HEALTHY RECOVERY PLAN

For a safe and sustainable future

CAPE
Canadian Association of Physicians for the Environment

Association Canadienne des Médecins pour l'Environnement
ACME

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We can change the world

Imagine a Canada where you can wake up in the morning, go outside to enjoy your morning coffee, and breathe clean air, even in our largest cities. The air pollution and noise from our cars, trucks, and buses has been replaced by fresh smells from our rejuvenated urban green spaces, the low hum of electric vehicles, and bicycle bells.

You go off to work at your well-paying job that also gives you the satisfaction of knowing you are contributing to a more sustainable planet. Perhaps you work in renewable energy, or sustainable transportation, or within a sustainable healthcare system.

We have an opportunity to build that Canada now.

In response to the economic crisis associated with COVID-19, the federal government is set to deploy funds in a public mobilization unlike any since the Second World War. The investment choices our government makes will determine whether we fall back towards a fossil fuel-intensive economy that puts our health at risk, or move Canada forward on a path to meeting our climate targets, and ridding our economy of greenhouse gas emissions while driving investment in sustainable jobs.

Recently, organizations representing 40 million healthcare workers worldwide -- two-thirds of the global workforce -- supported an open letter addressed to G20 leaders, calling upon them to create a green and healthy recovery in order to support people through COVID-19 and its economic fallout, and prevent further crises related to climate change and planetary decline.

This report represents a Made-in-Canada set of recommendations based on this call to action.

In this report, we focus on recommendations for upcoming federal fiscal stimulus spending, along with supporting regulatory measures, that protect human health through ridding Canada's economy of greenhouse gas emissions, in line with Canada's emissions reduction commitments. Under the Paris Agreement, Canada committed to reducing its GHG emissions by 30% below 2005 levels by 2030. The Canadian government has also said we will achieve net-zero emissions by 2050. This report provides a path to meet those targets, through investments in renewable energy, sustainable transportation, sustainable homes and buildings, sustainable healthcare, and protecting and connecting to nature.

Unfortunately, as per the most recent annual projection by the Canadian government that includes actions taken by governments, consumers, Canada was on track to miss its 2030 GHG emissions commitment by 162 annual megatonnes of greenhouse gases. That gap alone is more than double the annual emissions from personal vehicles in Canada. So, we have some work to do.

The World Health Organization has called climate change the greatest threat to global health in the 21st Century. Climate change is already harming Canadians' health, causing increases in extreme weather events, cases of heat stroke, cardiorespiratory issues, and Lyme disease from ticks that can now survive in our warmer climate. Along with fighting climate change, these actions will also improve our air quality. Research has linked air pollution to asthma (especially in children), lung cancer, COPD, and other respiratory illnesses, as well as cardiovascular disease, diabetes, other forms of cancer, and depression.

In this report, we specifically quantify the potential health benefits related to improved air quality in Canada of actions and investments resulting from one potential path to Canada meeting our 2030 Paris Agreement emissions pledge and then its 2050 net-zero target. This path calls for investments and regulatory changes leading to decarbonization of electricity generation and public transit by 2040, and vehicles, residential and commercial buildings, and healthcare by 2050.

In new research released for the first time in this report, Navius Research simulated the health benefits of climate actions that meet Canada's emissions reduction targets, using Health Canada's own Air Quality Benefits Assessment Tool.

Navius Research's results show that if Canada meets its climate targets, we will save an estimated 112,000 lives between 2030 and 2050 due to air quality improvements alone. That is approximately the current population of the City of Waterloo, Ontario.

As part of this new research we commissioned for this report, Navius Research has also simulated key economic impacts of an emissions scenario in line with Canada's climate target of net-zero emissions by 2050. They found that if we make the changes we need to hit our climate targets, Canadian clean jobs will increase from 210,000 full-time equivalent positions in 2020 to 1.5 million in 2050.

In this report, we have made 25 recommendations to the federal government for investments and regulatory changes to put Canada on the path to meeting our 2030 and 2050 emissions reduction targets. These recommendations would build the sustainable world we need.

But if we are going to build that world, we need your help.

Please go to http://cape.ca/healthy-recovery/ and send this report to your local Member of Parliament. Then, share this report with your friends and family and encourage them to do the same.

We have the plan to decarbonize, save lives, and create jobs. We just need the political leadership to make this vision our reality.

Robin Edger
Executive Director and CEO
CAPE

Executive Summary

The COVID-19 pandemic has exposed and exacerbated pre-existing challenges to Canadian health, healthcare systems, our economy, and society. And yet, amidst the tragedy and disruption is the opportunity to create the world as we need it to be post-pandemic. As our governments work to stimulate the economy, they have the opportunity to create jobs, decrease inequities and save lives by investing in a healthy recovery.

In response to the economic crisis associated with COVID-19, the federal government is deploying funds in a public mobilization unlike any since the second world war. The investment choices our governments make will determine whether we fall back towards a carbon-intensive economy that continues to put our health at risk, or if we march Canada forward on a path to meeting our climate targets, and ridding our economy of greenhouse gas (GHG) emissions while driving investment in sustainable jobs.

