclear power include Kazakhstan, South Africa, Australia, the US, and Nigeria. Kazakhstan, the US, and Nigeria respectively are the first, second-, and third-largest producers of natural uranium in the world.[301] South Africa and Australia are the largest and second-largest exporters of uranium and thorium ore globally; though this is worth less than the trade of natural uranium ($526 million to $4 billion in 2017).[302] As a result of their significant reserves of uranium and thorium, as well as their respective production capabilities, these are the other states that stand to gain the most from an increased reliance on nuclear power fueled by uranium and thorium. With respect to an increase in the use of nuclear power, there are clear winners due to the dispersion of uranium, and to a lesser extent, thorium reserves, globally. Canada will have an opportunity to capitalize on its position as an exporter of crucial fuel. The transition towards increased use of nuclear power would provide an opportunity for exporters of uranium, and to a lesser extent thorium, to leverage this into enhanced economic prosperity. Further, exporters could also seek to increase diplomatic influence with states that import uranium or thorium, emulating non-renewable exporters such as Saudi Arabia that brazenly use energy exports as an instrument of foreign policy. States that lack either the capital or stability to feasibly construct and maintain nuclear reactors are likely to be the losers from a transition towards greater reliance on nuclear power in place of non-renewable energy.

3.1.3 Market-Access Technology

Recommendation: The Canadian Government should invest in technology that will expand Canada's energy market access and its range of more sustainable higher-value energy exports that can replace coal and oil. This includes investing in Liquefied Natural Gas tanker transport technology and in production of value-added energy products like fertilizers and chemicals.

Two key challenges facing Canada's energy export sector are that the oil sands are unlikely to become profitable again for any extended period of time in the future, and that currently Canada has limited global market access compared to competitors that have more strategic geographic locations and more robust export infrastructure. Canada can seek to improve its position in global energy markets by improving its energy transport infrastructure and by differentiating its energy products.

Liquefied Natural Gas (LNG) is a prime example of a sector in which Canada should improve its transport technology and infrastructure. Canada currently exports LNG exclusively via pipeline, which largely limits its direct market access to North America.[303] Greater investment into new tanker technology would allow Canadian LNG to reach new markets, particularly in Asia where demand for LNG is already strong and projected to continue increasing.[304] Compared with other non-renewable resources, natural gas results in fewer carbon emissions per unit of energy generated. It can be used for electricity generation and as a transportation fuel.[305] As such, it is a better alternative to coal or oil for those economies that will continue to require the use of non-renewable energy for some time. Expanding Canada's natural gas sector is thus a promising proposal that also aligns with the objective of facilitating a transition to sustainable energy.

Canada should also enhance the competitiveness and differentiation of its energy products by investing in the production of value-added goods. Taking crude oil as an example, at present a significant portion is exported in unrefined form to processing facilities in the US, or it is processed domestically into secondary products like gasoline or diesel. Expanding Canadian production of value-added energy products like fertilizers, petrochemicals, and plastics would be beneficial as these goods have a higher market value than primary resources. An expansion in these sectors would also create new sustainable, high-paying jobs for Canadian workers, helping to compensate for job losses in fossil fuel sectors.[306]

3.1.4 Agency for Energy Trade

Principle: Trade policy changes should protect the economies of energy export-dependent provinces like Alberta and Saskatchewan.

Principle: Canada's fossil fuel exports play a crucial role in Canada-United States political and economic relations and in American energy security.

Concern: Future economic conditions are unlikely to improve the profitability of the oil sands.

Recommendation: The Canadian Government should create a national agency under Environment and Climate Change Canada that strategically connects with new markets for more sustainable energy exports and value-added energy products.

Trade policy targeted at prioritizing green energy production and exports may have a negative impact on fossil-fuel export-dependent provinces, particularly Alberta and Saskatchewan, that rely economically on oil sands and non-renewable energy exports. The promotion of green energy exports through subsidizing renewable energy and ending subsidies to non-renewable sector subsidization may result in economic instability for central Canada's economies.[307] A green transition in Canadian trade should stimulate job creation in the green energy sector for individuals within these provinces.[308]

Canada requires a regulatory national agency operating under Environment and Climate Change Canada to ensure the profitability and feasibility of green energy exports in order to ensure a stable transition towards new markets for more sustainable energy exports and value-added energy products. It would work closely with Global Affairs Canada and Natural Resources Canada for this purpose. This body would also be mandated to plan for and facilitate Canada's transition away from non-renewables as a cornerstone of its economy. Canada is a net exporter of oil and is heavily reliant on the exportation of this non-renewable energy resource to sustain its economy.[309] In 2017, the energy sector accounted for over 11% of Canada's national GDP and contributed $14.1 billion in government revenues.[310] As a result, it is imperative for these new energy exports to continually provide a source of income, without drastically increasing the national trade deficit. The absence of energy trade would increase the Canadian deficit from 3 billion dollars to 7.3 billion dollars; a large portion of which is composed of non-renewable energy trade.[311] Additionally, the US is the main importer of Canadian crude oil, and a transition away from the trade of this resource would create a gap in the trade relationship between the two nations.[312] Trade with the US makes up 96% of Canada's total exports of fossil fuels, which clearly exemplifies this relationship.[313] A national agency could work to create and stabilize connections to new markets; while ensuring the trade deficit does not increase by a significant margin, as well as ensuring energy exports to the US are maintained or substituted to a certain degree. This agency should also work to lower trade barriers on low emissions

and renewable energy sources and technologies to increase the uptake in sustainable exports.[314] The national agency may also work towards creating new trade partners and expanding trade relations with nations that are focused on the sustainable energy market. This could prove beneficial, expanding its energy export focuses on a larger range of nations and tapping into economic benefits that currently are not being taken advantage of.

3.1.5 Regional Energy Framework

Concern: Canadian firms and exporters currently do not want to face a competitive disadvantage from unbalanced taxes or restrictions, particularly as other energy exporting countries have competitive advantages that Canada lacks, such as strategic geographic market access and better export infrastructure.

Recommendation: Convene talks with the United States and Mexico (or sub-state administrations) toward a regional harmonized framework for carbon accounting, carbon taxation or transfer, patents and licensing of green technology, and coordination of sustainable technology research and development.

A climate transition would likely face blowback from the Canadian firms, who fear new climate policies will place new burdens on their financial and temporal resources, thereby reducing their global competitiveness. Firms fear the elevated cost of compliance associated with environmental legislation will increase operational expenses, reduce profitability, and lead to higher prices across the value chain.[315] Beyond this, firms fear the strain additional regulations will have on their operational capacity. High regulatory burden and a fragmented jurisdictional landscape are two of Canada's largest competitive weaknesses [316] and additional environmental regulations would only exacerbate challenges faced by Canadian businesses.[317]

These challenges could, furthermore, lead to carbon leakage, or the process where, due to the high cost of enacting climate policies, businesses choose to move to a jurisdiction with more relaxed regulations.[318] This could ultimately lead to an increase in total emissions,[319] making reduction in incidences of carbon leakage imperative. To minimize the risks to Canadian business and competitiveness through the course of an energy transition, along with increasing the efficacy of environmental legislations, Canada should attempt to harmonize environmental standards across North America. With harmonized standards, the negative of trade barriers on individual firms is reduced,[320] lessening the threats to competitiveness or carbon leakage within firms. Furthermore, harmonized standards allow treaty parties to pool together resources to generate a more pronounced impact,[321] avoid duplication of efforts,[322] and send a strong signal about the importance of climate change as a pressing geostrategic issue.

3.2 Taxes and Government Regulation

3.2.1 Feed-in Tariffs

Principle: A variety of economic incentives are needed to bring about the diversification of energy sources and the Canadian economy.

Concern: Markets do not currently incentivize investment in renewable technologies such that installed capacity can be rapidly increased and provide for energy needs.

Recommendation: Implement feed-in tariffs for electrical energy.

Renewable energy technology (RET) installation costs are high, while the profitability of energy markets is volatile.[323] This leads to a lack of investment and installation in market conditions. Two policy options are typically implemented to remedy this situation and increase the start-up profitability of renewable energy, thereby increasing investment. Feed-in Tariffs (FIT) regulate the *price* of renewable energy by setting a rate above market values that is guaranteed for a period of time.[324] In contrast, Renewable Portfolio Standard (RPS) policies regulate the *quantity* of renewable energy in a market. RPS requires minimum percentages of RETs to make up the energy being sold (e.g. 20% of an electricity company's energy must come from solar photovoltaic technology.).[325] While the literature acknowledges that both are used widely – in 2018, 100 countries used RPS while 110 used FIT – it generally suggests that FIT is better suited to increasing the installed capacity of RET.[326] For Canada, FIT offers the opportunity to set different tariff rates for different RETs, thereby allowing provincial governments to target the development of certain technologies in the medium term.[327]

However, FITs are not a panacea. They can distort electricity markets and raise electricity costs for consumers.[328] Setting the correct rate is difficult– too high a rate will inflate electricity prices and encourage the growth of near-term RETs while precluding the development of potentially more efficient medium-term RETs. It can also encourage investment in RET which is highly speculative and can experience negative setbacks. At the same time, too low a tariff rate does not provide adequate incentive for the investment in and installation of RET.[329] Germany, Denmark, Cyprus, Spain, and South Korea present examples where FIT greatly increased the installed capacity of RET, yet also led to increasing energy costs.[330] Yet, FIT policies can be developed which mitigate these costs and still spur development. They can be combined with RPS,[331] and can be developed as a two-part policy, in which capacity payments are determined at auction while energy payments are tied to the spot market price of electricity.[332] If auctions take place annually for five-year price rates, tariff rates can adapt to market conditions over time, while still providing a stable and profitable environment for RET development and operationalization.

We recommend Canada implement a FIT system because they are found to be the most effective policy instrument to increase total renewable energy generation.[333] They stimulate research and development, reduce costs, and lead to rapid deployment of RET, and are better for industrial development and job creation.[334] We outline the need for Canada to shift *rapidly* to renewable energy wherever possible; FITs are a key economic tool in the achievement of this goal.

3.2.2 Economy-wide carbon pricing

Principle: Carbon pricing is the best economic tool to reduce greenhouse gas emissions.

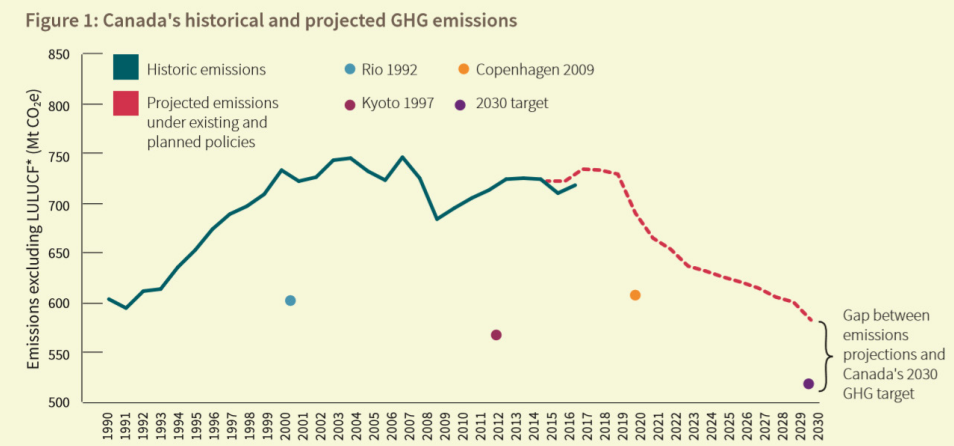
Concern: The market itself does not account for negative externalities of fossil-fuel burning; which needs to be corrected.

Recommendation: Maintain the federal "backstop" Carbon tax, increasing it from $50 per tonne (2022) to $210 per tonne (2030) to meet Paris Agreement commitments.

Recommendation: Maintain and improve output-based carbon pricing systems.

The evidence from *Canada's Energy Commission* is congruent with numerous other studies: "carbon pricing is the most cost-effective way to reduce greenhouse gas emissions.[335] A carbon tax costs the economy less than economy-wide regulations with subsidies, or industry focused regulations with subsidies.[336] Canada's national price on carbon, which works as a federal "backstop" that takes effect in the absence of provincial prices on carbon will rise to $50/tonne in 2022.[337] However, future increases in the price of carbon have not been announced, and current announcements are insufficient to meet Canada's international commitments to cut emissions under the Paris Agreement. The adjacent graph demonstrates the need for increasing costs on carbon in order to meet commitments.[338]

Canada's Ecofiscal Commission's modelling demonstrates that the tax rate must rise to $210 per tonne by 2030 in order to meet its obligations.[339] In addition to aforementioned emissions accounting, by maintaining output-based carbon pricing for emission-intensive, trade-exposed sectors, Canada's carbon tax scheme can prevent emissions "leakage" through exports and accurately capture the extent of our national responsibility for emissions. Output based systems also address international competitiveness, by attaching a price to emissions only in excess of the international industry specific average for EITEs.[340] These emitters therefore remain included in the economy-wide price on carbon, while the adapted policy ensures this does not incentivize firms to outsource emission-intensive production overseas. Revenues can be recycled into research and development, mitigation technologies, and industry diversification.[341] In sum, Canada's carbon tax should not only be maintained, but increased. It is the most effective economic tool to respond to the reality of climate change.



