Climate Change Policy in Newfoundland and Labrador

A Report Prepared for the Progressive Conservative Party of Newfoundland and Labrador

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Chair

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Introduction

This Committee was struck on the 25th of September 2019 in a press release from the Leader of the Official Opposition Party for Newfoundland and Labrador, Mr. Ches Crosbie. The task entrusted to it was to advise the PC Leader on how Newfoundland and Labrador can best do its part to help Canada meet its international commitments to the Paris Agreement. Mr. Crosbie appointed the Chair of the Committee, Dr. Sean McGrath, Professor of Philosophy at Memorial University and Director of ENGO For a New Earth, along with two members of the Progressive Conservative Party. The Chair of the Committee appointed the remaining six members of the Committee. At the first meeting of the Committee, in December 2020, it was decided by the Committee that, with all due acknowledgment of the political origins of the Committee, the Committee would be non-partisan and advisory. The Committee planned to report back to the PC Leader in the spring of 2020. The work of the Committee was delayed due to the coronavirus pandemic.

For the sake of brevity, this report does not review the science of climate change, nor does it entertain skeptical arguments casting doubt on the anthropogenic causes of global warming. This is not because the members of the Committee consider the science irrefutable, but because the Committee recommends that Newfoundland and Labrador follow Canada's endorsement of the judgment of the majority of international climatologists, expressed at the signing of the Paris Agreement in 2015, and represented in the reports of the United Nations' Intergovernmental Panel on Climate Change (IPCC). All of the data, as well as the most up-to-date science, for any policy written for this province can be found in IPCC (2018).

Global Warming and the Paris Agreement on Climate Change

From its inception, the Committee understood its work in the light of the 2015 Paris Agreement. This historic agreement on international action on climate change was signed in 2015 by 175 governments, including Canada, and ratified in 2016. It commits all signatories to greenhouse gas (GHG) emissions reduction of 30 percent above pre-industrial averages by 2030, and progressive reductions moving towards net-zero emissions by 2050 ("The Paris Agreement," 2020). Such reductions have been judged necessary by a majority of international climatologists to keep global warming under 2 degrees above pre-industrial averages. The temperature of the earth has already hit 1 degree above pre-industrial levels, which is hotter than the planet has been in over 10,000 years. As there has been very little reduction of emissions since 2015, the temperature is climbing. At the current rate of emissions, we are heading towards 4 degrees by

the end of the century, which is a temperature that many climatologists believe to be incompatible with global civilisation.

The follow-through on the Paris Agreement has been mixed to say the least, as the following graph makes clear.

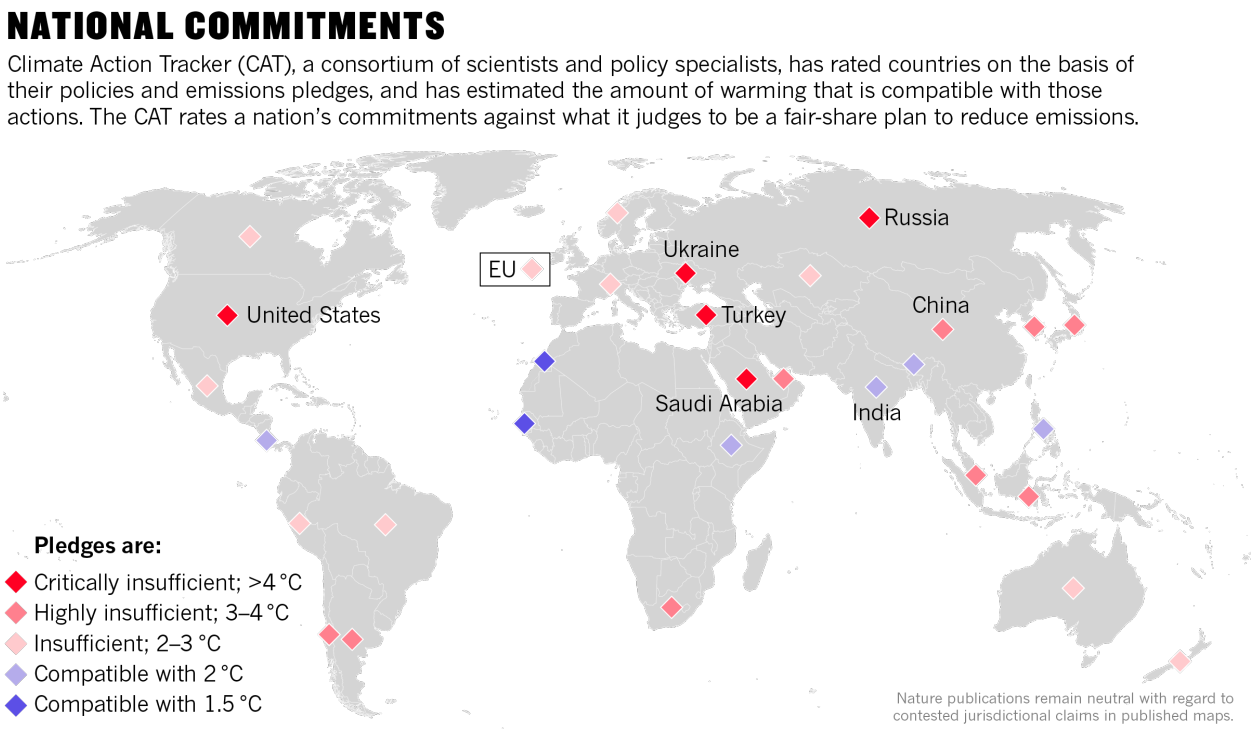


Figure 1: Projected global warming according to national commitments to GHG emissions reductions

Rapidly increasing temperatures, if left unmitigated, will displace billions of humans with unbearable summer heat in the global south and disturbances in the production of agriculture and water supply world-wide. Wildfires, frequent intense storms and flooding, desertified agricultural belts, acidified and deoxygenated oceans, billions of climate change refugees—all of this combined with unforeseeable feedback loops will likely have profound impacts on the international economy and political order.

Given the amount of GHGs already in the atmosphere from a century of industrial activity, some of these changes are now inevitable, leading many climatologists to recommend that, in addition to mitigation, we must think in terms of adaptation, including 'managed retreat' from coastal areas and floodplains - a point of particular importance to residence of Newfoundland and Labrador, many of whom live on the coast. Climatologists believe that the next ten years are decisive, that we are at the tipping point, in a "climate emergency," and while the inaction of the

past four years might be remedied by swift action by governments now, a point will come in the next ten years when it will be too late, and the near future will be forced to bear the burden of our current inaction.

The longer we wait, the quicker emissions need to be cut, and the more drastic the transition to a decarbonised economy will be. If emission cuts had started in 2000, reductions of 3% per year would have been sufficient to keep the increase in global average temperature below 2ºC. Now GHG cuts of more than 10% per year are necessary to achieve the same goal (Figures 2 and 3).

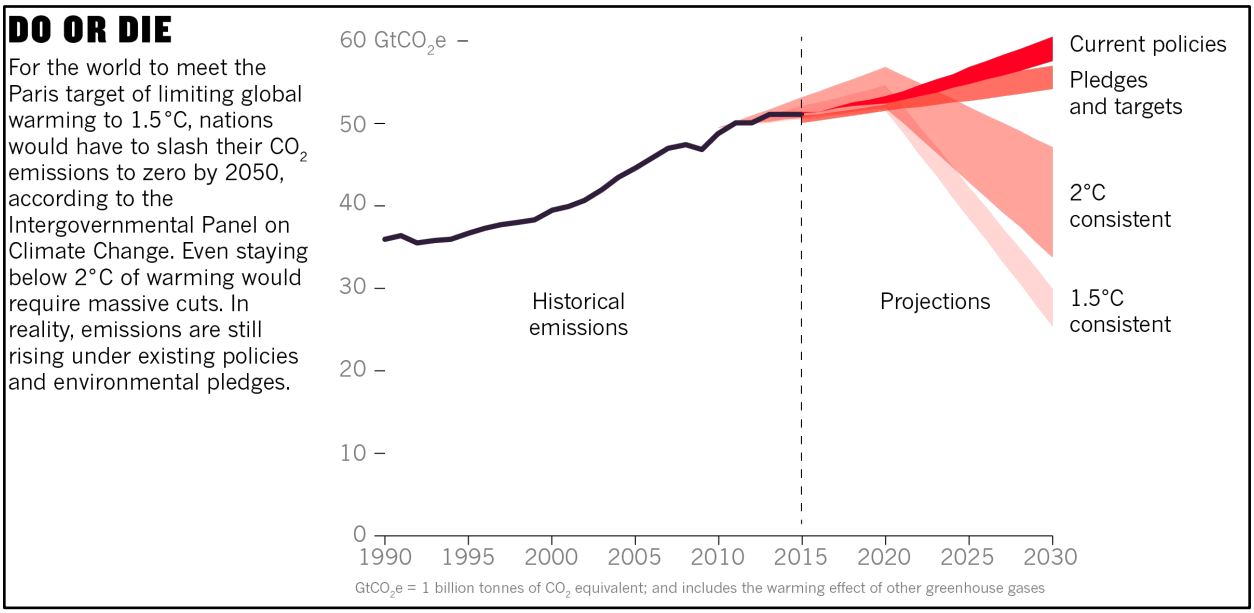


Figure 2: Emissions reductions required to keep global warming to 2 degrees

The question of what such drastic reductions in emissions will mean for Newfoundland and Labrador was at the forefront of this Committee's deliberations. It is important to recognise at the outset that in terms of GHGs produced, not all fossil fuels are equal. Coal, for example, produces almost twice as much GHGs as natural gas. Below is a list in pounds of CO2 emitted per million British thermal units (Btu) of energy for various fuels:

Fuel type	**CO2 emitted**
Coal (anthracite)	228.6 / Btu
Coal (bituminous)	205.7 / Btu
Coal (lignite)	215.4 / Btu

Coal (subbituminous)	214.3 / Btu
Oil converted into diesel fuel and heating oil (emission from the refining process not included)	161.3 / Btu
Gasoline (without ethanol)	157.2 / Btu
Propane	139.0 / Btu
Natural gas	117.0 / Btu

Figure 3: CO2 emissions (in pounds per million British thermal units) according to fuel type

Climate Change Policy in Newfoundland and Labrador

Climate change strategies are not new in Newfoundland and Labrador. The first action undertaken by any provincial government of Newfoundland and Labrador was the 2001 commitment of the Liberal government under Premier Roger Grimes to reduce GHG emissions by 2020 to 10% below 1990 levels. The province was acting as a member of the Conference of New England Governors and Eastern Canadian Premiers (Paddon, 2017: 97-112; Curtis, 2020: 58). The commitment was ratified in 2007 by the Progressive Conservative Government under Premier Danny Williams, and again in 2011 by the Progressive Conservative Government under Premier Kathy Dunderdale. The first comprehensive climate change strategy by any government of Newfoundland and Labrador was the 2005 *Charting our Course: Climate Change Action Plan* of the Progressive Conservative Government, which was followed in 2011 by the *Climate Change Action Plan*, also of the Progressive Conservative Government. In 2016, the Liberal Government passed Bill 34, "An Act to Regulate Greenhouse Gas Emissions from Industrial Facilities in the Province" (Trimper, 2016). In 2019 the Liberal Government of Premier Dwight Ball published its 2019 plan, *The Way Forward on Climate Change in Newfoundland and Labrador* (Government of Newfoundland and Labrador, 2019).