Recently, organizations representing 40 million healthcare workers worldwide, or two-thirds of the global workforce, supported an open letter addressed to G20 leaders, calling upon them to create a green and healthy recovery in order to support people through COVID-19 and its economic fallout, and prevent further crises related to climate change and planetary decline. In Canada, over 400 civil society organizations have called for a Just Recovery that prioritizes the health and wellbeing of everyone, without exception, and builds resilience to prevent future crises. This report represents a Made-in-Canada set of recommendations based on these calls to action.

This report focuses on recommendations for upcoming federal fiscal stimulus spending, along with supporting regulatory measures, that protect human health through the decarbonization of Canada's economy, in line with Canada's emissions reduction commitments. It also outlines the air quality, health, and economic impacts of climate action that achieves Canada's 2030 emissions reduction target and 2050 net-zero emissions goal.

In this report, we outline many potential human health co-benefits of climate action. This report specifically illustrates and quantifies potential health benefits related to improved air quality in Canada of actions and investments resulting from one potential path to Canada meeting its 2030 emissions pledge and then its 2050 net-zero target. This path calls for:

A. Investments and regulatory changes leading to decarbonization of:[1]
   - electricity generation by 2040,
   - public transit by 2040,
   - light-duty vehicles by 2050 (including new vehicles by 2030),
   - heavy-duty vehicles by 2050,
   - residential and commercial buildings by 2050, and
   - healthcare by 2050.

1 These timelines are aligned with Navius Research's 2050 net-zero emissions scenario.

B. Investments in Protecting and Connecting to Nature
   - increase greenspace in our cities
   - increase access to nature in our national and provincial parks systems
   - protect, sustainably manage and restore natural ecosystems

In new research released for the first time in this report, Navius Research simulated the health benefits of climate actions that meet Canada's emissions reduction targets, using Health Canada's Air Quality Benefits Assessment Tool (AQBAT). Of note, additional health benefits related to improved physical activity levels, mental health benefits, heat illness-reduction, and long-term climate-related health impacts, amongst others, of the measures outlined below are not included in these health estimates.

Navius Research's results show that **if Canada meets its climate targets, we will save an estimated 112,081 lives between 2030 and 2050 due to air quality improvements alone.** That is approximately the current population of the City of Waterloo, Ontario.

On a yearly basis, if Canada meets its 2030 climate commitment and then our 2050 net-zero emissions target, air quality improvements will lead to approximately 5,000 to 11,000 annual avoided premature deaths in 2050.

As part of this new research CAPE commissioned for this report, Navius Research has also simulated key economic impacts of an emissions scenario in line with Canada's climate target of net-zero emissions by 2050. They found that **if we make the changes we need to hit our climate targets, Canadian clean jobs will increase from 210,000 full-time equivalent positions in 2020 to 1.5 million in 2050.**

Recommendations

In this report, we have made 25 recommendations to the federal government for investments and regulatory changes to put Canada on the path to meeting our 2030 and 2050 emissions reduction targets. Our recommendations are in the areas of clean energy, transportation, buildings, healthcare, and connecting to and protecting nature.

In order to build toward a recovery that supports human health through a healthy planet and a robust economy, the federal government should:

<u>Framework</u>

1. Establish a decarbonization framework that includes a legislated net-zero 2050 target, requires policymakers to set five year carbon budgets and impact reports, and establish an expert climate advisory committee to monitor, report and advise Parliament on emissions reduction and on targets and audit progress.

<u>Clean Energy</u>

2. Make the necessary investments in renewable energy production, energy storage capacity, and long-distance transmissions lines to put the country on track for net-zero electricity generation by 2040.
3. Fund skills training programs to support the just transition of workers into renewable energy.

Transportation

4. Invest in electric vehicle manufacturing, research and development, the electric vehicle supply chain, and skills-training for our workforce to transition into these areas.
5. Invest in zero-emission vehicle charging/refueling infrastructure, particularly for apartments, condominium buildings, and along highways.
6. Implement a national zero-emissions vehicle sales mandate that ratchets up gradually to 100% of light-duty vehicles sold by 2030.
7. Guarantee electric vehicle automotive loans over a period of three years so that their lease prices are more affordable for consumers.
8. Invest in public transit systems to ensure they are financially sustainable in the short-term through immediate transfers of funds for operational costs and ensure our public transit systems and school buses are equipped for the future through working with provinces and municipalities to make investments in zero-emission transit technology.
9. Invest in zero-emission heavy duty vehicle purchase incentives and commercial hydrogen refuelling and electric charging infrastructure.
10. Invest in the hydrogen supply chain, including hydrogen production, logistics, and hydrogen fuel-cell manufacturing.
11. Work with municipal leaders to sharply increase federal investment in infrastructure that makes our cities and towns more walkable and bikeable, from traffic-calming measures to separated bike lanes.
12. Invest in an e-bike purchase rebate program.