Graph from Canada's Eco Comission.

3.2.3 Tax revenue recycling

Principle: Carbon tax revenue recycling provides an opportunity to develop and progress the Canadian Economy.

Concern: Carbon pricing can disproportionately affect people living in rural communities, industry workers, and low-income families.

Concern: While the public is concerned by climate change and supports climate action, its willingness to pay for a carbon tax that adjusts for the full cost of negative externalities is low.

Recommendation: Carbon tax revenue should be recycled through provincial portfolios that address local needs and priorities, particularly including diverse economic supports for transition.

While carbon-pricing policies are the most economically efficient policy to reduce emissions, citizens have a very low willingness to pay for climate change mitigation.[342] In developed countries, individuals distance themselves from the impacts of climate change, and do not vote for direct action they perceive as imposing personal hardship, such as a carbon tax.[343] While the costs of a carbon tax may be more clear, they are actually less costly than other sufficiently stringent policies.[344] While carbon pricing is often considered to not be politically viable, its cost-effectiveness paired with effective revenue recycling can make it the most politically viable option in the long term.[345]

The required increase in Canada's carbon tax to $210 per tonne by 2030 is expected to translate to an increase in gasoline prices of 3.8 cents annually.[346] This demonstrates that many of the oft-feared repercussions of carbon pricing, such as higher gasoline prices, are unfounded: gradual increase in the price on carbon drives innovation by firms and mitigation by households, reducing its cost.[347]

Furthermore, within each province Canada's carbon tax currently recycles more revenue back to households than it costs, directly benefiting individuals and families.[348] Carbon tax revenue should be used to support those who are disadvantaged by the policy (e.g. oil and gas workers, rural and low-income households) through cheque-rebates, funding job-training, and home modernization grants.

Recycling of substantial carbon tax revenue supports economic and environmental objectives. Provincial governments should develop portfolios of revenue recycling, prioritizing objectives that are most relevant. Revenue recycling has a variety of positive impacts: personal and corporate income tax cuts can spur innovation and investment; direct investment in renewable and nuclear technology can support research, development, and operationalization of renewable technologies, thereby driving adaptation and modernization; investments in infrastructure can improve economic and environmental efficiency; revenue can be used to provide transitional support to industry; and household transfers *can directly reverse negative perceptions of the carbon tax*.[349] The carbon tax is a progressive solution that both cuts emissions and brings about the futurization of the Canadian economy.

3.2.4 Individual emissions tracking

Principle: If we are to hold states and corporations accountable for emissions, individuals must also act (demand-side accountability) in order to spur change on the supply side.

Concern: There is a lack of cohesive efforts to reduce carbon emissions at both the individual and corporate levels.

Concern: People need to be incentivized to reduce their emissions, so they may be assisted in the process of changing pre-existing habits.

Recommendation: The Canadian government should encourage individuals to track emissions by incentivizing them with benefits from the government; thereby propelling the radical change in purchasing habits which are necessary to bring about change at the corporate level.

As we approach the feared 'Point of No Return' coined by climate scientists, radical change must take shape in some form over the next few years.[350] States and corporations have failed to adopt a mechanism that will precipitate serious emissions reductions in key areas, particularly in industry. Ahead of transport and construction, industry (manufacturing) has the highest projected energy demand growth over the next few decades.[351] The key challenge yet to be addressed is how to mitigate growth on the supply-side to target carbon emissions reduction where it is needed most. The answer lies in the hands – or pockets – of the individual consumer.

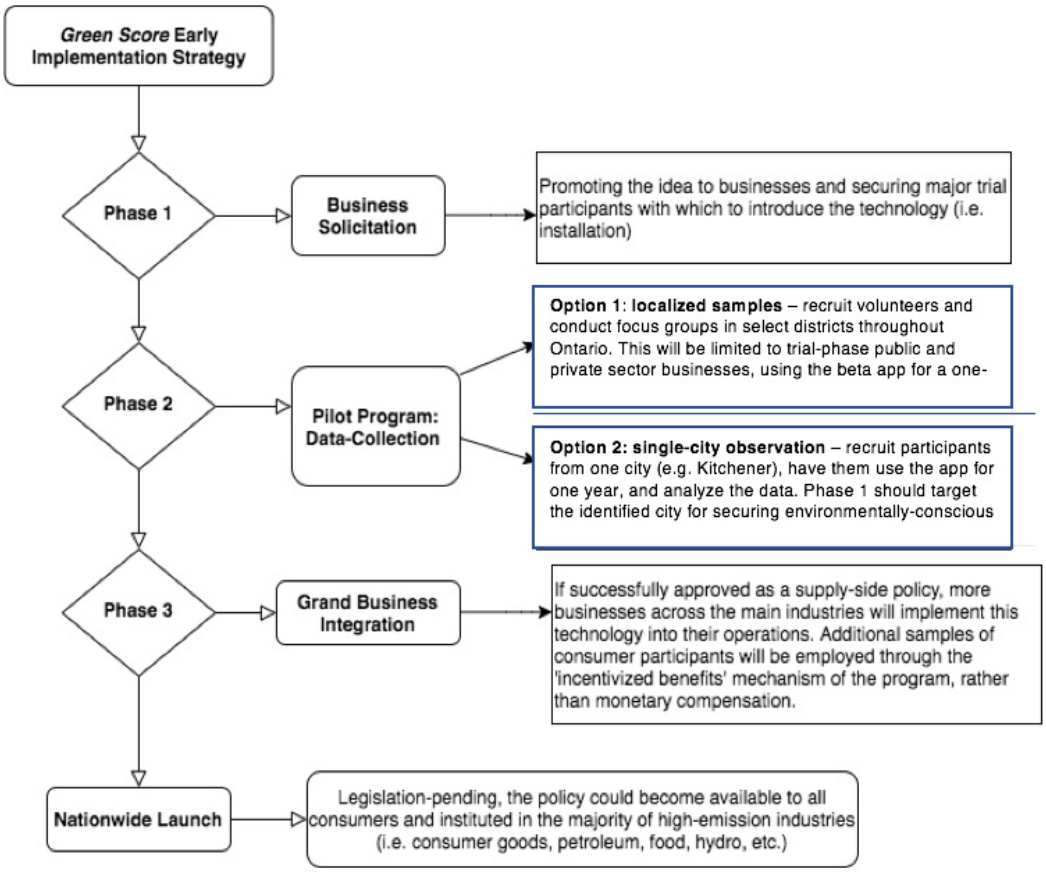
There is a severe inconsistency between global climate objectives and climate action. Climate policies across most corporate entities have been typified as "grossly inadequate".[352] If we intend to reach critical climate objectives, such as a 45% reduction in carbon emissions by 2030, more radical solutions are necessary, especially as emissions and energy demand continue to rise. According to Andrew Winston of Winston Eco-Strategies, one of "three actions" that companies must adopt includes empowering customers to drive change.[353] This acts as a crucial component to decreasing the demand for energy, which is driven by consumer lifestyle and behavioral choices. If demand is lower, conditions are better for supply-side transformation.[354]

The process of incentivizing individuals may require a state-sponsored program that compensates individuals who meet a 'carbon threshold' as a part of a larger carbon monitoring program. This may act as an innovative mechanism which could ultimately distinguish Canada as a leading energy innovator.

As one of the highest greenhouse gas emitters per capita in the world, the average Canadian emits an estimated 16,000 kg of CO2 annually (2018).[355] The vastness of Canada's land mass causes a greater need for relatively long transportation periods; transportation is thus a major contributor to emissions. In order to compensate for individual energy emissions such as those resulting from transportation that are harder to avoid, it is appropriate that we aim to achieve a reduction in individual emissions across different areas.

Although radical by today's standards, a mechanism that could deliver a significant shift in individual consumer consciousness is a carbon footprint tracking app, *Green Score*. Through this non-compulsory, state-sponsored program, consumers can scan their virtual 'card' at stores, gas stations, and for bill payments to automatically calculate their CO2 emissions based on purchases. The scoring scheme could be standardized by one 'point' per 100kg CO2 emitted; for example, this would mean the average Canadian would score 160.

This data would give the government a greater understanding as to how incentivized recommendations could be framed and sub-



Green Score Implementation Strategy Chart.

sequently executed. For example, the federal or provincial government could set a target score of 120, reducing individual emissions per capita by 4,000 kg CO2. The social benefits aspect of the program could range from government checks, paid work leave, university tuition grants, and free transportation passes, depending on how well an individual scores and what is feasible for the government.

In order to mitigate the inevitable shortcomings of such an unprecedented program, the ideal implementation strategy should have a gradual action plan. This will not only help test the effectiveness of this mechanism, but also determine the potential extent of its applicability. There is an inherent possibility that data is affected by underuse or misuse of the technology, which is why observational studies should be used to assess the reliability of the data. A three-phase plan could be the most useful for identifying design flaws and refining the app so that it is fit for public activation. Given the complexity in introducing the concept to several industries in the private sector, the initial phase would be pivotal in understanding public perception and projecting costs. This will help make the strategy both economic and comprehensive. The *Green Score Implementation Strategy Chart* conveys a proposal for the three-stage method.

If this program became policy and is overseen by the relevant federal institution, there is great potential to introduce a new framework for reducing carbon emissions. Taking a unique bottom-up approach, *Green Score* accounts for much of the supply chain emissions in our purchases. Moreover, this

is the perfect opportunity to analyze the impact of individual consumer choices on supply-side accountability. Diversifying strategies to reduce carbon emissions not only boosts Canada's position in the global fight against climate change. By challenging conventional strategies through such means, there is greater potential to shift consumer mindsets and compel corporations to address environmental externalities. If realized, a change in demand would subsequently force corporations to transform their habits, products, and services, in order to adjust to shifting demands. In other words, individual emissions tracking could spur a new way of tackling anthropogenic climate change from the bottom-up.

3.3 Financing and Monetary Policy

3.3.1 Incentivize renewable investment

Principle: Non-renewable industries should invest in renewable energies.

Concern: The transition to renewable energy may negatively affect the non-renewable industry, and industry players may resist the energy transition.

Recommendation: The Government of Canada and the provinces of Canada should provide incentives to nonrenewable industries to further invest in renewable forms of energy.

One of the main challenges of transitioning to renewable energies will come from the fossil fuels corporations that have an interest in protecting their industry and their various stakeholders. As a result, Canada should promote and incentivize investment in renewable energies by corporations involved in non-renewable energy industries. This can be achieved through subsidies, programs that encourage exchanges between the nonrenewable and renewable sector, and the incorporation of nonrenewable and renewable forms of energy. Below are a few recommendations that may make the transition more palatable and convenient.

Some of the major players in the non-renewable industry, such as Royal Dutch Shell, and ExxonMobil are already investing in some form of renewable energy; however their investments represent a small percentage of their total capital.[356] Canada should work at both the provincial and federal level to increase investments for renewable industries. Increasing subsidies that favour sustainable energy, while reducing those that support non-renewables, is an effective way of achieving this goal. The role of subsidies is illustrated later in the report. The Government of Canada already offers incentives for investments in the renewable sector, particularly in the field of research and development, where Canadians are leading innovation worldwide in hydrogen and fuels cells as well as carbon capture technologies.[357] However, it is possible to further encourage investments by creating fast-track permits, licensing approval programs, and by loosening some of the regulations.

3.3.2 New investment portfolios and vehicles

Recommendation: Given Canada's highly regulated and centralized banking system, private and state-owned banks must focus on creating new types of investment portfolios to diversify risk, and investment concepts to manage payback periods for projects. These should include Green Bonds and co-partnerships.

In order to grow private investment into companies that will advance energy innovation, there must be a public-private effort to create new investment strategies. High risks, low returns and a long time to maturity are key hurdles that must be addressed if we

hope to increase investment in energy innovation and curb the effects of climate change. One advantage Canada has compared to other countries, such as the US, is its highly centralized banking system. Unlike in the US, the Canadian Banking system is consolidated. Canada only has 80 banks, 6 of which have a 93% market share.[358] This is relatively small in comparison to the US, which has over 7000 independent chartered banks.[359] This high market share owned by only 6 institutions will make it easy to coordinate a policy response and find new ways of incentivizing investment through innovative financial vehicles.