None of these initiatives have come anywhere close to meeting their targets with respect to the reduction of GHG emissions. The first thing that any party should do before it drafts another plan is review these previous plans and ascertain what went wrong with them. Far from decreasing as planned, GHG emissions increased in the province by 8.7% between 2005 and 2016, growing from 9.9 MT CO2e to 10.8 MT CO2e in those nine years (Curtis, 2020, p. 71). Effective climate policy requires not only more coherent policies (e.g. sectoral alignment and coordination), but stronger integration (e.g. local to national; horizontal and vertical), and improved governance processes (e.g. multi-level). The latter requires particular attention to the increasing interdependence between governments and non-government stakeholders.

Although the Newfoundland and Labrador Liberal Government's recent plan, *The Way Forward: On Climate Change in Newfoundland and Labrador*, helped make climate change a more integral part of public discussion in the province, the document is marred by a glaring inconsistency. Government is aiming—by 2030—to reduce provincial greenhouse gas emissions to 30% below its 2005 emissions level. However, the Liberal party has not indicated—in this document or elsewhere—how a 30% reduction by 2030 is compatible with doubling offshore oil production, which the provincial and federal governments announced in the February 2018 *Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry* (Government of Newfoundland and Labrador, 2018). Environmental activist, Nick Mercer summarised the conundrum in *The Independent* on the 5th of March, 2019:

> In 2016, the production of 77 million barrels of offshore crude oil was responsible for 1.6MT of GHG emissions. Assuming the province's stated goal of increasing offshore oil production to 237 million barrels annually, we can extrapolate our numbers to suggest emissions from the sector will account for a staggering 4.9MT annually by 2030. The province's new annual emissions target for 2030 is 6.9MT, meaning offshore oil production alone will account for 71 per cent of provincial emissions, assuming targets are met. We cannot have meaningful climate action in Newfoundland and Labrador without curtailing the production of oil and gas (Mercer, 2019).

Mercer's point is that if oil and gas development expands to the degree anticipated, and with no significant change in the level of GHGs emitted in oil production currently in the province, Government would only be able to keep its ambitious emissions commitment by reducing emissions in all other sectors, construction, transportation, agriculture, to less one third of total reductions. In 2016 about 25% of NLs emissions were due to the oil industry, 75% due to all other sectors. Mercer assumes that a greening of the NL infrastructure on this scale is unreasonable, and indeed no plans are in place for this level of transformation. Mention should also be made of Newfoundland and Labrador's global climate responsibilities. McGlade and Ekins reported in 2015 that to stay below an increase in global warming by 2ºC, 85% of Canadian oil reserves must stay in the ground (McGlade, 2015). Almost all environmental groups agree that the continued, unqualified dependence of Canada on fossil fuels is unsustainable in light of the inevitable end of the oil age before the middle of this century. Nevertheless, the current economic crisis in the province, which is the result of a perfect storm of a ballooning debt caused by overspending on the Muskrat Falls Hydro-electric project, a dwindling fishery, and a tourism industry on pause for the foreseeable future due to the coronavirus pandemic, necessitates that the oil industry remains essential to our economy in the days ahead. We will need the revenue generated by the production and sale of offshore oil, not

only to balance our budget, but also to finance the gradual transition to a carbon-neutral economy within the next three decades.

In short, the province has a long way to go to helping Canada meet its commitments to the Paris Agreement. In terms of its energy efficiency scorecard from Efficiency Canada, Newfoundland and Labrador came last behind all of the provinces. "Newfoundland and Labrador received the lowest number of points. The province lacks policies to advance vehicle electrification, non-electric fuel savings programs, building energy codes, and industrial energy efficiency. Yet, the low rank signals that there is substantial opportunity to improve efficiency, across all fuels and sectors … As the province grapples with cost overruns from the Muskrat Falls project, a strategy to promote the electrification of buildings and transport, while cutting bills for those most in need is more important than ever" (Canada Energy Efficiency Policy Scorecard, Newfoundland and Labrador, 2020).

It is clearly time for a new, more realistic climate change action plan for the province, one which will stand out from previous plans in its inclusion of measurable and actionable goals, annual reporting and public monitoring. Any such plan must factor in the province's off-shore oil dependence in the present and near future. Rather than avoiding this issue, or pretending that there is no tension between reducing GHG emissions and oil development, the Committee advises any government seeking to implement a new climate change policy to be up-front about this tension, to factor it into all data analysis, and to be creative about dealing with it. For example, instead of simply cheering on the companies investing in our offshore, Government needs to explain to the public how this industry is necessity for the near future, but has a foreseeable end. Further, a specified and significant portion of oil revenue (the Committee recommends 20%) needs to be set aside and earmarked for developing the green economy, through electrification, stimulating innovation, subsidising wind and solar energy developments, and promoting local agriculture. In other words, progressive actions in Newfoundland and Labrador to help mitigate climate change will have to include a planned reduction in oil and gas production, but in the interim, oil revenue can and must be used to finance such actions.

Newfoundland and Labrador's response to climate change must be evidence-based and influenced by the best knowledge available. Climate change is a global issue and various collaborative approaches and policy responses are being debated that will ultimately influence actions taken in Newfoundland and Labrador. For example, as jurisdictions around the world work to reduce GHGs, various policy responses have evolved such as clean fuel standards, carbon taxation, and emissions trading ('cap-and-trade'). Responding to climate change in Newfoundland and Labrador may involve multiple options. Future policies and programs must

be complemented by meaningful actions on the part of individuals, communities and businesses throughout Newfoundland and Labrador.

Responding to climate change involves two approaches: reducing and stabilising the levels of heat-trapping GHGs in the atmosphere ("mitigation") and adapting to the climate change already occurring ("adaptation"). Essentially, mitigation involves reducing the flow of GHGs into the atmosphere, either by reducing the source of gases or enhancing the 'sinks' that store these gases (such as the forests, oceans, and soils). Mitigation aims at preventing or otherwise reducing significant human interference in natural systems allowing for ecosystems to adapt naturally to climate change. The goal of adaptation is to find means to adjust to actual or expected future climate. That is, adaptation focuses on reducing vulnerability to the harmful effects of climate change (e.g. sea-level rise). It is noteworthy that the faster the climate changes, the harder it will be to adapt.

In this report the Committee offers specific recommendations for both mitigation and adaptation, but because no single solution fits all future challenges, we encourage flexible approaches which promote reversible and incremental steps, approaches which favour ongoing learning and capacity to adjust as conditions change.

Climate Change in and Around the North Atlantic

Due to its unique location in the northwest Atlantic, with the adjacent merging of Arctic and southern Gulf stream oceanic currents, the effects of climate change on the island portion of Newfoundland and Labrador are expected to be complex. In much of Labrador with a more continental climate, patterns of climate effects may have a different trajectory. As such, the interactions of continental weather patterns from the west and maritime influences from the east will complicate climate change predictions. The Committee has adopted the 'Precautionary Principle' in an effort to reduce risk of errors in assumptions and projections by erring on the side of caution.

It is clear that a warming ocean will affect the patterns of fish migration, with cod stocks, for example, moving from the Grand Banks to subarctic waters around Labrador (DFO, 2019). There is evidence to suggest that the recent decrease in shellfish stocks in our part of the North Atlantic is due to a warming ocean. It is not only warming waters that threaten the fishery, however. Climate change leads to increased ocean acidification which has detrimental effects on marine life, from tiny plankton to larger species like the northern cod (McGrath and Ramm, 2019). Atmospheric CO2 (one of the major GHGs allegedly responsible for current global

warming) is absorbed by the sea, causing increased acidity. Additionally, these alterations will affect the ocean's capacity to sequester and store CO2, thus changing the global carbon cycle.

Climate change also leads to a reduction in the amount of oxygen the ocean can hold (deoxygenation). Deoxygenation affects marine ecosystems, particularly invertebrates such as crabs and plankton, which make up the basis of Atlantic marine food webs (Richardson, 2004). In general, climate change causes the "maximum sustainable yield" (MSY) of fisheries—or the amount of fish that can be caught before it harms the integrity of the stock—to decrease. A 2019 study published in *Science* examined the impact of warming on 235 fish populations from 1930 to 2010. Temperature-dependent models reveal that the MSY has decreased by 4% on average, with some fisheries losing as much as 35% (Free, 2019).

Large parts of Canada are warming twice as fast as the rest of the planet, mostly in the North (including Labrador), and weather patterns in Canada are changing dramatically. Water expansion and the melting of arctic glaciers are causing the sea level to rise. In our province sea level is rising by up to 3 mm per year on the island with a potential rise of between 0.8 m and 1.0 m by the end of the century (Batterson and Liverman, 2006). Global warming is not uniform; 2ºC is an average. The UN Environment Program reported in a press release on the 13th of March 2019 that, "Even if the world were to cut emissions in line with the existing Paris Agreement commitments," which we are not on track to do, "winter temperatures over the Arctic Ocean would rise 3-5ºC by 2050" (cited in McGrath and Ramm, 2019, p. 21) By the end of the century temperatures will increase by at least 7ºC in the North (with some estimates ranging as high as 10ºC). This means that Canada, with its vast northern territories, will experience massive environmental alterations due to global warming. Indeed, it already has. The tundra is melting and thawing permafrost will trigger the release of even more greenhouse gases, particularly methane, but also releasing methyl mercury into the food chain, causing additional warming and harm. Species like seal, polar bear and walrus, which rely on ice cover, are being forced to adapt to unprecedented conditions and face decimated numbers in some areas.

The following figure shows how all levels of marine life in the North Atlantic, from phytoplankton to the northern cod, are currently being impacted by habitat loss and shifts in population distribution (Figure 2).