Buildings

13. Establish zero-emission building requirements for new and existing homes and commercial buildings in the National Building Code, and work with provinces and territories to adopt these across the country.
14. Incentivize energy efficiency, electrification, low-carbon building materials, and green roofs for new homes and commercial buildings.
15. Increase federal investment in deep emissions-reducing home and commercial building retrofits and incentivize households making the switch from gas stoves to electric.
16. Invest in skills-training for Canada's low-carbon building workforce.

Healthcare

17. Increase funding for systematic promotion of the Choosing Wisely Canada program for the reduction of unnecessary and potentially dangerous investigations or therapies.
18. Work with provinces to mandate environmental standards for renovations or new healthcare facilities and allow healthcare facilities and regions to apply for green infrastructure funding.
19. Provide funding to provinces to incentivize systematic increases in the proportion of healthcare purchase orders and contracts certified by third party sustainability certifiers.
20. Provide funding to provinces tied to incremental pollution reduction targets for healthcare-related transport pollution, targeting financing of zero-emission vehicle substitutes for healthcare fleet vehicles, telemedicine support structures, as well as public and active transit integration.
21. Provide the provinces with financial support for the systematic accounting and reduction of toxic substances released by health institutions in healthcare delivery, tied to mandatory incremental reduction goals.
22. Fund a national healthcare system-wide solid, liquid and air waste accounting to enable waste reduction initiative planning and impact assessments.

Nature Expansion and Conservation

23. Work with provincial and municipal governments to invest in urban tree cover, new urban green spaces, improvement and expansion of existing urban green spaces, park trail upgrades, and green corridors.
24. Invest in initiatives that enhance the accessibility and quality of our national and provincial parks systems.
25. Invest in a broad range of measures that preserve, manage and restore our natural ecosystems.

...if Canada meets its climate targets, we will save an estimated 112,081 lives between 2030 and 2050 due to air quality improvements alone.

Introduction

The COVID-19 pandemic has exposed and exacerbated pre-existing challenges to Canadian health, healthcare systems, our economy, and society. This crisis has highlighted the need for us to understand the linkages between human health and planetary health. It has forced governments and citizens to prioritize health in an unprecedented way as we work together to save lives.

In response to the economic crisis associated with COVID-19, the federal government will be deploying funds in a public mobilization unlike any since the Second World War. The investment choices our governments make will decide whether we fall back toward a carbon-intensive economy that continues to put our health at risk, or if we march Canada forward on a path to meeting our climate targets, ridding our economy of greenhouse gas (GHG) emissions while driving investment into a clean economy and creating sustainable jobs.

Recently, organizations representing 40 million healthcare workers worldwide, or two-thirds of the global workforce, supported an open letter addressed to G20 leaders, calling upon them to create a green and healthy recovery in order to support people through COVID-19 and its economic fallout, and prevent further crises related to climate change and planetary decline. In Canada, over 400 civil society organizations have called for a Just Recovery that prioritizes the health and wellbeing of everyone, without exception, and builds resilience to prevent future crises. This report represents a Made-in-Canada set of recommendations to bring these calls to life.

In order to realize a lasting recovery and prevent further health crises, investments must co-solve the pandemic-related economic crisis and the problem of runaway greenhouse gas emissions.

This report focuses on recommendations for upcoming federal fiscal stimulus spending, along with supporting regulatory measures, that protect human health while outlining the first steps required at this moment in time to set us on a path for the decarbonization of Canada's economy. It also outlines the air quality, health, and economic impacts of a trajectory aligned with these recommendations that represents one possible path to achieving Canada's 2030 emissions reduction commitment and 2050 net-zero emissions goal. This path assumes:

A. Investments and regulatory changes leading to decarbonization of:[2]
   - electricity generation by 2040,
   - public transit by 2040,
   - light-duty vehicles by 2050 (including new vehicles by 2030),
   - heavy-duty vehicles by 2050,
   - residential and commercial buildings by 2050, and
   - healthcare by 2050.

2 These timelines are aligned with Navius Research's 2050 net-zero emissions scenario.

B. Investments in Protecting and Connecting to Nature
   - increase greenspace in our cities
   - increase access to nature in our national and provincial parks systems
   - protect, sustainably manage and restore natural ecosystems

The best way for us to honour the sacrifices that both the Canadian healthcare workforce and our population at large have made over the course of the pandemic is to build back prioritizing safety and equity, thus ensuring that similar crises are made less likely. Let's build back better.

Recently, organizations representing 40 million healthcare workers worldwide, or two-thirds of the global workforce, supported an open letter addressed to G20 leaders, calling upon them to create a green and healthy recovery in order to support people through COVID-19 and its economic fallout, and prevent further crises related to climate change and planetary decline.

...Let's build back better.

Two Priorities: Protecting Health & Economic Recovery

Protecting Health

Climate Change Health Risks

"If COVID-19 is a sprint to save lives, climate change is the marathon."