The first of these 'vehicles' are green bonds, which are "medium-low" risk bonds that are designated to encourage sustainability and to support climate-related companies. More specifically, green bonds finance projects aimed at energy efficiency, pollution prevention and sustainable technology.[360] The advantage over single financing approaches is that the pooling of projects leads to reduced risks and more stable cash flow streams. Green bonds also come with tax exemptions and tax credits, making them a more attractive investment compared to other long-term bonds.[361] Canada's banking system must work together to dramatically increase the availability and attractiveness of green bonds by covering the vast areas of potential innovation to increase the amount of "green energy" Canadians have in their investment portfolios. If each bank worked together to create a list of the most promising investment opportunities in all areas of clean tech, the banks could equally divide these investments amongst themselves to create lower risk investment opportunities for all Canadians – regardless of who you bank with.

The next recommendation is to have Co-Investment partnerships between the public and private sector. Public authorities would select highly qualified private investors and a panel of scientific experts (based on pre-

determined criteria) as partners for identifying and understanding the optimal investment in energy innovation.[362] Once the private investor has consulted with the panel of scientists and decided to back a project, the public authority would automatically or semi-automatically match the investment with public funding.[363] This would significantly streamline the access to public funding for early stage start-ups and lessen the private risk due to the government now having an active stake in the success of the project. The use of private investor expertise would ensure that funding goes to the companies offering the greatest commercial potential, and there would be stipulations that the public sector receives a payback if ventures are highly successful.[364]

3.3.3 Forward Guidance

Recommendation: Increase work cooperation between the government and the International Energy Agency to provide forward guidance to ensure stable tax rebates and policies to reduce risk for institutional investors and incentivise private investment.

The term "forward guidance" is often used in economics to describe fiscal & monetary policy taken by a central bank during times of economic hardship. The Bank of Canada will often commit to a certain interest rate – the rate at which banks lend to each other – and stick with this rate for long periods of time. By doing this, it provides stability and reduces risk for borrowers at the individual level because they know the banks will not suddenly spike interest rates due to the forward guidance and commitment given by the Bank of Canada. A similar concept should be applied to things like tax rebates, and policies surrounding the energy sector. There is not a specific policy recommendation, but rather more of a suggestion for a policy that could apply to many different barriers to energy innovation. By providing a commitment to not change regulations regarding certain aspects of energy, this will significantly reduce the "political/policy risk" for investors and create a more favourable investment climate for private capital to flow into energy innovation projects.

3.3.4 Shifting Subsidies

Principle: The government should discourage investment in extraction by making renewables the economically feasible choice.

Concern: The cessation of subsidies to the fossil fuel industry may result in an international lawsuit from China for a violation of the Canada-China Foreign Investment Promotion and Protection Agreement (FIPA).

Recommendation: Shift federal oil sands subsidies into renewables.

A lack of government resources to soften oil start-up costs and rising extraction expenses leaves fossil fuel investments vulnerable to international market volatility – especially the price of oil – and turns the oil sands into an extremely high-risk, low-reward enterprise, discouraging further investments toward fossil fuels.

Cancelling subsidies to the fossil fuel industry will not violate the Canada-China FIPA and is unlikely to result in a lawsuit because Canada has the legal right to cancel subsidies under the treaty. A cancellation would redirect Chinese-Canadian trade and investment away from fossil fuels and toward renewables. Furthermore, precedent shows that China is unlikely to launch a lawsuit over the subsidies: China did not pursue legal action against Canada for the federal carbon tax, which more directly violates the spirit of the treaty; additionally, China did not sue Canada for its public commitment to eliminate fossil fuel subsidies at the 2009 G20 summit (based on the global consensus that fossil fuel subsidies are inefficient).[365] The government may also find reassurance in the fact that the treaty already explicitly excludes

subsidies from the equation in Article 8.5.[366]

The World Trade Organization's summary of the dominant economic literature concludes that if the market is perfect, subsidies actively harm the economy, but subsidies can correct for externalities in all markets.[367] A subsidy should not be used to correct a failure in the sense of propping up a failing industry (such as fossil fuel extraction), but instead should correct for a market that does not reflect externalities to "increase production or consumption of an under-produced good."[368] In the case of fossil fuels, which produce negative externalities, the amount of fuel produced is far above the socially optimal amount. Canadian fossil fuel subsidies "are not intended to correct a market failure, but to improve the economic standing of [a] specific interest group…."[369]

The logic of the supporters of oil sands subsidies is clearly laid out by the WTO and is systematically disproven. Assuming that the oil sands yield positive externalities that are not reflected in the market (i.e. job creation), subsidies would avoid burdening consumers with the higher prices required to achieve the positive externality, thus allowing the domestic extraction to remain internationally competitive and for the public to benefit from the externalities.[370] However, this ignores "the costs associated with financing and distributing a subsidy [...] Economic costs will still be incurred, even if taxes are levied in a non-distorting manner."[371] In order to be competitive with global oil extraction, Canada protects its domestic oil industry by subsidizing costs. Canadian oil, by virtue of having subsidies, proves that it *cannot* compete in the global market; in other words, it is a dying industry.

Oil must reach roughly $50-60 per barrel to be profitable to extract in the oil sands.[372] It grows increasingly likely with each passing year that this requirement will not be met as energy demands and consumer prefer-

The Canadian Crude Index demonstrates the volatility and unprofitability of Canadian oil (Yahoo! Finance).

ences change – indeed, we may have already passed 'peak oil' in Canada.[373] The Canadian Crude Index has rarely hit $50 in the last four years and sits at $32.57 at the time of writing this report.[374] Consequently, the value of the oil sands supply chain has been declining since 2014; in 2019, there was an estimated 57% decrease in capital investment in the oil sands.[375] Since revenues are decreasing executives have tried to lower expenses in a number of areas, including laying off Albertan oil workers. Oil projects in Canada are no longer feasible and investors are packing their bags: "Nearly all major foreign oil and gas companies have abandoned their investments in oil sands since oil prices collapsed in 2014, often taking multi-billion-dollar write-offs. Equinor, Total, Shell, ConocoPhillips, Koch Industries, and Kinder Morgan are just a few of the international companies that have walked away from investments in Canadian oil sands."[376] Teck Resources also recently withdrew its bid for its Frontier oil sands project in part due to the unprofitability of the venture.[377]

Canada's oil subsidies actually hurt the oil industry by further lowering the global price of oil by forcing international producers to compete with the subsidized exports at a lower price, affecting the bottom-line of producers and benefitting net importers because of globally cheap oil.[378] In other words, Canadians are not the 'winners' of the arrangement. The economic literature suggests that the reason for these inefficient subsidies is that politicians do not always utilize subsidies optimally, and that "subsidization is correlated with the political influence of the beneficiaries."[379] The literature elaborates that "rent-seeking on the part of beneficiaries and the political economy of the decision-making processes" help in large part to drive these inefficient decisions, and in democracies, lobbying groups

"may influence the taxing and spending patterns of governments."[380] Oil subsidies within Canada have led to "large individual gains to firms operating in that industry, while the costs of the subsidy program, which are larger in aggregate, [are] spread over a very large number of taxpayers. [This created strong incentives for the fossil fuel beneficiaries] to organize and use campaign contributions to try to influence the type of decisions taken by political incumbents. But because the costs of the subsidy program to taxpayers are so diffused, there is no similar urgency on their part to organize to oppose the program."[381]

The economic theory of the WTO is strongly supported by numerous studies and observations of Canadian politics. In the 2019 Canadian federal election, Canada Proud, a registered third-party campaign advertiser, attempted to sway the results of the election by spending hundreds of thousands of dollars on Facebook advertisements.[382] Many of their advertisements during and after the election were politically slanted toward the oil sands. Most importantly to our observations, however, is the composition of the donors who funded Canada Proud's pro-oil discourse: almost half of its donations were from CEOs and businesses with direct ties to the Alberta oil sands.[383]

The Government of Canada does not actually know just how much money it is handing over to the fossil fuel industry. The Canadian Office of the Auditor General produced an audit that concluded the analysis of subsidies to the fossil fuel industry from the Department of Finance and Environment Canada were remarkably incomplete: "Overall, we found that the Department of Finance Canada's assessments to identify inefficient tax subsidies for fossil fuels were incomplete, and that **the advice it provided to the Minister was not based on all relevant and reliable information**."[384] In particular, the Auditor General found enormous shortcomings in the assessment of tax expenditures and the reduction of taxes to the fossil fuel sector.[385] The Canadian Minister of Finance, Bill Morneau, rejected all recommendations of the Auditor General to further investigate Canada's tax codes and potential subsidies to the fossil fuel industry. Morneau was found guilty of ethics violations in 2017 and was accused of alleged bribery and corruption in the SNC-Lavalin affair, in which he denies any wrongdoing.[386]

Shifting subsidies to renewables may not necessarily increase Canadian energy security, but it will increase job security. The government should use the subsidies to help pay for many of the recommendations included in this report, especially to pay for training toward employment in renewables. The government could easily utilize the proven structures of existing programs such as the Ontario Job Grant (up to a $10,000 contribution from the government per trainee).[387] This could potentially create 330,000 direct new jobs every single year, versus the existing structure under the oil sands which creates 205,000 direct and indirect new jobs total per year.[388]

3.3.6 Expand the Property Assessed Clean Energy (PACE) Program

Principles: Promote renewable energy production at local levels and help local renewable energy projects become more competitive and worthwhile endeavors.

Concern: High initial investment makes it difficult for homeowners and small business owners to self-finance renewable energy retrofits and increases hesitancy to make long-term investments into renewable energy.

Recommendation: Expansion and implementation of Property Assessed Clean Energy (PACE) program in every province and municipality to remove barriers to expansions in residential energy efficiency and retrofit market.

There are two main concerns that prevent property owners from investing in renewable energy retrofits or energy efficiency measures. First, the high initial investment costs required to finance renewable energy that make it difficult for homeowners to self-finance such projects. Typically, loans such as home equity loans that homeowners would use to finance such projects would have shorter terms. Second, since many homeowners move every 5 to 7 years, many are hesitant to make long-term investments.[389]

A Property Assessed Clean Energy (PACE) program addresses these issues by allowing those who invest in renewable energy to place additional tax assessments on his or her property. These assessments will be repaid over a longer term, 15-20 years, with additional annual payments on their property tax bills, therefore eliminating the large initial cost of investment.[390] The cost can be converted into a net-monthly payment, that is similar to expenses such as cell phone service and wifi. Additionally, PACE assessments are tied to the property, are transferable, and would decrease concerns about investment recovery. Therefore, upon sale, the new owner will get the benefit of the renewable energy that is produced and take over payments on their property tax bill.[391] Since it is tied to the property, there is strong collateral available in case the owner defects on the assessment. Currently, Nova Scotia and Ontario have implemented PACE programs, but these are limited in scope and fall short of the ideal program. Provinces must work to reduce administrative barriers and legislative program constraints in order to create more successful programs. In Alberta, a legislation aimed to implement PACE was passed in January 2019.[392] British Columbia and New Brunswick have begun initial conversations and Saskatchewan has included PACE programs in their vision for a sustainable future.[393] In order to further implement this program across Canada special tax districts will need to be created, federally, that acknowledge renewable energy retrofits and energy efficiency measures as public goods.

3.3.7 Fund renewable energy projects by Indigenous communities

Principles: Promote renewable energy production at local levels and help local renewable energy projects become more competitive and worthwhile endeavors.

Principle: Increase renewable energy deployment throughout Indigenous populations, who are still heavily reliant on coal and fossil fuels to generate power.

Concerns: Funding has consistently been an issue for renewable energy projects in Indigenous communities. There is simply not enough funding available to carry out everyday operations. It is a considerable challenge for Indigenous proponents to raise money on the same level as a business.

Concern: Given the length of time fossil fuel energy producers have had to establish themselves, smaller scale renewable energy producers are struggling to remain competitive and acquire power purchase agreements. This makes it increasingly difficult for renewable energy projects to obtain the capital required for investment

Recommendation: Additional funding bodies and grants dedicated to indigenous renewable energy source projects that provide grants and soft loans for these projects to increase the cash they have on-hand to support renewable energy projects.