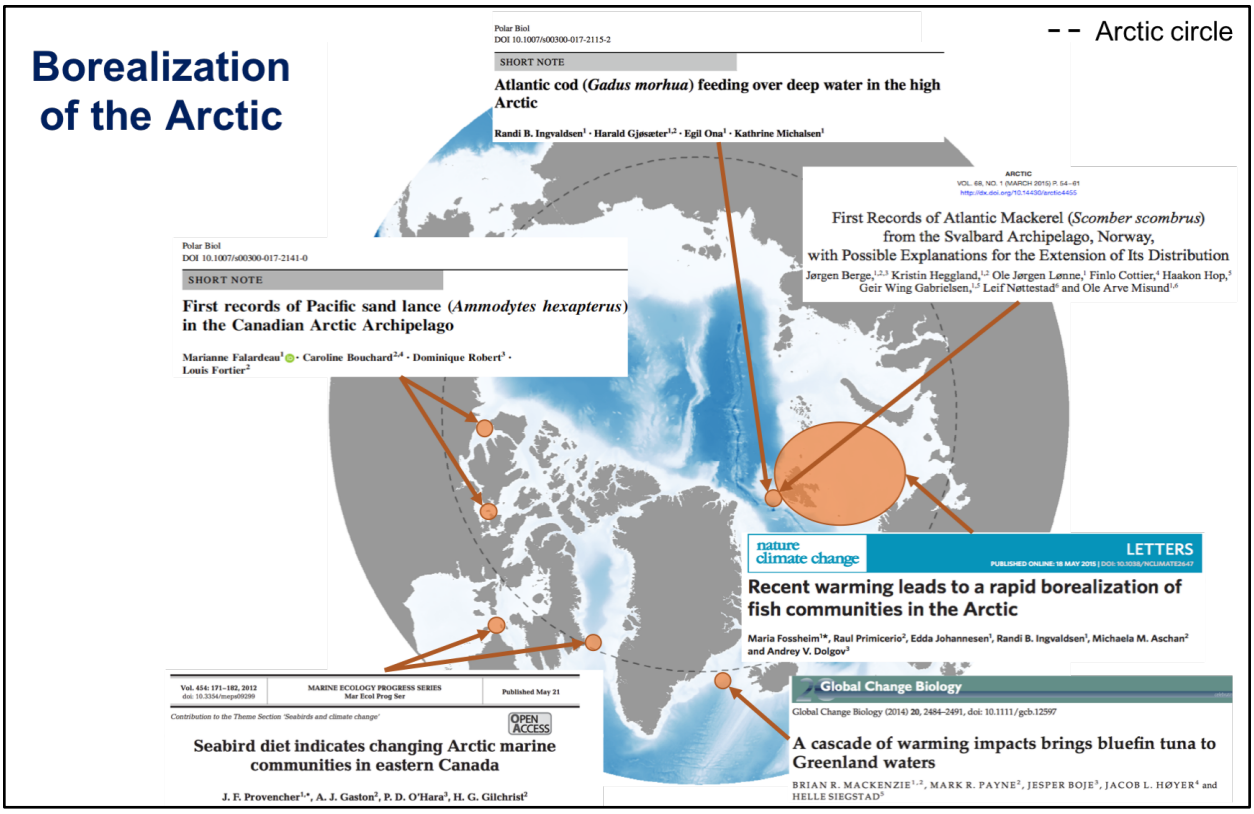


Figure 4: Distributional shifts of temperate species towards arctic waters (McGrath and Ramm, 2019)

Climate change has a particularly noticeable impact on northern communities who rely on marine ecosystems. A recently published white paper, sponsored by Memorial University, the Royal Society of Canada, and Newfoundland and Labrador ENGO, For a New Earth, "The Future of Oceans," states:

> The Northern peoples of Canada, including the Innu and the Inuit of Eastern-Québec and Labrador, are seeing dramatic changes in their ways of life; more than any demographic group, they are dependent on predictable environmental characteristics and weather patterns. In recent years Arctic peoples are facing unstable land and sea-ice conditions as well as increased economic and food insecurity. By 2050, four million people, and around 70% of today's Arctic infrastructure, will be threatened by thawing permafrost. Some northern communities have already declared a 'climate change state of emergency' .... Yet, as we mobilise mitigation and adaptation actions in resistance to our modern climate crisis, it is important to keep in mind that we are not the first in the history of this land to do so. There is a 9000-year history of human occupation within the present boundaries of Newfoundland and Labrador, and this history is marked by periods of adaptation, transformation and migration, correlating with environmental and climatic changes in the

> past. The Innu, Inuit and Mi'kmaq are our connections to this past, and if we are to be successful, they must be involved in all discussions and decisions related to mitigation and adaptation in the present and future (McGrath and Ramm, 2019, p. 32).

Summary of Committee's Main Recommendations

The Committee has a set of four major recommendations (with 30 sub-recommendations) for any government of Newfoundland and Labrador endeavouring to produce responsible and realistic climate change policy for the province. The recommendations are summarised below, and discussed in detail in the rest of this report. As a general principle to guide the crafting of climate change policy in Newfoundland and Labrador, the Committee recommends that Newfoundland and Labrador's action on climate change be regarded as a part of an international response to the problem, one that takes into account Newfoundland and Labrador's unique geography, demography, and its particular socio-economic situation within the federation. Furthermore, the Committee urges policy makers to craft a strategy that is realistic, "actionable," and not a string of false promises and unsustainable commitments.

The main recommendations are as follows:

1: Reduce emissions in Newfoundland and Labrador (with targets established by sector);

2: Implement policies that will facilitate the transition to renewable energy in Newfoundland and Labrador;

3: Plan land and ocean use in Newfoundland and Labrador with a view to mitigating and adapting to climate change;

4: Set a climate change monitoring strategy in motion with sensitivity to regional and economic differences and inequalities in the province, with public, annual reporting.

The sub-recommendations are as follows:

Under main recommendation 1 (reduce emissions):

(1.1) The Committee recommends that emissions reporting and reduction be universalised to include all companies, regardless of their size;
(1.2) The Committee recommends that Newfoundland and Labrador oil be produced by the least carbon-intensive means possible and branded as "*the cleanest oil in Canada*";
(1.3) The Committee recommends that the Newfoundland and Labrador oil industry be conceived and directed as a transitional industry, one that is necessary in the immediate future, but which Government is committed to eventually transforming into a sustainable energy sector;

(1.4) The Committee recommends that Government develop and implement a liquid biofuels strategy which identifies the most promising pathways for local biofuels production and opportunities to grow the local market;
(1.5) The Committee recommends increasing support for research addressing the efficiency of marine transportation with a view to reducing GHGs in that sector;
(1.6) The Committee recommends that Government work with public and private partners to install an electric vehicle (EV) charging infrastructure strategically throughout the province with an eye to widespread adoption of EVs;
(1.7) The Committee recommends that Government provide support to businesses, institutions, municipalities, and other organisations who wish to install EV charging stations on their properties;
(1.8) The Committee recommends that Government work with vehicle retailers to ensure that appropriate maintenance expertise exists within the province for EVs;
(1.9) The Committee recommends that vehicle registration charges be set in proportion to a vehicle's rated fuel consumption;
(1.10) The Committee recommends that Government support the transition of public and commercial fleets to EV technology, including assistance for organisations interested in electrification;
(1.11) The Committee recommends that Government investigate successful models of public transportation in rural areas and assess their transferability to regions in the province, and dedicate a significant portion of public funds towards developing this sector.
(1.12) The Committee recommend that the Progressive Conservative Party of Newfoundland and Labrador establish an independent committee to examine the science and practice of carbon taxation, to weigh the pros and cons of applying various forms of carbon tax in this province, and make a judgment on the issue based on informed, non-partisan scientific research on the complex economics of the mechanism;
(1.13) The Committee recommends that Newfoundland and Labrador devise a carbon tax that is in keeping with what other provinces are doing while taking into consideration the particular economic circumstances of various populations of the province;
(1.14) The Committee recommends that the return of the carbon tax to consumers be weighted according to their earnings and other circumstances affecting their capacity to transition to a less carbon-intensive lifestyle (such as geographical location);
(1.15) The Committee recommends that carbon taxation be understood to be one of a range of political economic tools for bringing about the decarbonisation of the province, one that is particularly necessary for incentivising changed patterns of consumption, but which on its own is not sufficient to achieve net zero.

Under main recommendation 2 (facilitate the transition):

(2.1) The Committee recommends that Government dedicate a significant portion of revenue generated from the oil industry (for example, 20%) toward the production of sustainable technologies;
(2.2) The Committee recommends that Government integrate Muskrat Falls energy into a comprehensive climate change strategy for the province**;**
(2.3) The Committee recommends that Government invest in a cross province, all ages, education program to inform the public about the reality of climate change and what it will mean for Newfoundlanders and Labradorians in the near future;

Under main recommendation 3 (strategically plan land and water use):

(3.1) The Committee recommends that Government establish state-of-the-art legislation for integrated, climate sensitive, land-use planning;
(3.2) The Committee recommends that the province quantify carbon sink-source relationships for Newfoundland and Labrador forests and implement ecosystem-based management (EBM) strategies to enhance potential carbon sinks;
(3.3) The Committee recommends making maintenance of peatland ecosystem carbon storage and sequestration a stated objective of land-use planning;
(3.4) The committee recommends that Government conduct a complete overhaul of building practices in Newfoundland and Labrador in order to reduce emissions from that sector and bring it in line with best environmental practices;
(3.5) The Committee recommends the development of domestic, industrial and municipal engineered wetlands for processing waste-water;
(3.6) The Committee recommends that Government actively oversee and support community pasturelands as part of the provinces climate change action plan;
(3.7) The Committee recommends that Government subsidise climate-resilient and reduced-carbon farming practices and actively stimulate the development of agricultural business risk management programs in the province;
(3.8) The Committee recommends that Government take a more proactive approach to the management of the province's moose population and consider introducing a limited culling of the population for local consumption, both as a means of reducing human-moose road collisions, and increasing local food productivity;
(3.9) The Committee recommends that Government examine the potential for mitigating climate change through the improvement of the ability of the surrounding ocean to sequester CO2e, for example, through enhancing the productivity of plankton;
(3.10) The Committee recommends the development of Environmental Flow Releases (EFR) for all large-scale hydroelectric projects in its jurisdiction;

(3.11) The Committee recommends that Government actively promote and support all public and private enterprises seeking to diversify the fishery in the province and localise processing.

Under main recommendation 4 (monitoring):

(4.1) The Committee recommends that Government establish a committee for monitoring and annually reporting on progress on emissions reduction and climate change action in the province.

1. Reducing Emissions

Approximately half of the province's GHGs come from the energy-intensive sector, which includes offshore oil and gas, mining, newsprint, oil refining and electricity generation. According to the Canada Energy Regulator (CER) Newfoundland and Labrador's GHG emissions in 2016 were 10.8 megatonnes (MT) of carbon dioxide equivalent (CO2e). Thus, *Newfoundland and Labrador's emissions have increased 16% since 1990. The province's emissions per capita are 20.3 tonnes CO2e per capita, – 4% above the Canadian average of 19.4 tonnes per capita.*

GHG emissions from the oil and gas sector in 2016 totalled 2.7 MT CO2e., composed of 1.6 MT from offshore oil production and 1.1 MT from petroleum refining. In 2016, Newfoundland and Labrador's power sector emitted 1.5 MT CO2e emissions, which represents about 2% of Canada's GHG emissions from power generation.

Proportionally, the largest emitting sectors in the province are transportation at 36% of emissions, oil and gas production at 25%, and electricity generation at 14%. Soon, the province will produce most of its electricity from hydro sources. Based on the 2016 Conference Board of Canada environmental report card receives an "A" grade on low-emitting electricity production, ranking above all international peers except Norway. It also scores reasonably well on SOx emissions, with a "B" grade. However, compared with national and international peers, the province ranks poorly. Newfoundland and Labrador gets "C" grades for GHG emissions and waste generation and a "D" grade on water withdrawals. Moreover, the province scores "D–" grades on three of the four air pollution indicators: NOx, VOC, and PM10 emissions. REF The industrial emissions data for the province (https://www.exec.gov.nl.ca/exec/occ/greenhouse-gas-data/Provincial_GHG_Data_2016-2018-Newfoundland and Labrador_Industrial_Facilities.pdf.)