- Diarmid Campbell-Lendrum, Climate Change and Health Team Lead, World Health Organization

The World Health Organization has called climate change the greatest threat to global health in the 21st Century.[3] Pre-COVID-19, the World Economic Forum's 2020 Global Risks Report stated that the majority of potential crises facing the world in terms of impact and probability would be connected to the climate crisis.[4] In medical terms, this makes climate change Triage Level 1 --most urgent-- in terms of its need for active management to ensure planetary health.

Canada is not yet doing its part to address this crisis. Just weeks before the novel coronavirus pandemic abruptly changed our lives, UNICEF, the WHO, and the *Lancet Journal* released *A Future for the World's Children*, which included an index of "child flourishing." Canada ranked 21st out of 180 countries in support for present-day child health, but only 170th in sustainability, making us one of the wealthy countries that most "threaten every child's future through climate change."[5]

Under the Paris Agreement, Canada committed to reducing its GHG emissions by 30% below 2005 levels by 2030. The Canadian government has also said we will achieve net-zero emissions by 2050.[6] Canada's 2050 net-zero domestic goal was driven by the Intergovernmental Panel on Climate Change's 2018 report that found that limiting global warming to 1.5°C would require human-caused emissions of carbon dioxide to reach net-zero around 2050.[7]

Unfortunately, as per the most recent annual projection by the Canadian government that includes actions taken by governments, consumers, and businesses up to September 2019, Canada was on track to miss its 2030 GHG emissions commitment by 162 megatonnes.[8] Even using a more optimistic government projection that factors in policies and measures that are under development, credits through the Western Climate Initiative, and contributions from the land use, land-use change and forestry sectors, Canada will still fall short of its commitment by 77 megatonnes of GHGs.[9]

In contrast, the United Kingdom reduced its greenhouse gas emissions 43.1% between 1990 and 2018.[10] Much of its success has been attributed to cross-party cooperation facilitated by the passage of a Climate Change Act in 2008.[11] This requires lawmakers to debate and legislate 5-year carbon budgets which are set 12 years ahead of time, allowing long-term targets to be translated into near-term actions. It also created an independent expert body, the Committee on Climate Change, which advises Parliament on carbon budgets, and employs high-quality models to monitor progress on emissions reduction and climate resilience. The long-term consistency in this approach allows for greater investment certainty, and good progress.

Recommendation #1

The federal government should establish a decarbonization framework that includes a legislated net-zero 2050 target, requires policymakers to set five year carbon budgets and impact reports, and establish an expert climate advisory committee to monitor, report and advise Parliament on emissions reduction and on targets and audit progress.

As a whole, Canada is warming at double the global rate, with its northern region warming at triple the global average.[12] Given this, under all feasible emissions scenarios a child born today will be living in a Canada at least 1.5°C warmer than the 1986-2005 reference period by the time they are in their twenties.[13] This means that the floods, wildfires, changes in infectious-disease patterns, and severe allergy seasons already impacting people across the country will continue to worsen until mid-century (See Figure 1).

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9 *Ibid.*
10 United Kingdom Department for Business, Energy, and Industrial Strategy. (2020). *2018 UK Greenhouse Gas Emissions, Final figures.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/862887/2018_Final_greenhouse_gas_emissions_statistical_release.pdf
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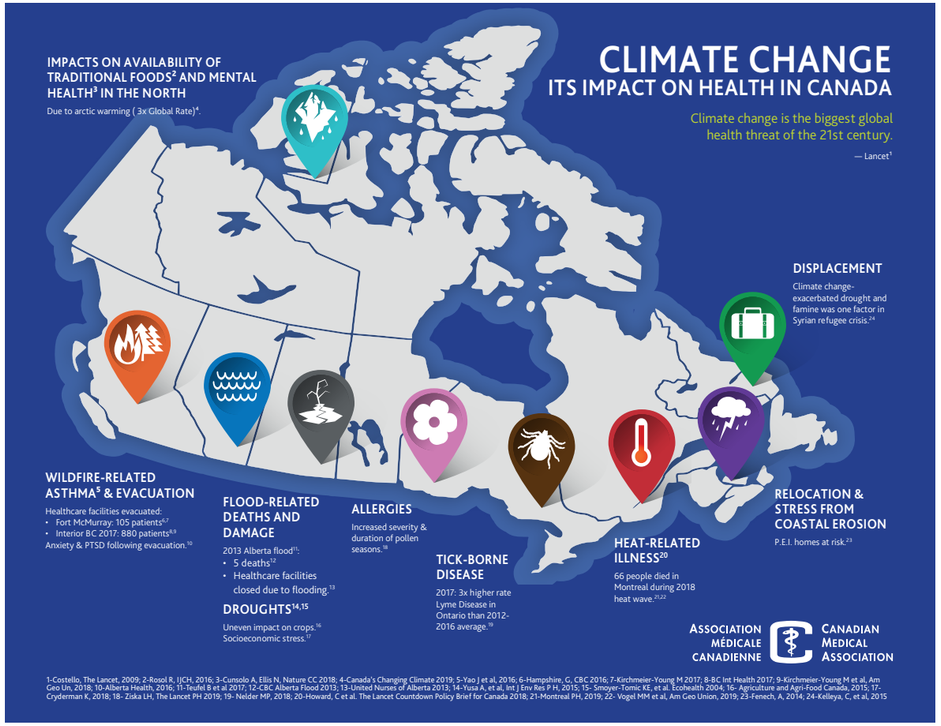
Figure 1: Climate Changes Health in Canada