Recommendation: Power purchase agreements and independent power purchase policies are a financial mechanism for obtaining the capital renewable energy projects require and should be implemented in every province. This will not only help indigenous renewable energy

To combat climate change, Canada must pay close attention to Indigenous communities who, for the most part, lack strong energy infrastructure and rely on diesel and fossil fuels for energy. Approximately 250 remote Indigenous communities are not connected to Canada's electricity grid, forcing them to rely heavily on diesel powered generators.[394] Part of Canada's $180+ billion plan of infrastructure investment includes aiding these communities to use their natural resources. The aim is to produce renewable energy, which would further enable them to tap into their vast potential for forest-based biomass and renewable energy. The Government of Canada has announced a $20 million initiative to reduce diesel reliance in remote Indigenous communities to help them move towards a sustainable energy system.[395] Indigenous participation in the sustainable energy economy has grown rapidly over the past 20 years. British Columbia leads nationally with 52% indigenous sustainable energy projects followed by 21% in Ontario, and 10% in Québec. The remainder is spread out between the other provinces.[396] One fifth of Canada's power is supplied from facilities that are fully or partly owned by Indigenous communities. Creating more opportunities for these communities to work in the renewable sector such as hydro, wind, and solar also creates new job opportunities. In the last eight years, there have been 15,300 direct jobs for Indigenous workers as a result of diversifying energy sources.[397] Through these initiatives, the Canadian government is able to tackle climate change through inclusive, diverse, and viable measures.

Firstly, while there has been significant leadership throughout Indigenous communities to implement renewable energy into their communities, there are still many barriers that prevent effective implementation of small scale renewable energy. Currently, Indigenous communities are exempt from taxes on income from on-reserve activities and the Federal Department of Indian and Northern Affairs offers non-repayable grants for Indigenous groups' environmentally beneficial energy initiatives of up to $250,000.[398] Ontario has a $250 million Aboriginal Loan Guarantee Program to facilitate loans.[399] These initiatives allow Indigenous communities to develop their own renewable energy sector and become energy-independent. While there has been significant leadership in Indigenous communities to implement renewable energy into their communities, there are still many barriers that prevent effective implementation of small scale renewable energy. The main issue for these projects is a lack of funds to support investments and use capital for revenue generation.[400] Therefore, their inability to raise funds in a similar way to corporations presents a significant challenge even in the most advanced Indigenous communities. Additional funding bodies will be required to provide successful renewable energy projects in Indigenous communities the ability to continue to make improvements and grow their own energy sector. Also, if sustainable development is linked to other development funds, communities will be able to access more grants to finance renewable energy projects.

Power Purchase Agreement (PPAs) are contracts to sell the output from energy generation projects to creditworthy purchasers and are an essential financial mechanism for energy producers.[401] Developers who don't get power purchase agreements struggle to demonstrate cash flows capable of repaying loans with returns for their equity investments. Therefore, one way to support renewable energy projects is to prioritize power purchase agreements for green energy producers, as PPAs can play an important role in attracting financing for small business and indigenous power projects. A long power purchase agreement with a fair power purchase rate facilitates the growth of the renewable energy projects and can help the industry become more competitive as a whole. One way governments can take leadership is by signing PPAs between public utility and independent clean power generators.[402]

Independent power purchase (IPP) policies, in every province, can be a way for the government to help support PPAs, and it resolves the limited capital issue that small scale renewable energy projects face. The IPP policy provides an opportunity for non-utility entities to generate power to help utilities meet the demands for sustainable energy that is affordable and flexible.[403] IPP policies are beginning to spread in the territories. The Government of Yukon has fully implemented its IPP policy and Nunavut is moving in a similar direction. The IPP policy in Yukon aims to provide 10% of Yukon's power via independent power purchase and have 50% of IPP projects have some component of First Nations ownership.[404] This policy offers three options: a standing offer program (SOP) for small projects, a call for power for large scale IPP projects and an unsolicited proposals process.[405] SOP facilitates the contracting process between IPP projects and utilities by establishing a rate, under SOP, for delivered energy based on the avoided costs of thermal generation.[406] These rates assist potential power generators with pricing and market certainty for their generated power. IPP policy approaches can include directly supporting PPA agreements between utility and small renewable energy generators. Such a policy, facilitates local energy projects, further develops relationships with Indigenous communities, encourages local economic development and results in local job creation. Indigenous involvement needs to be prioritized by working with Indigenous governments as provincial and territorial governments implement their IPP policies.

3.4 Labour Policy

3.4.1 Just Transition Act

Principle: No group should unfairly bear the costs of an energy transition.

Concern: Workers in the fossil fuel sector are fearful of being abandoned by the energy transition and need to be supported throughout.

Concern: The rights of Indigenous communities must be protected throughout the energy transition.

Recommendation: The Canadian government must implement a Just Transition Act to ensure that workers in the fossil fuel industry and affected communities (particularly Indigenous communities) will be supported and protected throughout the transition.

The Canadian government has pledged to introduce a Just Transition Act to support individuals and communities vulnerable to potential negative consequences of an energy transition.[407] The Canadian government must uphold this promise to ensure that the energy transition is equitable, fair, and just - ensuring that no group unfairly bears the cost of the energy transition. Many workers in the fossil fuel industry have expressed anxieties about how an energy transition will impact their livelihood, so the Canadian government must reassure these workers that they will not be left behind. The Task Force on Just Transition for Canadian Coal Power Workers and Communities published a report in 2019 with ten recommendations for how to craft and implement the Just Transition Act.[408] These recommendations include proposals such as pension bridging programs, transition centres, and investing in retraining workers for new industries. This report provides a good foundation for the government to begin drafting policies to ease the burden of transition, however there is more work to be done. Additional inquiries should be conducted into the unique needs of individuals in the oil and gas sector, as well as into how best to support Indigenous communities who are only vaguely mentioned in the Task Force report. A comprehensive Just Transition Act would support all workers in the fossil fuel industry and affected communities, paying particular mind to the needs of Indigenous communities who have historically enjoyed a disproportionately small share of the benefits of energy transitions.[409]

4. Indigenous Stakeholders

When creating any energy policy which directly impacts the environment and the land that Canadians inhabit, it is crucial to respect the rights of Indigenous communities and consider the opinions of communities before any significant policies are developed. This report focuses on utilizing the partnerships between policy makers and Indigenous stakeholders, and is committed to maintaining adherence to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and to any land agreements that have been made between Indigenous communities and the Government of Canada. Reconciliation can only occur if consent from leaders is given when policy is created, consideration of issues and concerns of communities are applied, and collaboration with Indigenous stakeholders has been implemented.

4.1 Co-planning with Indigenous communities

Principles: The inherent rights and needs of Indigenous communities should be respected when any new policies are created or initiatives are created.

Concerns: Indigenous communities are historically under-represented at the negotiating table and their inherent rights can be ignored when large policies are implemented.

Recommendation: Organizing meetings with chiefs and leaders of Indigenous communities when policies are created to ensure communities are part of the planning process and can benefit from energy facilities.

Recognizing and respecting the rights of Indigenous communities in Canada constitutes the first step in engaging in a collaborative dialogue on the issue of energy transition. This begins by adhering to UNDRIP by "recognizing that respect for indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment." It is equally important when updating technology and building energy infrastructure that programs encourage local and indigenous ownership, in order to "enable them to maintain and strengthen their institutions, cultures and traditions, and to promote their development in accordance with their aspirations and needs".[410] Any new facility should undergo planning that considers the opinions, needs, and concerns of Indigenous communities that reside on the land that is to be used. It is a community's right to take part in, and benefit from, projects concerning or utilizing their land and ought to be within their discretion to influence and be involved in the process of utilizing this land.[411]

The case of the Northern Saskatchewan Dene community and Cameco, one of the world's largest producers of uranium, provides a clear example of a fair agreement between a company seeking to profit from indigenous land space, and the Indigenous community itself. In facilitating their mining operation across the lands of the Dene community, Cameco assured the needs and concerns of their people were genuinely and thoroughly considered. Each of their facilities are subject to an Environmental Assessment Report, a necessary process for any project with an environmental risk. Each facility in Northern Saskatchewan is closely monitored by community liaisons who are leaders in their communities and communicate with Cameco's operations. Important to consider, however, is that Indigenous communities in Northern Canada generally share a strong opposition towards facilities that pose a potential threat to the environment; particularly in terms of infrastructure and waste removal.[412]

4.2 Social Programs for Indigenous Groups

Principles: Educational programs are necessary to engage, empower, and employ youth across Indigenous communities.

Recommendation: Create social programs to employ Indigenous people and empower Indigenous youth in communities affected by the implementation and extraction of energy sources.

Social programs that aim to empower and employ affected Indigenous communities will be a necessary component of the energy transition. There are many innovative methods and programs facilitated by corporate entities that seek to carry out this objective, which have been implemented in the past.

As mentioned above, Cameco engages in exemplary practices with Indigenous communities affected by its operations. Cameco holds a community investment program wherein their officers work directly with Indigenous elders and elders and leaders to implement initiatives in youth education, health and wellness, as well as sport and recreational activities.[413] Moreover, community engagement programs seek to restore and maintain open, collaborative communication between the energy company and Indigenous communities.[414] As a result, the needs and concerns of Indigenous communities are genuinely heard and are taken into consideration or are implemented.

Similarly, the Independent Electricity System Operator (IESO) - a state-owned enterprise responsible for directing and executing energy operations in Ontario - runs indigenous relations programs. These programs consist of conserving energy and appropriately managing it for the involved communities. It also entails teaching Indigenous communities skills and knowledge necessary to apply and work for energy operations, in addition to investing in business development and partnerships within Indigenous communities.[415] Moreover, Indigenous persons are involved in long-term electricity planning for their communities.[416] Programs run by Cameco and the IESO can, and should, serve as an example for all future government energy projects.

5. International Initiatives and Diplomacy

Climate change is an existential threat that is not strictly bound by national borders. Carbon emissions and the resulting effects are an international problem, and the response will also have to be international. The transition from fossil fuels towards increased nuclear and renewable energy production requires engagement with international actors, including both traditional allies and unconventional partners. It will also rely on the joint development of technological innovations, such as carbon capture, and the trading of information. Through targeted recommendations concerning emerging technologies and a renewed multilateralism internationally, a policy of transitioning towards cleaner energy sources can be initiated on a global scale.

5.1 Key Geopolitical Considerations

Principle: Canada should seek to mitigate the impact that its transition from non-renewable energies will have on its population.

Principle: The impact of carbon emissions transcends national borders, and states must be accountable for their respective carbon emissions and pollution.

Principle: Canada should mobilize its significant industrial and intellectual resources to develop viable renewable energy technology and capacity.

Principle: Canada should take initiative and capitalize on its capabilities and partnerships, to become a world leader in the development and trade of renewable energy.

Concern: The production, exportation, and consumption of non-renewable energy constitutes a significant portion of the global economy, making a transition costly.

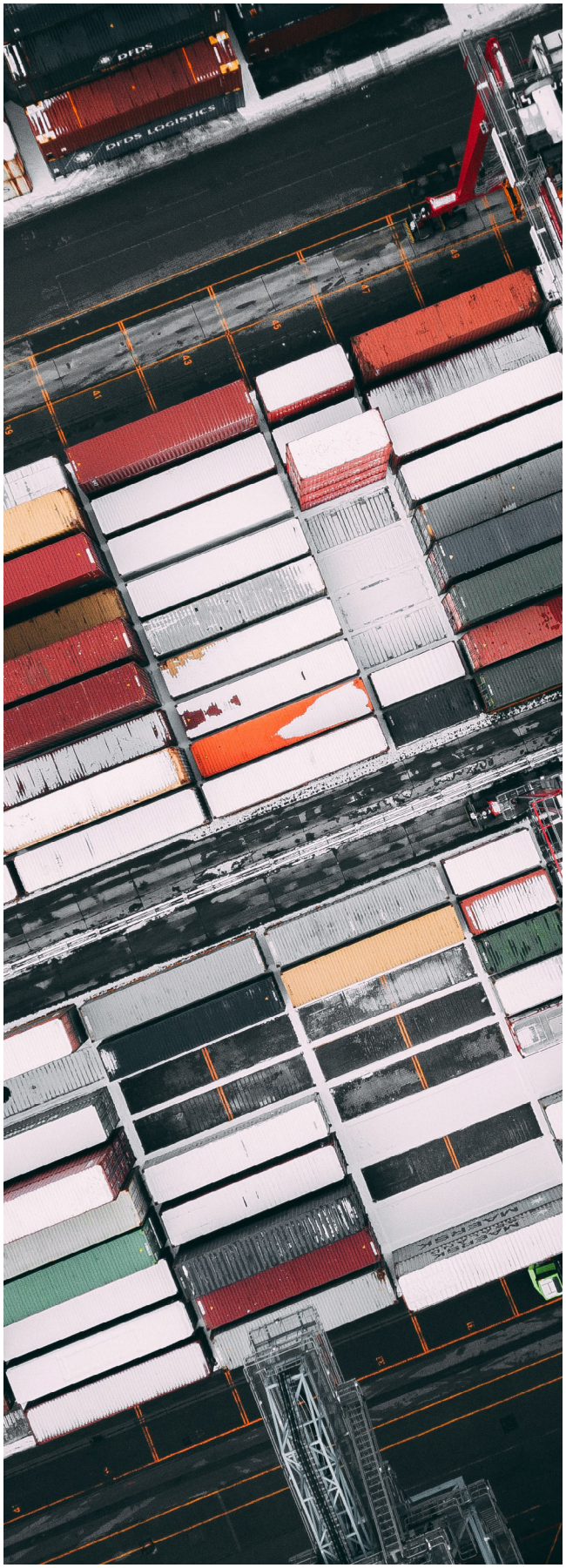
Concern: There needs to be a consistent or robust accountability mechanism with regards to the carbon emissions and pollution of states.