Until Muskrat Falls goes online, most of the electricity in the province will continue to be generated by the Holyrood Thermal Generating Station, which burns No. 6 heavy fuel oil at the

rate of approximately 6,000 barrels (950 m^3) per day, per unit at full load. In an average year it puts out pollution equivalent to 300,000 cars on the road.

While the Muskrat Fall project has been beset by problems and overspending, and while the adverse environmental impacts of large dams must not be underestimated, it is clear that with the transition from oil burning power generation to hydroelectric in the near future, Newfoundland and Labrador will significantly reduce its emissions. Considering the great environmental, economic, and political cost of Muskrat Falls, this feature of the unpopular project should be highlighted in future discussions concerning Newfoundland and Labrador's contribution to Canada's climate change strategy.

Industrial Emissions

The Committee approached the Newfoundland Environmental Industry Association (NEIA) in the spring of 2020 with a set of questions concerning industrial emissions reductions in Newfoundland and Labrador. Specifically we asked: Have companies represented by NEIA been tasked with reducing GHG emissions as part of Canada's compliance with the Paris Agreement? If so, are there goals and how are they being measured? The Committee learned that according to provincial legislation only those business operations over a certain threshold are required to report their GHG emissions, and only those over an even higher threshold are required to reduce (or offset). This category includes the major mines, offshore oil and gas facilities, and the oil refinery. (https://www.assembly.nl.ca/Legislation/sr/statutes/m01-001.htm.). The Committee was surprised to hear that a small percentage of companies operating in the province are in fact tasked with reduction. The Committee recommends (1.1) that emissions reporting and reduction be universalised to include all companies, regardless of their size. Those smaller companies which cannot afford to reduce emissions should be able to apply for a subsidy from Government to do so. No one should be exempt from the need for the province to reduce emissions.

Oil Production

The production of oil at this time in the history of the world is an ethically ambiguous undertaking. Given the strained economic circumstances of the province, particularly in the midst of a global pandemic that has all but suspended Newfoundland and Labrador's crucial tourism industry, the Committee believes that it is not reasonable to expect the province to halt production of oil in the coming years, or to cease exploration. But the Committee strongly recommends that all future oil production be carried out with the assumption that this is *a transitional industry*, and that a post-oil Newfoundland and Labrador is imminent and desirable. Furthermore, the Committee understands by emissions reduction more than merely curbing Newfoundland and Labrador's pollution: any government committed to combating climate

change will do this much while also encouraging a general trend towards decarbonisation worldwide. In other words it will not do for Newfoundland and Labrador to offer the 'cleanest' oil to the world while encouraging the burning of fossil fuels. Newfoundland and Labrador is in the same paradoxical position as Canada and other oil producing signatories of the Paris Agreement in this regard: it needs to produce oil for the sake of ending the production and consumption of oil. The economic gains of ongoing oil production need to be balanced by an honest recognition of the environmental cost of continuing to produce and consume oil. It is not adequate to commit to continuing to produce oil as long as the world continues to demand it. Newfoundland and Labrador should join the worldwide move toward a decarbonised future, as was recently argued at a highly publicised conference at Memorial University, "Decarbonize NL". We cannot exempt Newfoundland and Labrador from its global responsibility to future generations. Granted we are a small factor in the anthropogenic causes of global warming, but when it comes to principles that should govern environmental policy, size does not count. We will have a sustainable future for our children only when environmental responsibility is universally assumed.

The Committee has two main sub-recommendations in this regard:

(1.2) Newfoundland and Labrador oil should be produced by the least carbon-intensive means possible and to brand it without exaggeration or dissimulation as "*the cleanest oil in Canada*". This will allow Newfoundland and Labrador to market its oil in good conscience as a better alternative to Saudi oil or Albertan oil, which is produced using one of the most polluting, carbon-intensive processes, and at huge expense to the land and water of that province.

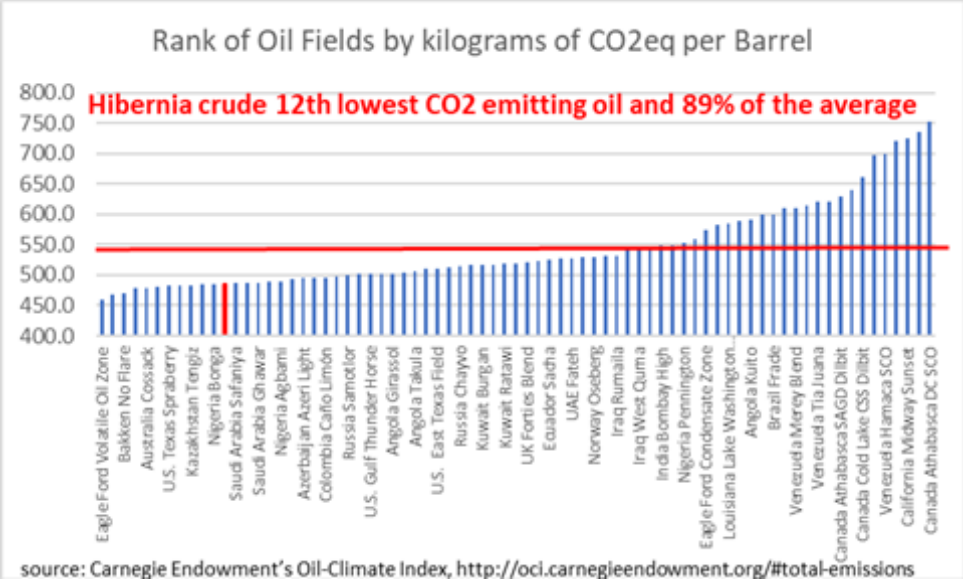
(1.3) Newfoundland and Labrador oil should be explicitly recognised, conceived and directed as a transitional industry, one that is necessary in the immediate future, but which Newfoundland and Labrador is committed to eventually transforming into an alternative energy sector. To repeat a point that bears repeating: Government needs to develop the offshore, since there are few other economic alternatives for Newfoundland and Labrador, struggling at the moment under a crippling debt from the Muskrat Falls project, and a ballooning deficit, *while* forecasting and actively working towards a decarbonised Newfoundland and Labrador, and a decarbonised global economy.

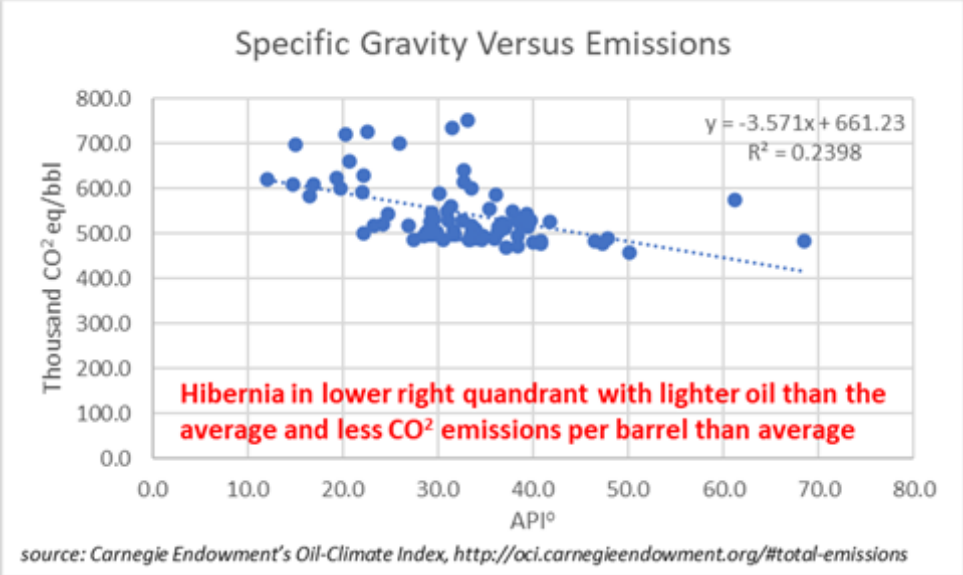
To produce the cleanest oil in Canada Newfoundland and Labrador needs to commit to producing oil with the lowest possible carbon footprint. It could follow the example of Norway in this regard.

> The companies operating on the Norwegian shelf are world leaders in the use of solutions to reduce and prevent greenhouse gas emissions. Emissions per unit of oil and gas produced are therefore lower compared to similar operations in other petroleum-producing countries. Energy efficiency measures, including the introduction of energy management systems and the installation of more energy-efficient equipment such as compressors and pumps, have helped to reduce emissions from petroleum activities. Combined-cycle gas turbines (CCGT) are one technological solution, in which waste heat from the turbines is used to produce steam, which in turn is used to generate electricity. CCGT plants improve energy efficiency and reduce emissions. (Norwegian Petroleum, 2020).

It should be noted that NL Oil is already a contender for the cleanest oil in Canada, according to Economist Wade Locke (in a private communication with the Committee):

> In 2013, NRCAN noted that 70 to 80% of emissions come from the tailpipe of vehicles and reported life-cycle estimates for Canadian light crude in the 500 kg per barrel. In a presentation to Memorial University, Mr. Keating of NALCOR noted that offshore east coast was 12 kg CO2 eq/barrel and the world average was 18 kg CO2 eq/barrel. While not a life-cycle estimate, the NACOR estimate indicates that NL crude emissions are 2/3 of the average. The Carnegie Endowment's Oil-Climate Index estimates that Hibernia crude has life cycle emissions of 486 kg CO2 eq/bbl which was 89% of the average for 75 fields analyzed (see table below). As the diagrams and tables below illustrate, NL oil (at least the oil which is similar to Hibernia) is one of the lowest CO2-emitting crude in the world.