Distribution of Health Impacts

Climate change is having different impacts on Canadians' health in various regions of the country[14].

Northern Canada

Northern Canada is experiencing the most rapid changes in climate and facing multiple health-related concerns. Melting permafrost, shoreline erosion and storm surges threaten the stability of homes, infrastructure and water supplies.[15] Warmer temperatures are shortening the ice season, impacting the way of life for Indigenous communities.[16] Hunting and fishing is more difficult as travel becomes more dangerous and traditional foods are harder to obtain.[17] Extreme weather events such as coastal erosion and forest fires may result in population displacement. These changes threaten food safety and security, water quality, physical and mental health, and traditional cultural practices of northern communities.

Atlantic Canada

Warmer ocean temperatures and higher sea levels are projected to increase the frequency and intensity of coastal storms.[18] [19] [20] As a result of human activities, Atlantic Canada has observed an upward trend in hurricane activity since the 1970s.[21] Past hurricanes and floods in Atlantic Canada have resulted in injury and death, infrastructure damage, power outages, and loss of access to emergency services.[22] Coastal communities may be faced with infrastructure damage, loss of their livelihood, displacement or loss of their community because of sea level rise, storms, coastal erosion, and flooding.[23] [24] Variability in precipitation and limited water resources could impact the fisheries and agricultural sectors, which could mean a loss of income – an important determinant of health.[25] [26]

Québec

Québec has seen significant climate-related health impacts, which are expected to continue as the climate continues to warm and extreme weather events become more frequent. Climate change health risks in Québec include heat-related illness,[27] [28] cardiovascular and respiratory risks from exposure to air pollution from forest fires,[29] ozone and particulate

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24 IPCC, 2019: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

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29

matter,[30] allergic reactions from pollen,[31] [32] [33] water, vector-borne and zoonotic diseases (ticks carrying Lyme disease are spreading quickly in Southern Québec),[34] [35] and increasing burdens of mental health challenges and illnesses.[36] Significant increases in the length of heat waves and warmer nights are expected. As a result, climate change has contributed to increased emergency department admission rates and mortality.[37] Flood hazard is a rising natural risk in Québec and has been linked to increased winter temperatures.[38] [39] Climate forecasts predicting more intense rainfall events only exacerbate the increasing flood risks in Québec in relation to climate change.[40]

Climate change has far-reaching implications for the health of the province's northern and Indigenous population. Warmer and shorter winters affecting the ice season are leading to increased travel risks between regions and decreased access to resources.[41] This contributes to increased mental stress, limited potential for subsistence hunting with food security implications, and increased likelihood of accidental injury and death while travelling on the land.[42]

Ontario

Climate change is putting Ontarians at increasing risk from heat-related illness, cardiovascular and respiratory disease, water-borne disease, injury, and other illnesses including stress-related disorders and poor mental health.[43] [44] Health impacts from air pollution are a current concern in Ontario and will be exacerbated by warmer temperatures.[45] The geographic range of Lyme disease and other vector-borne diseases is expanding in the province.[46] [47] The frequency and intensity of heavy precipitation, flooding, and other extreme weather events are increasing across Ontario,[48] [49] which could endanger many aspects of health including food security.[50]

Prairies

The Prairies are particularly susceptible to drought.[51] Climate change across the Prairies is expected to produce warmer and drier weather, droughts, changing vector-borne disease ranges,[52] increases in wildfires (particularly in the western prairies),[53] more weather variability, and more frequent and intense extreme weather events. People in the Prairie provinces already experience increasing climate change health impacts, including the highest human incidence of clinical cases of West Nile virus infection in Canada,[54] and food and water-borne diseases.[55]

British Columbia

Forest fires in British Columbia continue to devastate local communities. Climate change will increase the likelihood of warmer, drier, and longer wildfire seasons. As a result, the health risks associated with exposure to wildfire smoke are likely to increase.[56] Heat-related illness is expected to rise in southern British Columbia especially, which -- if similar to findings regarding a previous heat wave in Metro Vancouver -- will particularly affect seniors, the vulnerable poor, and people with mental health issues.[57] Climate change may also increase the occurrence of toxic algal blooms and shellfish poisoning as warmer