Concern: Canada has not capitalized on the opportunity to take the lead on renewable energy, leaving an opportunity for other state or private actors to seize a valuable leadership position in the development of renewable energy.

Recommendation: The Government of Canada must deepen and craft strategically its diplomatic relations with key partners in energy trade and states facing economic losses to build an international consensus favouring greater utilization of nuclear and renewable energy.

Recommendation: Canada must seek a multilateral approach with like-minded states to develop renewable energy technologies.

Recommendation: Canada must work through intergovernmental organizations to assist developing countries in adopting renewable energy production capabilities, which they are unable to independently afford.



A transition towards renewable energy means a transition away from the dominant forms of power generation currently used globally. As a result of the proposed shift from non-renewable energy, industries built on or around the production, exportation, or consumption of non-renewable energy sources would be significantly impacted. Diplomatic and military issues may be subject to complications associated with the economic upheaval. Over 20% of Canada's exports in 2017 were non-renewable energy products, such as crude petroleum and coal briquettes, valued at over $80 billion out of $377 billion in total exports.[417]

Coal is exported by a variety of states, ranging from wealthier ones such as Australia to less-wealthy states such as Mongolia or Mozambique.[418] Nearly three-quarters of coal imports are bought by Asian states, with the majority of the remainder being imported by European states.[419] However, natural gas and petroleum are a wildly different matter than coal. Natural gas exports amounted to $95 billion in liquid form, and $107 billion in a gaseous state, for a total of over $200 billion in 2017.[420, 421] Petroleum exports dwarf both coal and natural gas. Petroleum gas exports total over $257 billion, refined petroleum sits at $573 billion, and crude petroleum tops out all others with $792 billion.[422, 423, 424] Annually, over $1.6 trillion in petroleum is exported.

Non-renewable energy products are intrinsic to the workings of the global economy. Petroleum, natural gas, and coal are necessary components to operate innumerable features of everyday life; from running vehicles and factories, to heating homes and public buildings. It is crucial for the Canadian government to maintain its commitment towards targets set in the energy transition, as well as to foster an international consensus on the importance of this transition. International frameworks under the auspices of intergovernmental organizations, such as the Paris

Agreement, must be built upon and include effective enforcement and accountability mechanisms to ensure compliance. This could take the form of a multilateral effort to impose tariffs on the worst polluters and states that fail to adhere to environmental targets.

It is essential that Canada strengthen diplomatic relations with key partners in energy trade, to grow its capacity in the renewable energy sector. It is also essential that relations with countries with large stakes in non-renewable energy are strengthened through alternative measures and that the process is transparent from start to finish.

A transition towards the increased use of renewable energy as a replacement to non-renewable energy sources entails a significant shift from current practices and the implementation of technologies that are not widely available at necessary levels. Forms of renewable energy include solar, hydro, tidal, wind, geothermal, and biomass. Currently, adequate electricity storage capabilities and control over the precise amount of electricity generated, are lacking. This reality complicates any domestic renewable energy transition which does not include either significant baseline energy production, nor a willingness to trade in electricity to deal with energy surpluses and deficits.

Canada must ensure that the transition is managed in a way that accomplishes its goals without economic disruption devolving into financial crises. To that end, a renewed and intensified commitment to international institutions is necessary and Canada must seek to shore up its bilateral relationships with key partners such as the European Union. Geopolitically, the transition from non-renewable energy threatens an entrenched status quo with significant economic interests attached to the production of petroleum, natural gas, and coal. The entrenched interest of these states in the status quo must be preempted through the utilization and further development of existing intergovernmental organizations that can enact compliance measures against sovereign states while assisting them in the transition towards a more sustainable economy. A multilateral approach that sees comprehensive penalties, such as sanctions, against states that resist or oppose the reduction in consumption of fossil fuels could be necessary towards the transition to sustainable energy.

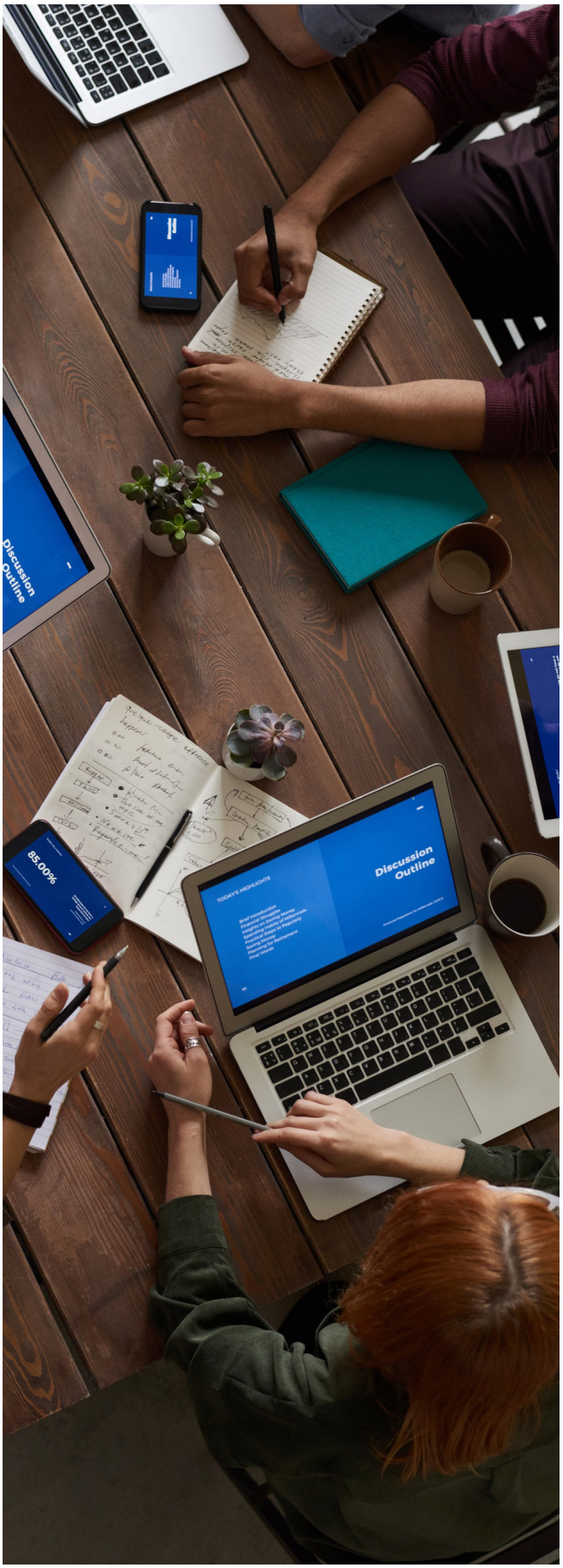
Canada has joined efforts to increase development in renewable energy technology. For instance, the joint project between Canada and Switzerland to develop carbon capture technology demonstrates Canada is on the right path towards engaging with like-minded nations to pioneer new renewable energy technology. However, if Canada is to truly become a global energy innovator, Canada must take a leadership role in ensuring that developing states have access to such technologies. The issue of developing states and their growing demand for affordable power is a necessary component in achieving aforementioned objectives. In many instances, developing states do not have the financial resources to effectively implement renewable energy sources and are forced to rely on non-renewable energy sources as a primary fuel source. For developing states undergoing rapid economic and population growth, there is a growing need for more affordable power, which is currently being met by non-renewable energy sources. A lack of finances available to fund renewable projects grants Canada a prime opportunity to take on a leadership role to provide the necessary resources to encourage developing nations to implement renewable energy rather than using fossil fuels. Canada can accomplish this through working with various intergovernmental organizations along with non-governmental organizations. The knowledge and expertise of these international organizations in conjunction with Canada's energy expertise has the potential to help developing nations

implement renewable energy sources more reliably in addition to accelerating the process of decarbonization on an international scale.

Similarly, states that uphold international institutions should seek a limited rehabilitation of states that are currently subject to diplomatic isolation and sanctions, such as Iran or Russia, in order to include them in the transition to sustainable energy consumption.

5.2 An International Coalition

A commitment to change is strengthened when countries come together in pursuit of a common goal. Climate change is a global problem that cannot be tackled by a single state, and as such, Canada cannot hope to save the planet without the cooperation of other governments. The success of transnational initiatives is demonstrated by the Power Past Coal Alliance founded by Canada and the United Kingdom in 2017. The alliance is composed of 97 national, provincial, state and city governments dedicated to a rapid, and just, transition from coal powered energy.[425] It is multilateral efforts such as these that motivate meaningful change on a global scale. Not only are governments in transnational agreements compelled to act in the best interest of their citizens, they are also held accountable by the states they are in partnership with. The Canadian government should spearhead a multilateral initiative with willing countries committed to combating climate change. The signatories of the UN Framework Convention on Climate Change present a promising group of governments that may support such a project on a voluntary basis. Thus our report outlines the following five international initiatives that the Canadian government ought to pursue. In order to achieve a global reduction of energy-based carbon emissions, Canada



should spearhead the creation of an International Climate Agreement. By engaging in knowledge sharing channels, Canada should bolster the development of green technology. The Canadian government should advocate for consumption-based accounting of CO2 emissions under the UNFCCC. While striving to be a leader in combating climate change, Canada must ensure that it develops a narrative that is inclusive to a variety of social and cultural beliefs. Finally, Canada should advocate for the adoption of a universal definition for environmental refugees, and provide aid to assist environmental refugees when possible.

5.3 International Climate Agreements

Principle: Canada should take a stronger stance on the international stage as key player in the sustainable energy transition

Concern: Canada has failed to uphold the principles of the Paris Agreement

Recommendation: The Canadian Government should take measures on the international stage to strengthen pre-existing climate agreements focused on the reduction of energy-based carbon missions.

Historically, climate change agreements have failed to execute substantial initiatives and reach the majority of emissions targets. As a result of these failures, it has become imperative to develop an initiative that is obtainable, yet still ambitious in scope.[426] The main issues with the Paris Agreement lay in its nonbinding nature, as well as its lack of incentivization for nations to reach their target goals.[427]

In the strengthening of international climate agreements, Canada should play a major role both as an international leader and as a cooperator, a vision that can be actualized through calling upon like-minded states to directly address the shortcomings of pre-existing climate security agreements. Canada could play a major role in spearheading this movement by creating domestic taxation of energy-based carbon emissions, as well as providing incentives for non-carbon emitting energy production. Canada as an international energy innovator could set a great example for other nations which are heavily involved in the oil industry, and are naturally skeptical about the feasibility of such a task. The first step of execution requires change at the federal level, as it would grant the Canadian government more legitimacy in advocating for other nations to coalesce. Targets set for the reduction of carbon emissions in the Paris Agreement have not yet been met by Canada, creating a difficult terrain to spearhead this leadership role.[428] Additionally, goals set for 2030 have also not been realized; and in actuality, the nations' emissions have steadily increased in the last 25 years.[429] Creating a comprehensive scheme to reduce carbon emissions for one nation would leave it at an economic disadvantage, particularly for natural resource-rich Canada.[430] This can be solved by setting smaller, incremental goals, which are easier to achieve and build up over time. Having other nations join in coalition with Canada would be the ultimate objective.

Canada's "Living Tree Doctrine " allows for the Charter of Rights and Freedoms to be interpreted in a contemporary context, including issues of climate change. Section 7, the right to life, liberty and security of persons, has the capacity to include persons living in Canada's Arctic who are threatened by the impact of carbon emissions on the environment, and other environmental degradations.[431]

5.4 Technology Sharing and Development: Canada's Global Efforts

Principle: Canada needs to broaden its efforts in national energy technology exports in addition to expanding its collaborative efforts to develop new energy technologies.