Oil producer	kgCO2eq/bbl emissions	Hibernia Emission as Percent
Eagle Ford Volatile Oil Zone	458.5	106.2%
Wyoming WC	468.6	103.9%
Bakken No Flare	470.8	103.4%
Eagle Ford Black Oil Zone	477.9	101.9%
Australia Cossack	478.3	101.8%
YAE Murban	481.3	101.1%
U.S. Texas Spraberry	482.3	100.9%

Algeria Hassi R'Mel	483.1	100.8%
Kazakhstan Tengiz	483.4	100.7%
Mexico Chuc	485.0	100.4%
Nigeria Bonga	485.3	100.3%
Canada Hibernia	485.7	100.2%
Saudi Arabia Safaniya	486.8	100.0%
Norway Skarv	486.9	100.0%
Saudi Arabia Ghawar	487.0	100.0%
U.S. Texas Yates	488.4	99.7%
Nigeria Agbami	490.1	99.3%
Saudi Arabia Zuluf	494.4	98.5%
Azerbaijan Azeri Light	495.4	98.3%
Norway Ekofisk	495.6	98.2%
Colombia Caño Limón	496.4	98.1%
Russia Romashkinskoye	497.9	97.8%
Russia Samotlor	499.2	97.5%
Mexico Cantarell	501.2	97.1%
U.S. Gulf Thunder Horse	501.6	97.0%
Colombia Cusiana	501.9	97.0%
Angola Girassol	502.1	97.0%
U.S. Gulf Mars	503.2	96.7%
Angola Takula	506.8	96.1%
Indonesia Minas	509.4	95.6%
U.S. East Texas Field	510.2	95.4%
China Nanhai Light	513.2	94.9%
Russia Chayvo	514.9	94.5%
Iran Aboozar	515.9	94.4%
Kuwait Burgan	517.1	94.1%
Denmark Dansk Blend	517.1	94.1%
Kuwait Ratawi	519.3	93.7%
U.S. Wyoming Salt Creek	519.6	93.7%
UK Forties Blend	520.0	93.6%
Libya Waha	523.6	93.0%
Ecuador Sacha	526.1	92.5%
Qatar Dukhan	527.3	92.3%

United Arab Emirates Fateh	527.7	92.3%
Qatar Bul Hanine	528.9	92.0%
Norway Oseberg	529.6	91.9%
U.S. Bakken Flare	531.4	91.6%
Iraq Rumaila	532.1	91.5%
Iraq Kirkuk	542.2	89.8%
Iraq West Qurna	544.0	89.5%
Brazil Lula	545.0	89.3%
India Bombay High	548.7	88.7%
Iran Marun	548.8	88.7%
Nigeria Pennington	553.5	87.9%
U.S. Alaska North Slope	558.9	87.1%
U.S. Texas Eagle Ford Condensate Zone	574.7	84.7%
China Qinhuangdao	582.6	83.6%
U.S. Louisiana Lake Washington Field	584.4	83.3%
Iraq Zubair	588.9	82.7%
Angola Kuito	590.4	82.5%
Nigeria Escravos Beach	599.0	81.3%
Brazil Frade	599.3	81.2%
China Bozhong	609.6	79.9%
Venezuela Merey Blend	609.9	79.8%
Nigeria Bonny	614.7	79.2%
Venezuela Tia Juana	620.0	78.5%
U.S. California Wilmington	621.7	78.3%
Canada Athabasca SAGD Dilbit	629.7	77.3%
Nigeria Obagi	640.9	76.0%
Canada Cold Lake CSS Dilbit	661.3	73.6%
U.S. California South Belridge	696.6	69.9%
Venezuela Hamaca SCO	699.8	69.6%
Indonesia Duri	721.1	67.5%
U.S. California Midway Sunset	724.4	67.2%
Canada Athabasca FC-HC SCO	734.9	66.2%
Canada Athabasca DC SCO	752.0	64.7%

Figure Five: Hibernia emissions compared with other oil producers (Wade Locke, MUN)

The Committee has learned that cleaning up Newfoundland and Labrador's oil production is a major focus for NEIA at the moment. "There are all sorts of opportunities for innovation and growth in the development and application of cleantech related to this industry" (Kieren Hanley, Executive Director, NEIA, personal communication to the Committee, 2020). NEIA describes this approach as "pursuing the adjacent possible": generating new activity within an industry from a different angle such as applying environmental considerations to the production of oil and gas. NEAI describes this as "a highly effective approach to diversification" and believes that "it is more likely that these strategies will succeed versus attempting to diversify by starting from scratch in a whole new industry/sector" (Hanley, 2020). Cleaning up our oil production is not only good for the environment, it is also good business. "It is clear as the world moves towards a lower carbon economy that there will be an increasing demand for a greener barrel of oil. In an age where energy is cheap, you can either compete by cost or by quality. We are not a low-cost producer, and will never be. So we need to compete on quality. What does quality oil look like in the 21st century? GHG intensity per barrel will be an important differentiator. If we don't pursue oil and gas development through the lens of sustainability, we simply won't be able to compete." (Hanley, 2020)

Transportation

'Transportation' accounts for 34% of Newfoundland and Labrador's GHGs and, aside from large industry, is the biggest source of emissions in our province. Transportation emissions arise from the movement of goods, services, and people from one location in the province to another. 59% of transportation emissions arise from cars and busses on-road.

Eighteen percent of GHG emissions due to transportation are emitted from freight on-road, much of which is from carbon- intensive diesel engines. In addition, 9% of transportation GHGs emanate from off-road diesel activities. There may be opportunities to reduce the emissions resulting from diesel use with the introduction of locally produced biofuels to the local market.

Thus the Committee recommends (1.4) that Newfoundland and Labrador should develop and implement a liquid biofuels strategy which identifies the most promising pathways for local biofuels production and opportunities to grow the local market (as per the 2011 Report "An Analysis of the Economic Development Opportunities Associated with the Green Economy in Newfoundland & Labrador" [Globe Advisors, 2011]). Any bio-fuels program must ensure that combustion of its products results in a net reduction in GHGs compared with fossil fuels. Six percent of transportation GHGs can be attributed to domestic marine activities. While this represents a small portion of the province's overall GHGs, solutions developed in this area can

be exported to other marine centres worldwide. The Committee recommends (1.5) increasing support for research addressing the efficiency of marine transportation.

Electrification

Electrification of private and transportation, as well as industrial and commercial transportation, must be a key to any climate change action plan for Newfoundland and Labrador, especially given the overabundance of hydroelectric energy generated by Muskrat Falls. From a financial perspective, EVs are a proven technology which provide value through fuel savings and lower maintenance costs. In the context of Newfoundland and Labrador's 98% renewable energy framework, each single adoption of an EV (1) reduces per unit emissions to near zero, and (2) adds new demand for electricity from the utilities. Rapid advances in technology and adoption will continue to drive down costs, making EVs even more economical. Electric trucks and busses are also beginning to enter the market, and electric aircraft are in development. To prepare for an increased adoption of EVs, the province must support the implementation of EV infrastructure.

Without intervention, a problematic cycle exists: the lack of infrastructure deters car buyers from deciding for electric, while the lack of EVs on roads stifles demand for infrastructure.
The province can influence the demand of EVs, and the rate of adoption, through a variety of incentives, for example rebates or tax advantages to those who purchase EVs, and disincentives, such as higher registration fees for non EVs. One EV can equate to approximately 5 tonnes of GHG reductions per year (plus an increased consumption of electricity).

The Committee recommends (1.6) that Government of Newfoundland and Labrador work with public and private partners to install EV charging infrastructure strategically throughout the province with an eye to widespread adoption.

The Committee recommends (1.7) that Government provide support to businesses, institutions, municipalities, and other organisations who wish to install EV charging stations on their properties.

The Committee recommends (1.8) that Government work with vehicle retailers to ensure appropriate maintenance expertise exists within province for EVs.

The Committee recommends (1.9) that Vehicle registration charges be set in proportion to a vehicle's rated fuel consumption. Consumers making environmentally sound choices will be rewarded, while consumers choosing vehicles with less efficiency will pay for the cost of producing GHGs.

Clearly an efficiently run and extensive system of public transportation is key to weaning consumers off of dependence on carbon-intensive private automobiles, and no one would describe the province's public transportation in these terms. The Committee recommends (1.10) that Government should support the transition of public and commercial fleets to EV technology, including assistance for organisations interested in electrification. Taxis, civic vehicles, delivery vehicles, etc. spend many hours on the road and their operators could benefit from the decreased costs associated with an EV fleet. With much of the province's population living in the Northeast Avalon region, there is an opportunity to reduce emissions through the implementation of stronger, electric public transportation systems in this region. Provincial leadership is required to move this issue forward. Despite continued public interest, municipalities in the region have been unable to work together on a public transportation strategy. The approach by the service provider in the City of St. John's (Metrobus) of attempting to grow services from the capital city outwards has proven to be unsuccessful. It is a challenge for each individual municipality to view public transportation through a regional lens. As in other Canadian jurisdictions, provincial government leadership is needed to establish and support a regional public transportation service.

Newfoundland and Labrador should provide the leadership and resources required to develop a new regional public transportation system for the Northeast Avalon. It is important to remember that petrol-powered busses will only achieve significant GHG reductions if ridership reaches a critical mass. A new regional public transportation system should be constructed to include express routes, park and rides, and participation incentives to demonstrate clear advantages to this mode of transportation to the public and grow ridership. This system should replace busses as they are retired with electrical counterparts (once economical), with the intent to fully electrify the fleet.

The Committee recommends (1.11) that Government investigate successful models of public transportation in rural areas and assess their transferability to regions in the province, and dedicate a significant portion of public funds towards developing this sector.

Pricing Carbon Fairly and Equitably

A standard tactic for GHG reduction used in many Paris Agreement signatory countries is a tax on carbon.

A carbon tax as commonly conceived is an *ad valorem* tax that takes a specified percentage of the value of the item the quantity consumed of which we wish to see reduced. In this respect the carbon tax is much like a consumption tax. It is progressive in nature and affects the income distribution accordingly. However, unlike a typical consumption tax such as the HST, the tax

proceeds of the carbon tax should not go to the General Revenue, as they currently do in Newfoundland and Labrador, but should be earmarked specifically for financing the transition to the green economy as well as refunding, to varying degrees, consumers.

The idea of the carbon tax is to provide a decentralised and efficient means of reducing GHGs by raising the relative price of carbon (e.g. gasoline) to the consumer. The tax thus creates an incentive at the level of the consumer to substitute away from the good that is now relatively more expensive and into other relatively cheaper goods and services. The extent to which this 'works', that is, the extent to which the carbon tax leads to a meaningful reduction of the carbon footprint depends chiefly on three things. The first is the rate at which the tax is levied. The second factor is the consumer's responsiveness to the higher price and the ability to substitute away from the product in question – the so-called elasticity of demand. The third consideration is consumer buy-in, or the public acceptability of the tax. For the present purpose the buy-in is the key consideration. For a consumer inclined towards the policy objective of carbon reduction, a carbon tax presents a fair and transparent means of allowing consumers to make individual choices about how to respond to the tax. A carbon tax thus works by harnessing incentives to effect behavioural change. It is well-known that economic policies that depend on incentives are likely to be ineffective if the policy objective is unclear. This is not the case with a carbon tax. Studies of consumer behaviour suggest that in a situation such as this, most consumers respond by substituting away from the taxed good (i.e., gasoline) to the extent practicable. The result is that climate policy is advanced through decentralised decision-making by consumers, cost-efficiently as the administrative systems required are already in place.

Alternatives to a carbon tax, such as permits (tradeable or not), and regulations tend to be administratively costly and require additional regulatory infrastructure. Given the size of the Newfoundland and Labrador economy in which a small number of players in each of three principal sectors account for most of the carbon emissions: the offshore sector, transportation, and electricity generation, it is unlikely that the scale economies are present to justify reliance on such approaches. By contrast, a carbon tax needs only relatively minor adjustments to existing tax protocols in order to enable refunds to taxpayers unduly disadvantaged by the tax. As a general proposition, the least-cost solution to a pollution control problem requires that all sources of pollution face the same tax rate. This condition is automatically met by a carbon tax.

The Trudeau government introduced a federal carbon tax in April 2019 and left it up to the provinces to decide whether they would implement it or come up with their own. To date British Columbia has introduced a carbon tax of $30 per metric ton of CO2e, which is applied to 70% of the province's emitters (Metcalf, 2020). The tax has helped cut fuel consumption and carbon

emissions, while the Federal government has lowered personal and corporate income taxes (Oreskes, 2020). The Federal carbon tax is approximately $20 per ton of CO2e, and is currently scheduled to increase $10 a year until it reaches a peak of $50 a ton in 2022. In 2019 the provincial Liberal Government under Premier Dwight Ball introduced a carbon tax for the province of $20 per ton.