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coastal waters provide conditions conducive to algal growth.[58] Some communities already have water quality issues for both drinking water and recreational use, and the incidence of water-borne disease may further increase with climate change. Higher sediment load due to landslides or heavy runoff may also affect water quality. Sea-level rise may also cause groundwater quality degradation in coastal communities that rely on groundwater.[59]

Distribution of Impacts within Regions

Just as the public health impacts from climate change differ between regions, they also differ between people within each region.[60] Those who already experience structural inequities such as colonization, racism and low income are often most vulnerable to climate change risks and impacts. For these systemic reasons, marginalized populations are more likely to already have poorer health, thereby experiencing more severe negative health effects and weakened ability to recover from events related to climate change.[61]

The evidence of unequal distributional impacts of climate change are particularly clear with regard to heat waves, where studies have found that heat-related deaths are much more frequent in racialized and poorer neighbourhoods.[62] Heat-related deaths can often be prevented if people are simply able to go somewhere cooler, whether an air-conditioned space in their own home, a local business, or a community facility. However, without financial and social resources, people are not able to escape the heat.[63]

Planetary Health: Fundamental to our Healthcare System

As a zoonotic virus that has transferred from animals into humans and brought the globe to a near-standstill, COVID-19 highlights the need to pay deep attention to the interface between humanity, animals, and disease vectors. Determining the best policy measures with which to manage this crisis requires reframing "health", which is frequently conflated with healthcare, as "planetary health", which was defined by the *Lancet* in 2015 as "the health of human civilization and the state of the natural systems upon which it depends."[64]

58 Taylor M, McIntyre L, Ritson M, Stone J, Bronson R, Bitzikos O, Rourke W, & Galanis E, (2013). Outbreak Investigation Team Outbreak of diarrhetic shellfish poisoning associated with mussels, British Columbia, Canada. *Mar. Drugs.* 11:1669–1676.
59 Ostry A, Ogborn M, Bassil KL, Takaro TK, & Allen DM. (2010) Climate change and health in british columbia: projected impacts and a proposed agenda for adaptation research and policy. *Int J Environ Res Public Health*, 7(3):1018-1035. doi:10.3390/ijerph7031018
60 Buse CG (2015). Health equity, population health, and climate change adaptation in Ontario, Canada. Health Tomorrow. 3(1):26-51. https://ht.journals.yorku.ca/index.php/ht/article/view/40177.
61 Rudolph L, Harrison C, Buckley L, North S, (2018). Climate change, health, and equity: a guide for local health departments. Oakland (CA), Washington (DC): Public Health Institute and American Public Health Association. http://nccdh.ca/resources/entry/climate-change-health-and-equity-a-guide-for-local-health-departments.
62 Kumar N, (2018). Cities, climate change, and health equity. Toronto (ON): Wellesley Institute. https://www.wellesleyinstitute.com/wp-content/uploads/2018/06/Cities-Climate-Change-Health-Equity-WIJune-2018-fv.pdf.
63 *Ibid.*
64 Whitmee S, Haines A, Beyrer C, et al. (2015). Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation-Lancet Commission on planetary health. The Lancet, 386: 1973-2028. DOI: 10.1016/S0140-6736(15)60901-1.

Within a planetary health frame, the ecological determinants of health, such as biodiversity, climate, air, and water,[65] not only influence human health directly, but also form the foundation of human society. A stable base allows for the development of political and economic systems that give rise to elements such as universities, buildings, and complex industry, which generate the social determinants of health, factors such as education, housing, and income.[66] Only when these building blocks assemble into a particularly high concentration of resources are we able to build and maintain extremely complex structures like our healthcare systems. While the work done within formal healthcare structures is critical, policymakers, health professionals, and the public alike are often surprised to learn that healthcare is estimated to account for just 5 – 25% of overall health status.[67] [68] [69] [70]

Not only does health depend on a stable ecological underpinning best ensured by tackling climate change – but so do our healthcare systems.

Air Pollution

"When we eventually take off our face masks, we want to keep breathing clean air."

- Dr. Maria Neira, Director of the Public Health, Environment and Social Determinants of Health Department, World Health Organization

In addition to the climate change dangers posed by emissions on a global scale, emissions from fossil fuels pose real and immediate threats to people's health in the form of air pollution.

Health Canada estimated that 14,600 premature deaths in Canada in 2019 could be linked to air pollution.[71] A recently released international study of air pollution impacts on life expectancy projects an even higher estimate, suggesting that in 2015, the year under review, 20,089 deaths in Canada were the result of air pollution, with 17,574 of these being attributable to fossil-fuel-related sources.[72] These estimates include deaths from chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD), and cerebrovascular disease (CVD), all of which are conditions that, in addition to contributing to mortality, can reduce quality of life and result in major healthcare system costs.