Concern: Canada will lag behind technological developments if it fails to bolster development of new green technologies.

Recommendation: Canada should bolster its efforts to develop green tech by engaging in more joint ventures and knowledge-sharing with countries developing similar technologies.

5.4.1 Nuclear

Since 1955, Canada has signed 95 treaties with various countries in regard to nuclear technology sharing and cooperation.[432] Given Canada's position as a global nuclear leader, this is unsurprising. However, in recent years emerging and expanding nuclear powers such as China, India, and Russia pose a challenge to Canada's leadership role as a global nuclear power.[433] Given Canada's middle power status, Canada's global leadership role in nuclear energy production and innovation serves as a vital source of upholding Canada's image on the global stage. As of the current date, Canada only has 19 operational reactors, and many of the reactors were first commissioned in the 1970s, having only received partial refurbishment to maintain operational capacity.[434] On the other hand, Russia as a competing power currently has 38 reactors operational along with a plethora of reactors that are currently under construction. As well, ten of the current operational reactors in Russia were constructed after the 2000s and utilize sophisticated modern technologies compared to the Canadian reactors.[435] While China has traditionally relied on Canadian nuclear technology, China has taken aggressive steps to expand and proliferate its domestic nuclear capabilities.[436] China's nuclear energy policy is to "go global" by exporting domestic nuclear technologies and expertise to countries that lack nuclear capabilities.[437] Competitive economies have taken aggressive steps to promote their domestic nuclear energy capabilities overseas; South Korea has recently engaged in joint venture projects with the United Arab Emirates valued at roughly 20 billion USD.[438] It is also important to note that South Korea is rapidly rising as a global nuclear power for their innovations in nuclear technology in addition to having one of the most efficient reactors, operating at 96% capacity.[439] Similarly to China, South Korea has also prioritized exporting their domestic nuclear technologies and is currently preparing to enter a booming nuclear energy export market worth $78 billion.[440] Amidst rising competition coupled with an increasing amount of countries interested in adopting nuclear technology, Canada must take further measures to boost innovation and development of new nuclear reactors that are capable of meeting the demands of an increasingly energy-intensive world. Given the complex supply chain and procurement processes of such technologies, it will be in Canada's best interest to collaborate with other nuclear powers in developing new technologies such as SMRs which are more economical, as well as easier to construct on a grand scale. Former Canadian initiatives have failed to pass the prototype stage due to cancelations and being outcompeted by foreign technologies; meaning that Canada must increase its efforts to bolster nuclear technology both domestically and globally to maintain its position as a global nuclear power.[441]

5.4.2 Renewable

Canada's increasing utilization of renewable energy sources positions the country as a global renewable energy leader. More than 60% of Canada's electricity is generated through hydro-electric sources along with an additional 7% of total electricity being produced through other renewable means.[442] Supporting Canada's strong initiative towards renewable energy is a wide portfolio of green technology (Greentech) companies that are boosting Canada's global position as an energy innovator. There are over 850 Canadian Greentech companies,12 of which have made the global Greentech 100 list for being the most innovative companies in their respective fields.[443] Canada continues to aggressively pursue joint green venture projects with other nations such as the joint development of carbon capture technology with Switzerland and many others. Canada's strong commitment to innovate in Greentech has attracted numerous foreign companies to invest in Canadian energy. In the past three years, five foreign Greentech companies pledged to invest close to a billion dollars in Greentech development within Canada, creating numerous jobs and bolstering Canada's renewable energy capabilities.[444] In addition to foreign investments in Canada, Canadian firms have embarked on ambitious joint ventures with foreign firms to develop carbon capture technology and other green technology. For example, one of the first industrial carbon capture machines is being developed by Svante Inc, a Canadian company along with Climeworks AG from Switzerland.[445] Given that these two companies are currently industry leaders in this field, the Canadian government's push to pursue joint ventures with foreign companies will further bolster Canada's position as a global Greentech leader in addition to attracting potential future ventures. In order for Canada to maintain its position as a Greentech leader, Canada must continue to incentivize Canadian companies to innovate and collaborate with those in like-minded foreign countries to achieve a sustainable future.

5.4.3 Combining solar energy with coal-fired power

Principle: Both coal and gas based generation are vital to powering many of the world's developed and emerging economies. Canadian energy producers should examine alternatives to the production of fossil fuels that are sustainable energy sources to provide electricity in a sustainable and reliable manner.

Principle: The impact of carbon emissions transcends national borders, hence states are held accountable for their respective carbon emissions and pollution.

Concern: Depending on the accessibility and functionality of existing coal-fired power plants, there may be costs for amending and installing new infrastructure and control equipment to enable co-fueling coal with solar energy, making this transition costly.

Recommendation: Canada should take a proactive stance and assist developing countries to adopt a cooperative arrangement – integrating both renewable and existing non-renewable power plants for the progressive phase out of non-renewable energy sources, allowing for the possibility of gradual phase out of fossil fuels.

The largest share of primary energy consumption worldwide is attributed to coal, followed by natural gas and oil; coal plays a particularly important role in developing countries, where its affordability is the major incentive for nations to fuel economic growth with reliable energy. Even with relatively low-priced natural gas directly competing with coal as regulations and policies aim to curtail coal use, coal continues to be the dominant source in the world's electricity mix.

Coal-solar hybrid energy generation is a cooperative arrangement where the two sources of energy are harnessed to create separate but parallel steam paths.[446] Hence, electricity is generated as a combined force feeding a shared steam-driven turbine. Coal contribution and the fluctuation of solar radiation are interconnected and adjusted appropriately depending on the operation time of a power plant. For instance, coal reduction mode is activated during daylight operations, when solar radiation increases relative to the latter part of a day, when solar input decreases.[447]

The option of combining solar energy with coal will help countries to work towards completely phasing out coal-fired electricity. Instead of solely relying on one single fossil fuel to generate electricity, a portion of coal demand will be replaced by substitutions from solar energy. In essence, this integration allows coal consumption to be reduced while sustaining electricity output. It also allows adopting countries to gradually increase their technical capacity for managing and integrating solar energy by starting on a smaller scale. The key advantage of this hybrid technology is rooted in its ability to sustain electricity generation and its flexibility to be applied to any form of conventional thermal power plant, either existing or newly built.[448] Coal is the most carbon-intensive of all fossil fuels, providing for nearly half the globe's electricity. With that said, many nations are not willing to commit to a total coal phase-out just yet.

This is an attractive and efficient option for nations that vow to decrease the usage of coal while increasing the plant's efficiency. The commercial viability of combining the two technologies has been proven in a number of cases. This hybridization would ultimately assist various nations by lowering their carbon dioxide emissions and facilitating a realistic transition.

South East Asia is a region that exhibits a heavy reliance on fossil fuel usage, particularly driven by increasing coal demand since 2010.[449] In the wake of the Paris Agreement, national governments have taken action aiming to reduce regional greenhouse emissions in South East Asia; precisely, the promotion of energy efficiency measures and the usage of renewable energy sources were the two major commitments undertaken by national governments as they reassessed their energy development trajectories.[450] However, the need for South East Asia to transition away from the heavy reliance on conventional fossil fuels did not result in the discontinuing of coal power. Coal usage remains prominent in the region, as there are 29 GW of coal-based capacity under construction to be complete by 2020.[451]

In combination with conventional coal-fired power generators, solar radiation and solar thermal energy work in tandem by increasing the plant's steam cycle, ultimately enhancing its power input. The first demonstration of a solar-coal hybrid power plant took place in Colorado in 2010, and was called the Colorado Integrated Solar Project. Official statistics reflect that solar thermal to electricity conversion efficiencies of the solar hybrid plant are higher than those of a solar-only power plant, reducing coal consumption by 2-3% and fulfilling the progressive commitment to phase out fossil fuels.[452] South East Asia's current power stations, notably Thailand's and Vietnam's non-renewable power plants could adopt the solar-coal hybridization method as this strategy allows for power output to be elevated while coal consumption is reduced.

5.5 Consumption-Based Emissions Accounting

Principle: Canada should be transparent and take responsibility for carbon emissions accounting in a way that is fair to other countries.

Concerns: Production-based emissions accounting neglects the 'carbon leakage' that occurs when developed countries import goods with 'embodied emissions' resulting from offshore production using inefficient or poorly regulated processes.

Recommendation: The Government of Canada should adopt a multilateral approach with like minded states to create an effective international accountability mechanism on carbon emissions and pollution by states; building off of the frameworks established by previous agreements such as the Paris Agreement.

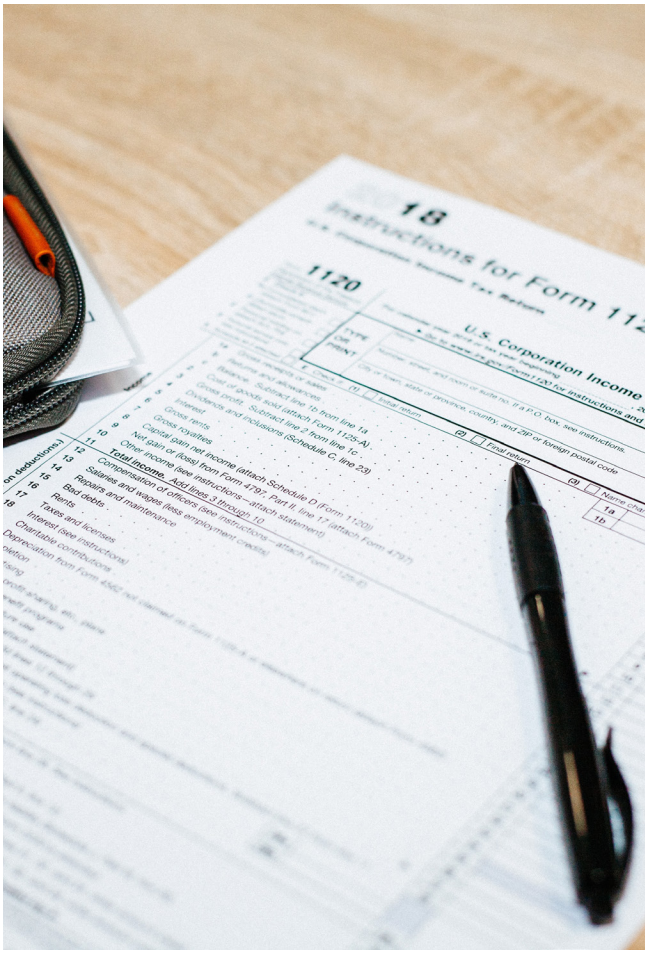
International climate change agreements pay great attention to production-based CO2 emissions by way of commitments to monitor and report national emissions under the Paris Agreement, among other frameworks. In tracking and reporting its own national emissions, Canada should observe the principles of transparency and fairness, particularly vis-à-vis developing countries, who have contributed least to causing climate change but who suffer most from its impacts.

National carbon accounting is complicated by international trade, because traded goods and services are said to contain "embodied emissions" comprising all the emissions released throughout their entire production process, from resource extraction to transport to end-user. In essence, Production-Based Accounting (PBA) methods count these embodied emissions toward the producing or exporting country's emissions total, while Consumption-Based Account-

ing (CBA) methods count them toward the consumer or importer's total. That is, under PBA, states are held accountable for the CO2 they emit directly, yet the emissions associated with the goods and services consumed by the citizens of the country are overlooked.[453]

Neoliberal globalization has enabled a process by which the production of emissions-intensive goods is offshored to developing nations, only to be consumed by the developed world. This phenomenon is referred to as "carbon leakage".[454] This is exacerbated by the fact that these producers tend to use production processes that involve less-efficient technology, less stringent environmental regulations, and even 'dirtier' fossil fuels, emitting more carbon than would production in the importing country.[455] However, international agreements have disregarded this process and instead established an artificial separation simply because there is a geographical one. Due to greater international trade, the volume of emissions embodied in trade have increased, causing the gap between the consumption-based emissions and production-based emissions of countries to widen.[456] As Davis and Caldeira demonstrate, the inclusion of consumption-based emissions within global climate change policy would address the historical and regional emission inequity, thereby facilitating a more just and viable international agreement.[457]

Canada should advocate for consumption-based accounting of CO2 emissions under the UNFCCC, as a conventional practice or as an additional protocol. Specifically, it should advance a more refined method of CBA that accounts for the relative carbon intensity of domestic versus foreign production by comparing the emissions produced by the exporter (i.e. producer) with the emissions that would hypothetically be produced if the importer (i.e. consumer) made the goods themselves. The emissions that would be created by domestic production of the goods are assigned to the importing country, while any additional emissions resulting from inefficient or poorly regulated processes are assigned to the exporting country.[458] This model of carbon accounting could create an 'efficiency spiral' by incentivizing countries to develop production technology that is marginally more carbon-efficient than their trading partners or competitors to attract more trade, leading them to develop a comparative advantage in the low-carbon production of particular goods. Moreover, Canada specifically would benefit because energy resources are one of its major exports, and can be rather carbon-intensive; this model would allow for a more equitable sharing of accountability for those emissions with the consumers of Canadian energy products. This would reduce carbon leakage and would place Canada as a leader for progressive, pragmatic and just carbon emissions accounting.