In its first year of implementation, the Trudeau carbon tax resulted in an approximate cost increase of 4.42 cents a litre for gasoline, 5.37 cents for light fuel oil (home heating fuel), 3.91 cents per cubic metre for natural gas and 3.10 cents per litre for propane. The CBC News calculated that the average Ontario household pays roughly $10 more a month for natural gas (based on average of 252 m3 of consumption) than it did in 2018. "The cost to fill an empty residential oil tank, which are common in places like rural New Brunswick and vary greatly in size, will increase by about $48 for a 910-litre model. The cost to fully refuel a Honda Civic (based on a 47-litre tank) will increase by about $2, while a full fill-up for a Ford Explorer SUV will cost about $3 more."

A large majority of economists agree that pricing carbon is an effective way to bring about behavioural changes in consumers and producers of fossil fuels (McCarthy, 2018; The Economist, 23 May 2020). It should be noted that although it is a market solution rather than a regulatory move, and ought in principle to find approval from conservatives who want a smaller state and a freer market, carbon taxation has been rejected by several conservative governments across Canada, notably in Ontario, Manitoba, New Brunswick and Saskatchewan. It is opposed in principle by the Federal Conservative party because it is deemed to be damaging to the economy and punitive on consumers and small businesses.

One of the chief conservative grounds for objecting to the Trudeau carbon tax is that it unjustly punishes the consumer and forces him or her to pay for emissions. The objection that a carbon tax on producers stifles the economy has also been made. The Trudeau government has responded to the first critique by insisting that consumers get the tax back when they file their tax returns. This leads to the question, How can a carbon tax incentivise consumer behaviour change if the tax is returned to the consumer at the end of the year? A third critique often levied at proponents of carbon taxation is that a carbon tax is not enough to meet the Paris goal of net zero emissions. In order for it to be adequate to meet the goal it would need to be set so high that it would almost surely stifle the economy.

The Committee cannot in this space respond to these three objections in detail, nor can it elaborate on the technicalities and permutations of carbon taxation, which is now a worldwide

phenomenon, with a wide variety of diverse applications. It's first recommendation to the Progressive Conservative Party of Newfoundland and Labrador in this regard, therefore, is (1.12) to establish an independent committee to examine the science and practice of carbon taxation, to weigh the pros and cons of applying various forms of carbon tax in this province, and make a judgment based on informed, non-partisan scientific research on the complex economics of the mechanism. Any decision made in this province on this crucial issue should be driven by evidence-based analysis, rather than by political slogans and assumptions.

With regard to the three objections, the Committee offers the following. Consumers need to be part of the solutions to climate change. The necessary changes in their patterns of consumption of fossil fuels will either need to be imposed on them by regulators, or emerge from them through their own decision making processes. The Committee prefers the later option, and therefore recommends (1.11) that Newfoundland and Labrador devise a carbon tax that is in keeping with what other provinces are doing while taking into consideration the particular economic circumstances of various populations of the province. With regard to stifling the economy, the Committee believes, along with a vast number of environmental policy makers and economists, that the future of the global economy is not in the development and consumption of fossil fuels but in the advancement of new, green technologies and the development of alternative energies. According to a recent article in *The Economist* green technology and environmental innovation is one of the fastest growing sectors of the global economy (The Economist, 21 May 2020). The quicker Canada becomes an active participant in the green economy, the better the economic outlook for the 21st century will be. The transition will certainly cost, but this Committee believes that any short-term economic pain associated with decarbonisation will be rewarded by long-term gain.

To the point that a carbon tax that comes back to the consumer at the end of the year is no incentive to change behaviour, the Committee recognises that the Trudeau government has been ambiguous on this issue and urges a clearer approach. In particular it recommends (1.13) that the return of the carbon tax to consumers be weighted according to their earnings and other circumstances affecting their capacity to transition to a less carbon-intensive lifestyle (such as geographical location). Lower income earners should get all or most of it back, as should rural consumers who have no other options than to burn gasoline, while higher earners and urban dwellers should be expected to shoulder some burden of the tax in order to incentivise a change in their behaviour. The carbon tax should be distinct from other taxes so that consumers can see how their patterns of fossil fuel consumption are costing them and so make an informed choice on the matter of limiting that consumption or pursuing less carbon-costly alternatives.

With regard to the third objection, the Committee concedes that carbon tax alone is inadequate to solving the emissions problem, and recommends (1.14) that it be understood to be one of a range of political economic tools for bringing about the decarbonisation of the province, one that is particularly necessary for incentivising changed patterns of consumption, but which on its own is not sufficient to achieving net zero. Neither the federal nor the provincial Liberal carbon tax introduced in 2019 goes anywhere near meeting either the 2001/2007/2011 targets of 10% reduction in GHGs in Newfoundland and Labrador, or the more ambitious 2019 target of 30% reduction by 2020. The Provincial Liberal carbon tax would reduce GHG by 1.7 MT between 2019 and 2030, which would mean a reduction of 1.85% (Curtis, 2020, p. 71). If the carbon tax is understood to be one of several tools employed in the province for reaching its emissions reductions goals, there will be no requirement that the rate of tax be relied upon to achieve the control target.

2. Facilitating the Transition to Renewable Energy

Government needs to advise the population of Newfoundland and Labrador that the future of the province is in renewable energy, even if it still remains unclear how that future is to be achieved. In this regard the Committee recommends (2.1) that Government dedicate a significant portion of revenue generated (for example, 20%) from the oil industry toward the production of sustainable technologies, for example, electrification, and to the transition of the province to a post-oil economy. Further, the Committee recommends (2.2) that Government integrate Muskrat Falls energy into a comprehensive climate change strategy for the province.

The Canada Newfoundland and Labrador Offshore Petroleum Board and Nalcor have invested significant time and resources to understanding and promoting to the global industry the prospectivity of large new, unexplored offshore oil and gas basins beneath the continental slopes of Labrador and the island of Newfoundland. This effort is paying off with the largest offshore land sale of exploration leases seen in 2018 (nearly $1.4 bn), even during a time of economic uncertainty and slowly recovering oil prices.

With regard to Recommendation (2.1) the authors of the white paper, “Stewarding the North Atlantic,” write:

> Due to detrimental effects related to climate change and its incompatibility with the Paris Agreement, the scientific verdict is clear: most Canadian oil reserves must stay in the ground to keep the increase in global average temperature below 2ºC. The reality of this climate emergency needs to be recognised, taken seriously, and acted upon. By doubling

> offshore oil production, Newfoundland and Labrador would appear to be exempting itself from the changes and limitations that all economies must impose on themselves to meet the greatest challenge of our age (McGrath and Ramm, 2019, 9).

This conundrum needs to be faced head on by any party crafting a viable climate change policy. We must not capitalise on the good will of other oil producing countries that are curbing production. At the same time, we must acknowledge that the province has become largely dependent on income from oil revenue royalties, and then implement policies to change that fact. The province must press on with oil development and production in the near term in order to accrue much needed royalties to help offset our current dire fiscal situation. Setting aside a significant proportion of revenues to create an endowment fund will help offset the negative impacts of producing more oil in a world that needs to decarbonise while helping to stimulate the growth of a green technology sector.

NEIA is in the midst of a substantive sector growth strategy. They have identified four key thematic areas of opportunity for growth for Newfoundland and Labrador in relation to the green economy: environmental monitoring, electrification and renewable energy, waste management, and operational efficiency. Environmental monitoring refers to products and processes that help us understand the environment, our impact upon it, and its impact on us and our economy. Newfoundland and Labrador has leading edge companies doing this kind of work through the use of lasers, radar, satellite, lidar, sonar, human senses, etc. who are selling across the world in a wide variety of different industries, and these initiatives are supported by significant capacity and expertise within our academic institutions. NEIA has recommended to this Committee that Newfoundland and Labrador needs to better communicate its expertise in this regard, particularly in and around ocean studies and development, and so attract investment and build the Newfoundland and Labrador brand. NEIA also suggests that regulatory frameworks can be implemented to demand further innovation in this area. In general, NEIA maintains that any emissions reduction policy should be complemented by a plan to stimulate the development of a green technologies industry, which can export products and services that will reduce GHGs elsewhere. NEIA is particularly interested in potential green power from Muskrat Falls, for example, electrolytic production of hydrogen as a green fuel export**.** This prospect speaks to (2.2), the recommended integration of Muskrat Falls energy into a comprehensive climate change strategy for the province**.** Due to the Muskrat Falls Hydroelectric project, Newfoundland and Labrador now has an abundance of renewable energy. The key challenge of selling this energy can be addressed through such innovative uses of the power in the green economy.

The future of renewables in the Province, and the use of Muskrat Falls energy to help Newfoundland and Labrador meet its climate change commitments, require a broadly eco-literate population. In the interest of facilitating the transition to a green economy, the Committee recommends (2.3) that Government invest in a cross province, all ages, education program to inform the public about the reality of climate change and what it will mean for Newfoundlanders and Labradorians in the near future. It is crucial that all age groups become more aware of the complex connections that exist between our behaviour, history, fishery, oil production and climate change. Aboriginal elders, who have much to teach us about surviving climatic shifts and living sustainably should be front and center of a provincial eco-literacy program. We need their experience and wisdom. Statistics show that millennials are highly engaged with the issue of climate change and are more aware of environmental challenges than previous generations. Consequently, they require a school curriculum that addresses these concerns and better informs them on the politics and science of climate change. Younger learners need to be taught the linguistic and technical skills to be able to understand the complexities of climate change. Changes to the school curriculum should be accompanied by a provincially-funded, public awareness campaign about the facts of climate change, its relation to fossil fuel production, and its effects on ecosystems.

3. Climate Sensitive Stewardship and Development of Land and Water

Since the pre-industrial period, land surface air temperature has risen nearly twice as much as the global average temperature. Climate change is predicted to bring weather that is warmer, wetter and stormier in some cases, and possibly colder in other cases. These extremes will exacerbate land degradation and adversely impact infrastructure, ecosystem function, and food security. Coastal areas are of particular concern because of erosion and flooding due to projected sea level rise. The province of Newfoundland and Labrador lacks any effective integrated land-use planning process, and is sadly trailing far behind many provinces in Canada that are evolving toward more holistic approaches. Although Newfoundland and Labrador has an ‘Integrated Land Use Committee (ILUC) its forum is not functional because the round-table of departmental interests are separately vying to exercise their separate legislated mandates. Indeed, some legislation can be superseded by other regulations or Acts, and there is really nothing in place that allows this ad hoc process to reach balanced ecological decisions. For example, the Crownlands Agency can pass an Order In Council (OIC) designating most of the interior of the Avalon Forest as a ‘Cottage Development Area’ with little or no consideration of other important issues, such as protection of rare and representative flora and fauna or the long term maintenance of productive forestlands.

The Committee recommends (3.1) that Government establish state-of-the-art legislation for integrated, climate sensitive, land-use planning. Government should establish a comprehensive geomatics strategy to support land use planning in the province. A priority of this strategy should be the digitisation and integration of its crown land and private land databases into a state-of-the-art Geographic Information System (GIS) that can be easily queried and researched.