65 Hancock T. (2015). Global Change and Public Health: Addressing the Ecological Determinants of Health. Canadian Public Health Association Discussion Paper.
66 Woolf SH. (2019). Necessary But Not Sufficient: Why health care alone cannot improve population health and reduce health inequities. *Annals of Family Medicine,* 17: 196--199. DOI: 10.1370/afm.2395.
67 Woolf SH. (2019). Necessary But Not Sufficient: Why health care alone cannot improve population health and reduce health inequities. *Annals of Family Medicine,* 17: 196--199. DOI: 10.1370/afm.2395.
68 Keon W & Pépin L. (2009). A Healthy, Productive Canada: A Determinant of Health Approach: Final Report of the Subcommittee on Population Health.. Ottawa: The Standing Senate Committee on Social Affairs, Science and Technology.
69 University of Wisconsin. County Health Rankings Model. 2014.
70 McGovern L, Miller G and Hughes-Cromwick P. (2014) Health Policy Brief: The Relative Contribution of Multiple Determinants to Health Outcomes. *Health affairs*.
71 Health Canada. (2019). *Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes.* 2019.
72 Lelieveld J et al. (2020). Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective. https://www.ncbi.nlm.nih.gov/pubmed/32123898

Research has linked air pollution to asthma, lung cancer, COPD, and other respiratory illnesses, as well as cardiovascular disease, diabetes, other forms of cancer (including childhood cancers),[73] and depression. Canadian studies have found that traffic-related air pollution is associated with the development and exacerbation of childhood asthma,[74] [75] ischemic heart disease,[76] hypertension and diabetes,[77] [78] and breast and prostate cancer.[79] A recent study of traffic emissions from trucks, cars and buses in the Greater Toronto-Hamilton Area estimated that traffic pollution is responsible for 872 deaths every year with trucks being responsible for almost 50% of the traffic pollution related deaths.[80]"

Emerging evidence from the current pandemic suggests that long-term exposure to air pollution is associated with more severe covid infections, however given that COVID-19 has been circulating for only six months, the data is yet to be peer-reviewed.[81] With affordable and less-polluting options now available for both electricity-generation and transport, there is no reason for Canadians to be experiencing current levels of illness and loss-of-life as a result of air pollution. We must strengthen in national ambient air quality standards based on up to date evidence and make concerted efforts to meet them along with our Climate targets.[82]

Health Benefits of Climate Action and Improved Air Quality

As discussed throughout this report, the potential human health co-benefits of climate action are many. Navius Research has provided analysis, released for the first time in this report, to simulate the health benefits to Canadians of improved air quality from one path to meeting our 2030 emissions reduction commitment and our 2050 net-zero target, using Health Canada's Air Quality Benefits Assessment Tool (AQBAT).[83] Of note, additional health benefits related to improved physical activity levels, mental health benefits, heat illness-reduction, and long-term climate-related health impacts, amongst others, of the measures outlined below are not included in the health estimates.

73 Schraufnagel DE, Balmes JR, Cowl CT, et al. (2019). Air Pollution and Noncommunicable Diseases: A Review by the Forum of International Respiratory Societies' Environmental Committee, Part 2: Air Pollution and Organ Systems. *Chest,* 155(2):417–426. doi:10.1016/j.chest.2018.10.041

74 Clark NA, Demers PA, Karr CJ, et al. (2010) Effect of early life exposure to air pollution on development of childhood asthma. *Environ Health Perspect*. 118(2):284-290. doi:10.1289/ehp.0900916

75 Carlsten C, Dybuncio A, Becker A, Chan-Yeung M, Brauer M. (2011). Traffic-related air pollution and incident asthma in a high-risk birth cohort. *Occup Environ Med,* 68(4):291-295. doi:10.1136/oem.2010.055152

76 Beckerman BS, Jerrett M, Finkelstein M, et al. (2012). The association between chronic exposure to traffic-related air pollution and ischemic heart disease. *J Toxicol Environ Health* A.75(7):402-411. doi:10.1080/15287394.2012.670899

77 Bai L, Chen H, Hatzopoulou M, et al. (2018). Exposure to Ambient Ultrafine Particles and Nitrogen Dioxide and Incident Hypertension and Diabetes. *Epidemiology,* 29(3):323-332. doi:10.1097/EDE.0000000000000798

78 Howell NA, Tu JV, Moineddin R, et al. (2019). The probability of diabetes and hypertension by levels of neighborhood walkability and traffic-related air pollution across 15 municipalities in Southern Ontario, Canada: A dataset derived from 2,496,458 community dwelling-adults. Data Brief. 2019;27:104439. Published 2019 Aug 28. doi:10.1016/j.dib.2019.104439

79 Parent MÉ, Goldberg MS, Crouse DL, et al. (2013). Traffic-related air pollution and prostate cancer risk: a case-control study in Montreal, Canada. Occup Environ Med. 2013;70(7):511-518. doi:10.1136/oemed-2012-101211

80 Clearing the Air: How Electric Vehicles and Cleaner Trucks Can Help Reduce Pollution, Improve Health and Save Lives in the Greater Toronto and Hamilton Area. (2020). Environmental Defence and the Ontario Public Health Association. https://clearingtheair.ca