5.6 Inclusive Narratives

Concerns: Geographic, political, social and cultural factors influence how different communities perceive climate change and its ramifications. The global narrative of climate change is rooted in a western framework that advantages states with a western understanding of the world. Those who do not have this understanding are at a disadvantage internationally in mitigating the consequences of climate change.

Recommendation: International climate change narratives need to recognize and adjust to different local understandings of climate change. Thus, the international community, in creating narratives about the need to respond to the dangers of climate change, should conduct research to adapt to these social and cultural nuances of understanding climate change.

Recommendation: When striving to be a global leader in climate change action, Canada should advocate for states to have the flexibility to adapt narratives and solutions to local contexts. This is to ensure that social and cultural beliefs are respected and upheld when addressing climate change solutions in an international context.

In conveying the risks of climate change globally, those who will be most affected face social and cultural barriers to understanding and dealing with the ramifications of climate change. In a study that examined the shaping of narratives about climate change in Jinja, Uganda, the research demonstrated that African climate change research has largely been focused on the impacts on rural communities.[459] However, little work has been done to educate many Africans on the consequences of climate change on urban cities, which will be exposed to the effects of droughts, floods, fires and reduced ecosystem services.[460] Those living in impoverished urban areas will suffer from climate emergencies such as these.[461] Those from western nations are at an advantage when it comes to both controlling the narrative and coping with the effects of climate change globally. One of the interesting findings was that communicating the danger of "climate change" was a very westernized ideology; most people who were interviewed had never heard the term "climate change" before but identified with the use of language such as "environment" and "changes".[462] This demonstrates that language has a substantial impact on the ways in which people understand the dangers of climate change.

Studies have demonstrated that an understanding of local contexts including social and cultural factors such as beliefs, religion and science, play an essential role in the way that different communities value mitigating the effects of climate change. In a study done by Morgan Scoville-Simonds, local perceptions influenced individuals' understanding of climate change, and ultimately had a larger impact on their desire to act than globally-driven narratives.[463] This plays an important role in shaping narratives about the winners and losers of international climate change. The "global narrative" of climate change and the consequences of climate change are largely controlled by westernized perspectives on the issue, whereas local contexts play a more significant role in shaping understandings in the developing world.

5.7 Environmental Refugees

Principle: Environmental refugees are a vulnerable community that will only grow as the consequences of climate change arise. A definition must be agreed upon regarding environmental refugees, and humanitarian aid and assistance must be both promised and delivered.

Concern: Environmental refugees already exist in great numbers across the globe, as a result of issues from climate change to ecocide, the destruction of ecosystems. This complicates efforts to mitigate their circumstances as well as finding common ground for a definition to refer to these forcibly displaced people.

Recommendation: Canada would benefit from the international recognition of being a global leader in the safeguarding of environmental refugees, both through pushing for an internationally agreed upon definition and providing humanitarian aid and assistance in relocation for these communities.

Environmental refugees are a forgotten intersection between the current and impending environmental crisis, and the forced displacement of entire communities from their homes, their ways of life, and their basic security. Currently, there is no definition that is internationally agreed upon to recognize nor to respond to the existence of environmental refugees. Here, they are defined as those people or communities forcibly displaced as a result of environmental degradation and climate change. This definition is referred to as environmental refugees, as opposed to the more common "climate refugees", as climate can refer to those issues resulting from direct or indirect climate change or disruption. This does not include then, those forcibly displaced

when the ecosystems they rely on are under attack as a result of war, or even genocide. This also does not include other refugees that would otherwise be recognized under "environmentally" displaced people. For that reason, it is perhaps best to keep the name broader, so that all aforementioned aspects may be covered. That being said, whichever name is used ought to be agreed upon as soon as possible, due to the imminent nature of climate change's repercussions. These individuals exist already, and they will only continue to grow in numbers and needs as the consequences of climate change unfold. It is thus imperative that we have a name to call them by.

Why have a definition? Why not refer to them just as refugees?

There is a particular need to define environmental refugees, as opposed to adding them into the broader category of refugees, as they have unique needs and grievances which are lost in the broader framework. Details that are lost cannot be addressed, and so the humanitarian efforts that ensue may very well not meet the particular needs of these individuals and communities. It is also important from an academic as well as political perspective, for the following reasons. For academics and others interested in studying environmental refugees, it is imperative to have one framework defining who those refugees are, so that the works of varying academics can be synchronized. Politically speaking, there are a number of concerns to be addressed. First, for those nations to whom these refugees will largely move towards, it would be to their benefit to help mitigate the causes for the forcible displacement of environmental refugees, particularly if they are not in favour of receiving said refugees. Second, on the other side of the issue, for countries seeking to help environmentally displaced communities and also benefit from the international prestige and recognition of such endeavors, there must be at least some universal understanding of who is being aided. Otherwise, the prestige and recognition can easily be lost in discussions of whether the helped group was truly that of environmental refugees. Debates concerning such definitions can become dangerous when there is a vulnerable community's security at stake; one must look only to Rwanda to see how devastating the situation can become for those vulnerable communities while the international community busies itself with debating definitions.

6. Narratives and Public Opinion

The established narratives regarding the energy sector need adjustment considering how the public currently perceives the industry. Through public-based narrative recommendations, changing public perception allows the industry to move forward with sustainable energy solutions without the consequences of the perceived negative sentiments felt by many. Moving forward with a sustainable energy policy domestically and internationally cannot be achieved without positively influencing how individuals, groups, and companies understand the energy industry.

6.1 Environmental Groups and Academics

Principle Safe-handling of nuclear energy should be emphasized as a priority.

Concern: Existing stigma surrounding nuclear energy, stemming from prior negative experiences may inhibit widespread adoption of nuclear energy and the realization of its benefits.

Recommendation: Collaborating with environmental groups and academics should be prioritized to ensure the most efficient and environmentally sustainable means of extracting and disposing of energy waste are utilized.

The federally-mandated Canadian Nuclear Safety Commission declares on its website that the Canadian government "ensures that radioactive waste disposal is carried out in a safe, environmentally sound, comprehensive, cost-effective and integrated manner."[464] In contrast, the not-for-profit Canadian Coalition for Nuclear Responsibility criticized the Canadian government in January for having "no adequate federal policies and strategies for the long-term management of radioactive wastes."[465] Considering the fears about nuclear energy resulting from high profile nuclear disasters such as Fukushima and Chernobyl, the dissonance between government statements and environmental groups must be addressed in order to advance a positive narrative about nuclear waste disposal.[466] To accomplish this, the Canadian government should collaborate with environmental groups and academics such as the Canadian Coalition for Nuclear Responsibility, Canadian Environmental Law Association, and The Sierra Club Canada to develop effective policies for nuclear waste disposal. These consultations should be undertaken using an intersectional approach that considers cultural, environmental, and regional factors, to ensure that proposed solutions are as inclusive and effective as possible. For example, Indigenous groups have been vocal about their concerns about waste disposal on their lands.[467] Indigenous communities have often borne the brunt of the costs regarding nuclear waste disposal and received little benefit.[468] These concerns must be considered throughout consultations, and the Nuclear Waste Management Organization must remain committed to their reconciliation policy so that collaborative solutions are proposed with the interests of all Canadians in mind.[469] The case study of the Northern Saskatchewan Dene community and Cameco included earlier in this report is a great example of such an agreement between a company seeking to profit from indigenous land, while maintaining a line of dialogue with the relative community.

6.2 Nuclear Energy Education Campaign

Principle: Negative public perceptions of nuclear energy use need to be minimized.

Principle: Different forms of media play a significant role in shaping the narrative and understanding of the nuclear energy sector.

Concern: The media can play a role in perpetuating negative public attitudes towards the use of nuclear energy in Canada.

Recommendation: Implement an educational campaign about nuclear energy in Canada with the aim to address public concerns regarding the public health and environmental impacts of nuclear energy. This campaign should include an online component.

The Government of Canada should spearhead an educational campaign addressing perceptions of the use of nuclear energy in Canada. Studies have shown that when educational resources are made publicly available to give a more complete understanding of the function and application of nuclear energy, there is a higher chance of public acceptance. Specifically, a study that examined public acceptance of nuclear energy across 19 countries (Canada being one), found that populations that trust their inspection authorities more highly are more likely to accept nuclear energy installations.[470] Additionally, an educational campaign that encompasses different categories such as public health concerns, myths, and the realities of nuclear energy in Canada will give the public an opportunity to receive accurate information about the industry. Throughout this campaign, it is important to refrain from using narratives surrounding nuclear weapons. Nuclear energy is often incorrectly associated with nuclear weapons because of global public perception. This serves as a main reason why a significant portion of the public

is against nuclear energy. Reducing the use of narratives surrounding nuclear weapons will allow the public to disassociate both terms, and focus on the meaning and reality of the nuclear energy industry in Canada. Introducing an online component to the educational campaign will allow for more practicality and reach while also catering to younger audiences who spend a significant amount of their time online.

6.3 "Nuclear Fusion Energy"

Principle: Nuclear energy terminology needs to be taken out of the context of nuclear weapons.

Concern: The public stigma surrounding nuclear energy makes voters, and in turn, policymakers, reluctant to support the expansion of nuclear energy.

Recommendation: The Government of Canada and the private industry should adopt the term "nuclear fusion energy" in order to encourage a more positive public perception of nuclear energy that enables its widespread adoption.

Nuclear energy has often been looked at negatively not only in regard to how it affects the planet, but also in its association with nuclear weapons. There should be a way to change the character of public discourse around nuclear energy; this could be done in part by adopting the term 'nuclear fusion energy.' Research has been conducted that revealed negative associations and imagery such as, accidents, destruction, contamination, and child cancer that are often linked with nuclear energy technologies.[471] These negative sentiments have been described as nuclear fears, which now encompass more than just the association of nuclear energy with nuclear weapons. One way to disassociate negativity from nuclear energy is by adopting new language that influences public perception more positively. A study that introduced the term 'nuclear fusion energy' to public participants was conducted in order to assess the possibility of changing public perception around the use of nuclear energy. The study revealed a public fear of nuclear energy, as a large portion of people in the study associated nuclear energy and its technologies with nuclear weapons.[472] A nuclear label, like the one that currently exists between the association of nuclear energy with nuclear weapons, is linked to a sense of stigma for the technology in question. This label exerts a powerful influence on shaping public discourse. Initial responses to nuclear energy exhibited negative sentiments that were associated with nuclear weapons, catastrophes, and terrorism.[473] By introducing the term 'nuclear fusion energy', researchers are able to assess the future levels of acceptance among the participants. Although it is too early to tell whether public perception has been impacted positively by adopting the term, it is important to look towards its potential utility in the future. The study provided the foundation of research that is necessary to move forward with changing the narrative surrounding nuclear energy. The term 'nuclear fusion energy' is meant to ease the stigma associated with nuclear technologies and introduces a new way of looking at how nuclear energy can be used safely and cleanly in Canada. The adoption of the term by nuclear energy researchers is a step in the right direction by industry leaders, and Canada would do well to align its own public communications with the terminology used by those at the cutting edge of nuclear energy and nuclear safety. Re-framing the terms in which nuclear power is discussed politically and publicly is the beginning to creating the cultural conditions under which acceptance can be made possible.

6.4 School Curricula

Principle: Future generations should be provided with the education necessary to understand their environmental impact and how it can be minimized.

Concerns: The lack of a uniform curriculum for Canadian school boards may result in a climate knowledge gap.

Recommendation: Provincial governments should create curriculum in order to educate students on energy creation and consumption in Canada. This curriculum should be created in collaboration with environmental and Indigenous groups.