Increased priority should be given to land stewardship and sustainable use of land resources, including soils, water, and biota, to ensure the long-term sustainability of these resources. It is recommended that a priority focus be given to supporting social enterprises that are community-based and tasked with delivery of optimal land-use in rural areas. Such initiatives take a regional approach thereby encompassing multiple communities. Nevertheless, regions should be designated based on a biophysical/ecological classification system.

In terms of adapting to a changing climate and a greener economy, the province needs to develop mechanisms for trade-offs between land-based GHG mitigation and other policy objectives. Future land-use decisions are likely to involve trade-offs between protection of carbon stocks with other land use priorities. Policy and administrative frameworks are needed to balance such trade-offs.

Forests

The forests of Newfoundland and Labrador, like forests all over the world are carbon sinks that take C02 from the atmosphere. They are our greatest asset in fighting climate change and their preservation should be highlighted in any provincial climate change plan. Forests currently absorb billions of tons of CO2 globally every year, an economic subsidy worth hundreds of billions of dollars if an equivalent sink had to be created in other ways. About 1–2 Gt of carbon is sequestered annually in pools on land in temperate and boreal regions. Such sinks represent 15–30% of annual anthropogenic carbon emissions, making terrestrial carbon stores an important part of the global carbon cycle. The Canadian boreal forest (soils and above-ground biomass) is estimated to store 71 billion tons of carbon, with another 137 billion tons in peatlands (Environmental Policy Unit, 2010). These ecosystems have a net cooling effect on climate due to their ability to remove atmospheric CO2 and store it underground for thousands of years. Conversely, when they are disturbed, GHGs are released back into the atmosphere and aid in accelerating climate change.

The Committee recommends (3.2) that the province quantify carbon sink-source relationships for Newfoundland and Labrador forests and implement ecosystem-based management (EBM) strategies to enhance potential carbon sinks. These steps should consider increased use of

technologies including spatial data management tools, novel inventory methods (e.g. remote sensing applications) and optimisation routines to improve planning and management regimes. The province should consider a system of gaining carbon credits through the implementation of sustainable forest management activities or operational methods. Re-investment in silviculture and protection of forests and peatlands should be enhanced.

An expected outcome of ecosystem-based forest management will be the maintenance of fifty percent of productive forest lands in a mature state for perpetuity. The spatial extent of such forests are dynamic and serve to ensure an optimal potential for sequestering of carbon. The Annual Allowable Cut (AAC) should be reduced to this end. In 1999, the Government of Newfoundland and Labrador in partnership with the Innu Nation in Labrador, completed an ecosystem-based forest management plan for District 19 in central Labrador (Fisheries and Land Resources & Innu Nation, 2018). This model has achieved international recognition and it is recommended as the general template for applying ecosystem-based planning to forest management districts on the Island of Newfoundland.

Operational strategies to sequester carbon should be pursued by improving harvesting systems designed to reduce emissions, such as reducing cut-over size, increasing the unharvested buffer widths to 100 m surrounding watersheds, 500 m for major water bodies/rivers and by reducing road or bridge construction. While focused on revitalising existing community pasturelands, the Committee recommends implementing a clear policy that is restricting the clear-cutting of existing forests for agricultural purposes. In other words, our review suggests that there is ample existing and cleared agricultural land available to commence community-scale food production. Any exceptions should require careful scrutiny and attempt to find alternative options.

The much more intensive stewardship of our boreal forests recommended here will also help the province adapt to a changing climate. Newfoundland and Labrador should develop a fully digital biophysical inventory of its land-base using standard ecological approaches with high resolution down to ecosite classification. This will replace the outdated and low quality Forest Resource Inventory (FRI), and complement the recommended ecosystem-based forest management plan. The overall objective is to consider all natural resources collectively in the development of operational forest management plans.

Peatlands

Peatlands have been determined to sequester relatively large volumes of CO2 and their inclusion in climate change models have significantly altered the predictions of effects and mitigations. Peatlands sequester and store carbon for millennia. Disturbance of peatlands also releases

methane (CH4), a very potent greenhouse gas. Newfoundland and Labrador is especially unique in this context because a consequence of the cool climate and high precipitation has resulted in vast peatland resources. Within insular Newfoundland and Labrador, peatlands cover an estimated 6,429,000 hectares with 1,115,000 hectares storing 16,958 million cubic metres of peat. Assuming an average bulk density of 81 kg m-3 and a peat carbon content of 50% this represents an estimated 687.9 megatons of stored peatland carbon (2520 Mt CO2e) on the island portion of the province alone. The vegetative cover of the Avalon Peninsula is estimated to be about 50% peatland. Many of these peatlands are especially deep with peat deposits of 20 to 30 m or more (Wells, 1983). There has been relatively little attention to the role of these peatlands in the regional modelling of the carbon cycle.

The Committee recommends (3.3) making maintenance of peatland ecosystem carbon storage and sequestration stated objectives of land-use planning. As a more limited (wetland-specific) measure, adoption of a wetland protection policy that recognises peatland carbon storage as an ecosystem function could be considered.

The Built Environment

A country's or a province's carbon footprint also reflects its building practices. The use of concrete, for example, is carbon-intensive, and the neglect of such emissions-reducing building practices such as passive solar and green roofing has a detrimental effect on a population's capacity to mitigate climate change. The committee recommends (3.4) that Government conduct a complete overhaul of building practices in Newfoundland and Labrador in order to bring them in line with the best environmental practices elsewhere. We can no longer continue to build as though it is still the 1970s. Better ways exist and if they have been implemented elsewhere, such as in Germany and France, they can also be pursued here.

Urban development has progressively been focused on diminishing plot sizes and maximising the numbers of houses in a development area. Relatively little attention is given to important factors, such as orientation to the sun that might allow for the optimisation of capturing passive solar radiation. In fact, many urban residences have the larger 'picture' windows facing the road which can often be north. Precious little attention is given to the potential to maximise absorption and storage (thermal mass) of solar radiation in our urban homes. Similarly, most new home construction has defaulted to the use of cheap electrical heating systems which are very low efficiency coefficient. Air heat pumps improve efficiencies somewhat. Appropriately sized lots, can allow for integration of geo-thermal based systems for central heating using water-based heat transfer. Hydronic systems vastly increase efficiency in storage and exchange of energy for heating.

With respect to the built environment, the Committee recommends (3.5) the development of domestic, industrial and municipal engineered wetlands for processing waste-water. Such a system creates win-win scenarios for mitigating climate change. While vastly reducing volumes of wastewater through plant uptake (phytoremediation), these enriched sites become lush in plants and algae that further increase the uptake and sequestering of CO2 while releasing oxygen. If implemented on a province-wide basis, the conservation of natural wetlands and the development of engineered wetlands would create huge carbon credits for the province, and offset emissions.

Agriculture

It is widely known that the province of Newfoundland and Labrador is food insecure. Labradorians, many of whom live in isolated communities rely on wild game and fish, which are increasingly threatened by climate change. The cost of groceries transported hundreds of miles from the south is often prohibitive to rural Labradorians. The Island of Newfoundland is especially challenged with respect to food security due to its isolation from the North American transportation network. The island experiences a short growing season with relatively low temperatures and frequent high winds. Agricultural land in Newfoundland is of relatively low quality due to acidic and shallow soils. Most land that was in production in the past was established by removal of the forest, followed by soil enhancement through liming and organic input. Many historical agricultural areas are now regenerating into forested meadows. Many outport communities established community pasture lands for grazing livestocks and gardening. Most of these are now fallow and/or relegated to ineffective leasehold arrangements that have resulted in the abandonment of their original agricultural focus.

The support of community pasturelands should be a part of the provinces climate change action plan (3.6) because an increased, sustainable and environmentally sensitive production of local food will decrease our reliance on importing carbon-intensive food from the mainland. All existing agricultural land leases need to be re-evaluated, particularly those related to community pasturelands, to ensure that they have been achieving the originally stated objectives. In particular, any such leases need to serve the higher needs of a “community” purpose. The modification of many existing leases could be the first step toward making agriculturally-zoned lands available to rural residents.

Government should subsidise climate-resilient and reduced-carbon farming practices and the development of business risk management programs in the province, as outlined by Canada’s House of Commons Standing Committee on Agriculture and Agri-food (3.7) (Finnigan, 2018).

Lastly, the province's moose population should be better managed, and a limited culling of the population for local consumption should be considered, both as a means of reducing human-moose road collisions, and increasing local food productivity (3.8). Such a process need not be at the expense of the moose population; quite the contrary. By becoming more actively involved in the stewardship of the moose population, Government will be in a better position to monitor and preserve its health. The same policies should be applied to the caribou populations, factoring in, of course, the recent historic declines in numbers.

Oceans

Alongside the pursuit of a green economy, Newfoundland and Labrador should be at the forefront of the worldwide movement toward a blue economy. We need to begin to consider the ocean's off our coast as our environmental responsibility, and not merely as a source of revenue. Climate change is having a dramatic effect on the North Atlantic and this Committee recommends that a study of "Stewarding the North Atlantic," prepared in a collaboration between Memorial University and the Royal Society of Canada in 2019 (McGrath and Ramm, 2019) should precede any drafting of climate change policy.

Newfoundland and Labrador is 'squeezed' between the super cold influences of the Arctic current and more maritime influences of the southern Gulf Stream. As such, potential for dire consequences associated with increased southern-moving volumes of super-chilled Arctic current flows need to be taken seriously. The Committee recommends that climate change mitigation can be advanced through the improvement of the ability of the surrounding ocean to sequester CO2 (3.9). This can be achieved through enhancing the productivity of plankton, notably diatoms which take up CO2 and their relatively heavy silica laden shells result in considerable biomass sinking as they die-off taking the CO2 into the depths and sediments of the ocean (Treguer and Pondaven, 2000).

Over the past couple of decades there has been considerable emerging science on the negative effects of hydro-development on seasonal flows into the oceans in the northern hemisphere. Specifically, the normal hydrological cycle of dramatically increased flows into estuaries and southward into the ocean has been reversed in the agenda to "hold-back" waters for release during the winter period when electrical demand is highest. Normally, the high spring flows release large amounts of available Silica into surrounding oceans which, along with other nutrients and the increasing available sunlight, support blooms of phytoplankton. The base productivity of the oceans in the northern hemisphere increases dramatically in spring and into the summer as nutrients concentrate, become more available and the photosynthesis period

increases. The ‘hold-back’ of these huge hydrological influences has depressed the productivity of our northern ocean (Neu, 1982).

Newfoundland and Labrador and Quebec support a vast array of mega-hydroelectric projects. There has been precious little attention paid to the real dramatic downstream effects of these many dams despite this being one the main outcomes of the International Review of the Impacts of Dams by the IUCN (World Commission on Dams, 2000) The Committee, in keeping with the World Commission on Dams (WCD, 2000), recommends (3.10) the development of Environmental Flow Releases (EFR) for all large-scale hydroelectric projects in its jurisdiction. Specifically, this will require an integral review of the natural flow of systems, such as the Churchill River in Labrador, if such historic data exist, or otherwise the integration of data related for adjacent watersheds, for example, using the Nauskapi River as a natural control in this case. The natural flow levels are used to develop operational mitigations releasing water in spring from reservoirs to help charge the estuaries and subsequently the adjoining marine surface waters with nutrient rich inputs to increase the biomass of phytoplankton that can then sequester CO2. Clearly decisions need to be made that fully accept that ‘spilling water’ to achieve an EFR ultimately reduces the stored capacity of the reservoir(s) for producing electricity.

This recommendation entails that Government direct its Crown agency responsible for hydro development to improve its expertise in Environmental Flow Releases, and to liaise with the Government of Quebec to establish EFR for its many mega-projects using downstream ecological indicators to confirm efficacies while also mitigating impacts to the marine environment of the eastern Arctic and northwest Atlantic Ocean.

With regard to fisheries, attention and resources need to be specifically directed towards self-reproducing commodities such as fish and seaweed. Other underused, sustainable food sources should be identified and promoted. Local consumption of seafood needs to be diversified to include shellfish and flatfish, which represent the majority of landings of Newfoundland and Labrador fisheries but are mainly exported outside the province. The recently rebuilt fish plant in Ramea diversified its harvest and will soon supply sea urchins, a highly desirable food in Japan, along with sea cucumber, lobster and whelk (McGrath and Ramm, n 84). Diversification in response to consumer demand creates new jobs. Government should actively promote and support such enterprises (3.11).

4. Monitoring

None of the recommendations above will be of any effect without an efficient, publicly

accountable system of monitoring progress on emissions reduction and other climate related goals. As we have seen, Newfoundland and Labrador has had close to 20 years of climate policy and "action plans" with little to no results. Indeed, emissions have increased dramatically in this time, even as the economy has contracted and become even more dependent on the one industry which it should be weaning itself off, oil. With an ageing population and ongoing outmigration, Newfoundland and Labrador does not have many options available to it. However, the Committee believes that if Newfoundland and Labrador aligns itself with the worldwide trend toward green economics, sustainable agriculture, and alternative energy, it will be in the best position to survive these difficult times of economic contraction and transition.

No policy is effective unless a transparent system of public reporting is in place to demonstrate results or lack thereof and to shift tactics when needed. In *The Way Forward on Climate Change in NL* the current Government of Newfoundland and Labrador has only committed to reporting on progress towards the goals set twice over a five-year period (Kean, 2019). As John Curtis has pointed out "this would seemingly provide only one opportunity for the public to evaluate outcomes during the actual implementation of the 2019 plan. This reporting structure also appears to be incongruous with federal policy on climate change. As mentioned above, the Pan-Canadian Framework on Clean Growth and Climate Change incorporates annual provincial-territorial-federal government joint progress reviews (Pan Canadian, 2016)" (Curtis, 2020, 72). In closing then, the Committee recommends (4.1) that Government establish a committee for monitoring and annually reporting on progress on climate change action. The report should be released to the public and made available to academic scrutiny in the interest of improving and refining its strategies for dealing with what some have called the greatest threat to our civilisation.

With that the Committee ends its recommendations. We would like to thank the Leader of the Progressive Conservative Party, Mr. Ches Crosbie, for commissioning this report, and by doing so, showing the environmental foresight and concern so necessary for this province at this turning point in its history.

Bibliography

Batterson, M. and D. Liverman. (2010). Past and future sea-level change in Newfoundland and Labrador: Guidelines for policy and planning. Current Research, Newfoundland and Labrador Department of Natural Resources. *Geological Survey*, Report 10-1, 129-141. http://nlhfrp.ca/wp-content/uploads/2015/01/Past-and-Future-Sea-Level-Change-in-Newfoundland and Labrador...pdf

Canada energy efficiency policy scorecard. (2019). Newfoundland and Labrador. https://www.scorecard.efficiencycanada.org/wp-content/uploads/2019/11/Newfoundland-and-Labrador-Great-Opportunity-Needed-Now-More-Than-Ever.pdf

Curtis, John Connor. (2020). Climate change's social justice ramifications for NL and related policy implications. [Unpublished master's thesis]. Memorial University, Grenfell Campus. Supervised by Dr. Kelly Vodden.

Dahlke, F.T.; Butzin, M.; Nahrgang, J.; Puvanendran, V.; Mortensen, A.; Pörtner, H.-O.; Storch, D. (2018). Northern cod species face spawning habitat losses if global warming exceeds 1.5°C. *Science Advances*, *4(11), eaas8821.* https://doi.org/10.1126/sciadv.aas8821

DFO. (2019, April 10). State of the Atlantic Ocean report shows the effects of climate change on marine ecosystems. Fisheries and Oceans Canada, News Release. https://www.canada.ca/en/fisheries-oceans/news/2019/04/state-of-the-atlatic-ocean-report-shows-the-effects-of-climate-change-on-marine-ecosystems.html

Economist. (2020, May 21). Never let a crisis go to waste: The pressure to make the post-covid rebound green. *The Economist.* https://www.economist.com/briefing/2020/05/21/the-pressure-to-make-the-post-covid-rebound-green

Economist. (2020, May 23). The world urgently needs to expand its use of carbon prices. *The*

Economist. https://www.economist.com/briefing/2020/05/23/the-world-urgently-needs-to-expand-its-use-of-carbon-prices

Environmental Policy Unit. (2010). Response to Newfoundland & Labrador public discussion document "Climate Change: Responding to Climate Change in Newfoundland & Labrador." Submission to the Office of Climate Change, Energy Efficiency and Emissions Trading, Government of Newfoundland and Labrador, 21 pp.

Finnigan, P. (2018). *Toward a resilient Canadian agriculture and agri-food system: Adapting to climate change*. House of Commons. https://www.ourcommons.ca/Content/Committee/421/AGRI/Reports/RP9814809/agrirp11/agrirp11-e.pdf

Fisheries and Land Resources & Innu Nation. (2018). *Forest management plan 2018-2022: Five year operating plan forest management district 19 (Central Labrador)*. Department of Fisheries and Land Resources & Innu Nation. Forest Management Plan 2018-2022 - Government of ...www.gov.nl.ca › mae › files › env-assessment-projects-...

Free, Christopher M, et al,. (2019). Impacts of Historical Warming on Marine Fisheries Production. *Science*, *363(6430),* 979-983. https://doi.org/10.1126/science.aau1758

Globe Advisors. (2011, September). *An Analysis of the Economic Development Opportunities Associated with the Green Economy in Newfoundland & Labrador.* The Government of Newfoundland and Labrador. https://www.gov.nl.ca/mae/files/publications-green-economy-nl.pdf

Government of Newfoundland and Labrador. (2018a). *Advance 2030: A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry*).https://www.gov.nl.ca/iet/files/advance30-pdf-oil-gas-sector-final-online.pdf

Government of Newfoundland and Labrador. (2018b). *Made-in-Newfoundland and Labrador Carbon Pricing Plan*. Retrieved from: https://www.gov.nl.ca/releases/2018/mae/1023n01/

Government of Newfoundland and Labrador (n.d.). *The Way Forward: A Vision for Sustainability and Growth in Newfoundland and Labrador.* https://www.gov.nl.ca/pdf/the_way_forward.pdf

Government of Newfoundland and Labrador. (2019). *The Way Forward on Climate Change in Newfoundland and Labrador*. Retrieved from: https://www.exec.gov.nl.ca/exec/occ/publications/The_Way_Forward_Climate_Change

Hanley, K. (2020, August 7). Diversify the economy through clean growth. *The Telegram.* https://www.thetelegram.com/business/local-business/guest-column-diversify-the-economy-through-clean-growth-482827/

IPCC. (2018). Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. P.rtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. P.an, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland, 32 pp.*

Kean, Gary. (2019, March 1). Environment minister Graham Letto launches climate change action plan in Corner Brook. *The Telegram*. https://www.thetelegram.com/news/local/environment-minister-graham-letto-launchesclimate-change-action-plan-in-corner-brook-288763/

Keeling, R.F., Körtzinger A., Gruber, N. (2010). Ocean deoxygenation in a warming world. *Annual Review of Marine Science*, *2(1),* 199-229.

McCarthy, S. (2018, April 4). 'Carbon pricing works,' Canadian economists say as national debate heats up. *The Globe and Mail*. https://www.theglobeandmail.com/business/article-carbon-pricing-works-canadian-economists-say-as-national-debate/

McGlade, C., and Ekins, P. (2015). The Geographical Distribution of Fossil Fuels Unused When Limiting Global Warming to 2ºC. *Nature*, *517*, 187-190. https://doi.org/10.1038/nature14016

McGrath, Sean J. and Carina Ramm. (2019, July 30). *Stewarding the North Atlantic. A white paper of policy recommendations based on the findings of the future of oceans*

symposium, held at Memorial University, on the 16th of March, 2019. For A New Earth. http://foranewearth.org/future-of-oceans/whitepaper_finaldraft-3-sjm/

Metcalf, G.E. (2020, June 1). How to set a price on carbon pollution. *Scientific American*. https://www.scientificamerican.com/article/how-to-set-a-price-on-carbon-pollution/

Mercer, Nick. (2019, March 5). Newfoundland and Labrador's 'Climate Change Action Plan' is All Bark and No Bite. *The Independent.* https://theindependent.ca/author/nick-mercer/

Neu, H. J. A. (1982, February). Man-made storage of water resources - A liability to the ocean environment? Part II. *Marine Pollution Bulletin, 13(2)*, 44-47. https://doi.org/10.1016/0025-326X(82)90439-8

Norwegian Petroleum. (2020). *Emissions to Air.* https://www.norskpetroleum.no/en/environment-and-technology/emissions-to-air/

Oreskes, N. (2020). How to Break the Climate Deadlock. *Scientific American*, 110-115.

Richardson, A.J.; Schoeman, D.S. (2004, October). Climate Impact on Plankton Ecosystems in the Northeast Atlantic. *Science*, *305(5690)*, 1609-1612. https://doi.org/10.1126/science.1100958

Shindell, Drew. (2020). Multidisciplinary studies of climate science and human society. Nicholas School of the Environment, Duke University. https://sites.nicholas.duke.edu/drewshindell/economic-valuation-of-benefits/

Treguer, P. and P. Pondaven. (2000, July 27). Silica control of carbon dioxide. *Nature,* vol. 406, 358-359. https://doi.org/10.1038/35019236

Trimper, Perry, Honourable. (2016). Bill 34: An Act to Regulate Greenhouse Gas Emissions from Industrial Facilities in the Province [of Newfoundland and Labrador]. House of Assembly. https://www.assembly.nl.ca/HouseBusiness/Bills/ga48session1/bill1634.htm

The Paris Agreement. (2020). United Nations Climate Change. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Wells, E. D. (1983). Peatlands of Newfoundland. In G. R. South (ed.), *Biogeography and*

Ecology of the Island of Newfoundland. (pp. 207-227). Dr. W. Junk Publishers.

World Commission on Dams. (2000). *Dams and Development: A New Framework for Decision-Making*. Earthscan Publications Ltd. London and Sterling, VA.

Yugo, M. and A. Soler. (2019, October). A look into the role of e-fuels in the transport system in Europe (2030–2050). *Concawe Review*, 28(1), 4-22. https://www.concawe.eu/wp-content/uploads/E-fuels-article.pdf