Including environmental literacy in secondary and elementary school curricula is important in educating the next generation about sustainable sources of energy. An education that focuses part of its curriculum on sustainability would allow students to develop environmental responsibility, critical thinking skills, and develop knowledge regarding their physical health and the environment; in addition to learning about the ecological footprint left by humans, students will also learn about eco-sustainable alternatives and environmental strategies that can effectively limit man-made impacts. The educational program should be created with the partnership of environmental organizations (such as Greenpeace, the WWF, and grassroots networks such as Friends of the Earth) that can provide pupils with hands-on experiences about environmental advocacy and educate them on sustainable energy sources. The program should be tailored to the natural resources available locally in each province, but should also address the environmental footprint specific to the province; this way, fossil-fuel dependent regions will not be able to promote pro-oil curricula. The education program should emphasize the perspectives of Indigenous groups who tend

to be vocal in climate activism but are often overlooked.[474] To further encourage student involvement in environmental advocacy, mandatory volunteer hours required for highschool graduation should require a large portion of volunteer hours be dedicated to assisting local environmental organizations and objectives. These mandatory volunteer hours would assist in the push for more environmental conscientiousness and increase the amount of hands-on support for environmental organizations.

6.5 A Financial learning hub

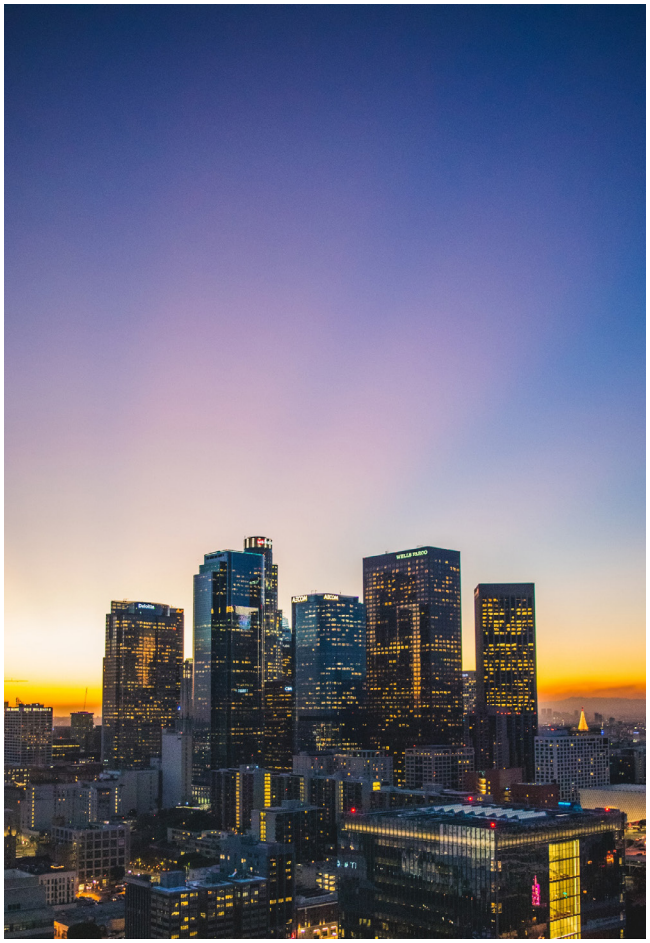
Principle: The Canadian public should have a means through which they can achieve a comprehensive understanding of climate-related financial information.

Concern: Canadians may not be inclined to spend their free-time accessing and completing climate-related financial courses.

Concern: If most Canadians are not knowledgeable about climate-related financial information, misinformation regarding an energy transition could circulate more easily.

Recommendation: The Canadian Government should create an accessible, user-friendly learning hub devoted to enhancing disclosures and information regarding climate-related financial information, incentivised through the accreditation of Continuing Professional Development certifications.

Filling the existing knowledge gap is a crucial step in shifting the public narrative and enhancing the accuracy of climate-related financial information.[475] The Task Force on Climate-related Financial Disclosures has launched an e-learning hub, which allows organizations to access online courses consisting of "self-paced, activity, and video based learning."[476] These courses are Continuing Professional Development (CPD) accredited, thus providing individuals and companies with a further incentive to complete the course. This form of e-learning to shape narratives surrounding climate change may also be useful in reshaping the narrative surrounding an energy transition by the Government of Canada. An accessible, interactive, and self-paced informative experience for all Canadians interested in educating themselves about an energy transition, including its benefits, challenges, and countering climate misinformation, will be very useful in shaping the public narrative. Ultimately, an online "Learning Hub' 'made accessible via the Government of Canada website and easily shareable through social media platforms, will be a crucial tool in driving public narrative in regard to a just climate transition. Providing certificates of completion, such as CPD credits, may be effective in creating public incentive to visit the learning hub.



6.6 Strategic government communications

6.6.1 Policy benefits

Principle: A successful energy transition requires broad public support.

Concern: Apprehension over the short-term benefits of an energy transition can limit public support.

Recommendation: The Canadian government should increase public support for the energy transition in the short term by emphasizing the tangible ways in which some of the policies outlined above can benefit everyday Canadians.

While the transformation of Canadian energy has both long- and short-term benefits, emphasizing tangible and visible positive effects can help bolster public opinion in support of transition and help overcome short-term concerns in political decision making. A past example in which immediate and concrete benefits supported change is the public health narrative that was used to counter fears about the perceived cost of Ontario's 2003-2014 transition away from coal. Proponents of the coal transition stressed the connection between growing health concerns and decreased air quality resulting from coal. The Ontario Medical Association also quantified the medical costs of air pollution, which led to the campaign mantra "air pollution costs Ontario more than $1 billion a year" and changed many opinions about the cost of a transition.[477] The estimated benefits of national phase-out of coal include $1.2 billion in healthcare savings from reduced air pollution, the prevention of almost 260 premature deaths, and 40,000 fewer asthma attacks.[478] The carbon tax is another energy policy that can be linked to specific and substantial positive impacts for everyday Canadians. Revenue recycled in the form of household dividends or income tax reductions are projected to have significant economic benefits for Canadians, as discussed in the Economy and Financing section of this report. By highlighting the direct and quantifiable benefits, negative attitudes towards the carbon tax can be overturned, and ultimately reversed. [479] In communicating the positive benefits of an energy transition, the Canadian government should emphasize immediate economic and health benefits in order to garner the necessary public support for the rapid change outlined in the above policy recommendations of this report.

6.6.2 Long-term narrative transformation and opportunity

Principle: National political cooperation is vital to transforming Canadian energy generation, and the narrative framing of climate change adaptation can create or thwart this cooperation.

Concern: Current climate change discourse in Canada is divided, politicized, and partisan – leading to inaction.

Concern: Alarmist rhetoric is not sufficient to mobilize action and cannot overcome the inertia of entrenched, dogmatic discourses; a new narrative is required.

Recommendation: The Canadian government's net-zero emissions plan should frame its communications through a core narrative, which grounds the transition to a sustainable economy as an opportunity to diversify Canada's economy and build a better future for the long term.

How climate change and energy transition are discussed has the potential to sow discord and engender resistance or to build unity around opportunity and change that is deep and lasting. Narratives of fear and disaster are significantly less productive than hope, and pose an obstacle to political progress.[480]

First, social psychology research shows that a better understanding of climate science does not necessarily translate to greater concern.[481] Second, people are psychologically wired to dissociate themselves from future and far-off consequences – and therefore unwilling to take immediate action that requires sacrifice and does not yield instant gratification.[482] Climate communication currently focuses on nativistic narratives that leave many who believe in climate science feeling resigned and hopeless, and those who are less concerned, alienated.[483] People's opinions on climate change - and support for economic and environmental policy that addresses it - are shaped by their world view[484] In Canada, this has led to increasing division. Doug Ford's anti-carbon tax stickers at Gas pumps,[485] Jason Kenny's efforts – including the 'War Room' (now renamed the Canadian Energy Centre), which announced "we are not about attacking; we are about disproving true facts,"[486] – and his politicization of energy projects as central to national unity,[487] have brought Canadian climate policy to a standstill. Now, businesses and investors are calling upon the government to produce its plan for net-zero emissions and establish a clear vision.[488] Rather than focusing on "economic chaos" and "ecological collapse,"[489] a narrative that focuses on the opportunities a sustainable energy transition brings can build unity around taking concrete action now.

While much of the content of our report focuses on establishing the concrete steps Canada should take to reach net-zero carbon emissions, realizing this plan requires building widespread political support. Communicating a narrative that emphasizes building a sustainable, diversified, and stable economy and that highlights the opportunity offered by a transition towards a sustainable future can engender this necessary support. The Alberta Narratives Project held over 55 workshops with 482 people participating in 120 hours of conversation through which they identified language and frameworks that unite people of different backgrounds and beliefs, and that lay the foundation for constructive dialogue and support for problem solving.[490] Their project constitutes the largest qualitative climate change communications project ever conducted. It is supported by extensive communications literature, and it develops a core narrative that can establish the common ground needed for climate action.[491] The key concepts that we recommend including in a national communications strategy are:

Diversifying the economy

- People recognize and are concerned about oil and gas dependency, and support diversifying the energy sector.

Honesty and recognizing challenges

- Focusing on people's resilience and adaptability allows them to consider the challenges of responding to climate change, but also to appreciate that the process is an opportunity to invest in the future and maintain a good quality of life.
- Acknowledging the challenges of transition "was seen as authentic and honest." People were positive about honest messaging, and hearing from people they trust, rather than from politicians.

Energy transition offers opportunities

- Expansion in renewable energy was supported as an opportunity for innovation.
- Professionals from the extractive industries were excited about the transferability of technical knowledge and highly skilled workers.

Transition towards the better future we build

- It is important that transition be 'towards' better sources of energy and broad economic stability, rather than 'away' from "dirty" fossil fuels.
- Economic transformation should be thought of as a move towards an economy with a widely diversified energy economy, with jobs that are 'sustainable' in that they are long-term and not subject to tumultuous global oil markets, and as an opportunity to build stronger communities that offer a better life - efficient cities, cleaner air, and so on.[492]

The government should develop a core narrative that is authentic and focuses on Canadians working together to build a better future in order to shape public opinion. Sub-narratives can be created to target certain audiences and build their support for societal transformation, such as using messaging that just transition policies ensure "no one is left behind," which resonates with conservatives more than social justice language surrounding marginalized groups, [493] and the above-mentioned strategy of emphasizing short-term benefits for immediate change. Who is communicating positive messages about transition is also important to bringing more groups into the fold. Groups such as Iron and Earth - a non-profit collective of oil and gas workers who are asking the Alberta government to invest in job-retraining and renewable technologies - are best situated to reach and convince others who work in extractive industries.[494] The implementation of the Just Transition Act, as recommended earlier in this report, would further help to shape positive narratives about job transition by demonstrating the government's commitment to ensure that all workers have the re-training and financial supports required to ensure that the transition leaves no one behind.

As the Government of Canada creates its plan for reaching net-zero carbon emissions, it must also create a narrative that brings together all Canadians to support the transformation of our economy and energy sector. Focusing on the opportunity for the economy and for ordinary people, and framing transition as a futurization movement will garner the widespread support and willingness needed to take on the challenge and realize the energy transformation we envision.

Conclusion

This report has outlined how we believe Canada can, and should, move forward in responding to climate change. Our policies are unified around our vision: transforming Canada into an international energy innovator and leader. We identified the major obstacles to action - short-termism, economic and infrastructural inertia, and public opinion - and proposed solutions to them in line with our principles. We have developed a comprehensive set of policy proposals, which take into consideration the domestic and international, a wide variety of energy sources, trade and financing, transportation and technological innovation, Indigenous stakeholders, and key narratives for communication. Our radical vision allowed this report to explore and plan how Canada should make the transition to a sustainable economy. Yet the breadth and depth of research mean our recommendations are grounded in reality, consider the challenges, and chart a realizable path forward.

This report is a beginning. It comes at an opportune time; in the coming months, the Government of Canada will begin consultations to develop its policy for net-zero carbon emissions by 2050. We speak directly to the government as it creates its strategy. This manifesto sets out what we believe should be implemented in domestic policy and be advocated for in coming COP meetings. However, we also speak beyond Parliament Hill. Enacting transformation involves action from all provincial and municipal governments, corporations, and the public. We hope that each will take this report as not only a balanced analysis and set of recommendations, but as an inspiration.

As we conceive of this report as a catalyst for action, it poses new queries. How would Canadian climate leadership intersect with shifting global power structures? When not tied to the extraction and export of raw natural resources, how will Canada's position in global markets be changed? How will engaging with Indigenous stakeholders and treating them as primary agents in transition move Canada towards reconciliation? What will Canada's transformation mean for youth across the country? These questions ask what future Canada is fundamentally moving towards.

Ultimately, this report has come from a place of optimism. Despite the challenges we face, we believe a just transition is **within our grasp**. We argue that the time to seize the opportunity to transform Canada's energy, economy, and society is now.

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