81 Hoang U, Jones NR.(2020). Is there an association between exposure to air pollution and severity of COVID-19 infection? Centre for Evidence-Based Medicine, Nuffield Department of Primary Care Health Sciences. University of Oxford. 2020. https://www.cebm.net/covid-19/is-there-an-association-between-exposure-to-air-pollution-and-severity-of-covid-19-infection/

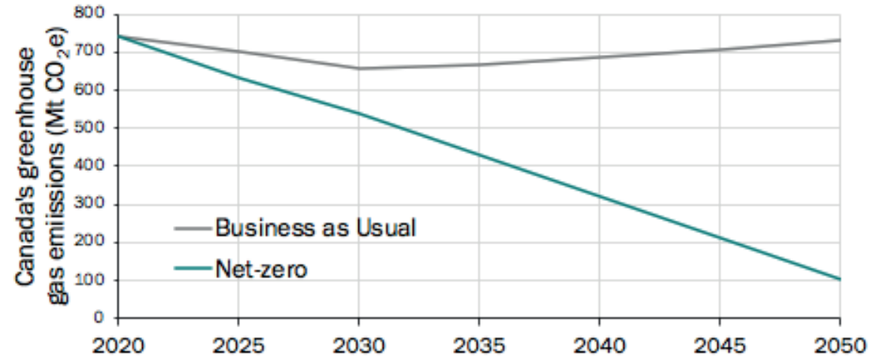
82 Gue, L., Macdonald, E., and Henderson, A. (2018) Have your CAAQS and meet them too. David Suzuki Foundation, Ecojustice, and The Lung Association.

83 Air Quality Benefits Assessment Tool available at: https://www.science.gc.ca/eic/site/063.nsf/eng/h_97170.html.

The projected change in GHG emissions from 2015 levels in 2050 is presented in **Figure 2** for both a business-as-usual (BAU) scenario and a net-zero scenario. The BAU scenario is a forecast of Canada's future under all currently implemented policies and planned policies that have been publicly announced.

The BAU scenario used in this analysis shows GHG emissions decreasing slightly out to 2030 under existing and planned policy but staying relatively constant from there out to 2050 (**Figure 2**).

Figure 2: GHG emissions by scenario from 2020 to 2050



In the BAU scenario based on Canada's future under all currently implemented policies and planned policies that have been publicly announced, we miss both our international climate commitment for 2030 (511MT annual emissions), and our net-zero target for 2050. In fact, we are nowhere close. However, in the 2050 net-zero scenario, Canada meets both commitments.[84]

Navius Research's study also quantified the anthropogenic sources of criteria air contaminants (CACs) -- a set of common air pollutants mainly emitted by fossil fuel combustion and known to cause negative human health impacts -- and how they are expected to change over time. The CACs explored in this study include the following:

- Nitrogen oxides (NOx), which are produced during fossil fuel combustion. NO_2 is a primary contributing pollutant to the formation of ground-level ozone.
- Sulphur oxides (SOx), which are also produced during fossil fuel combustion from smelters, power plants, refineries, and internal combustion engine vehicles.
- Particulate matter (PM10 and PM2.5), which are airborne particles in solid or liquid form and include dust from roads and fugitive dust from construction and mining. They are categorized by size, which largely determines the extent

84 This graph excludes sequestration from land-use, land use change and forestry (LULUCF) and Western Climate Initiative (WCI) emission credits, estimated to be 100MT annual emissions by 2050.

of environmental and health damage. PM10 is particulate matter with a mass median diameter less than 10 microns and PM2.5 is less than 2.5 microns.
- Volatile organic compounds (VOCs), which are carbon-containing gases and fumes such as gasoline fumes and solvents that come from the transportation sector, industrial processes, and residential wood burning. VOCs are a primary contributing pollutant to the formation of ground-level ozone.
- Carbon monoxide (CO), which is produced by incomplete combustion of fuels and is mainly released from the tailpipes of internal combustion engine vehicles.
- Ammonia (NH3), which is emitted from livestock waste management and fertilizer production in the agricultural sector.

Under a 2050 net-zero GHG emissions scenario, CAC emissions are expected to decline as a result of a reduction in fossil fuel combustion through, for example, technology and fuel switching, efficiency gains, changes in sector output, and changes in industrial processes.

In a scenario where Canada achieves net-zero GHG emissions in 2050, all CAC emissions likewise decrease out to 2050 (**Figure 3**). Some pollutants, such as NOx, SOx and CO, decrease more than others under net-zero climate policy. This is due to a reduction in fossil fuel combustion as the transportation sector switches over to electric vehicles and as the activity of certain sectors, such as oil and gas production, is reduced over time. CACs that are emitted to mainly from sources other than fossil fuel combustion, such as PM and NH3, show less of a decrease over time under net-zero climate policy, as their main sources of emissions such as construction, road dust, and agricultural processes remain.

Figure 3: Change in CAC Emissions from 2015 Baseline

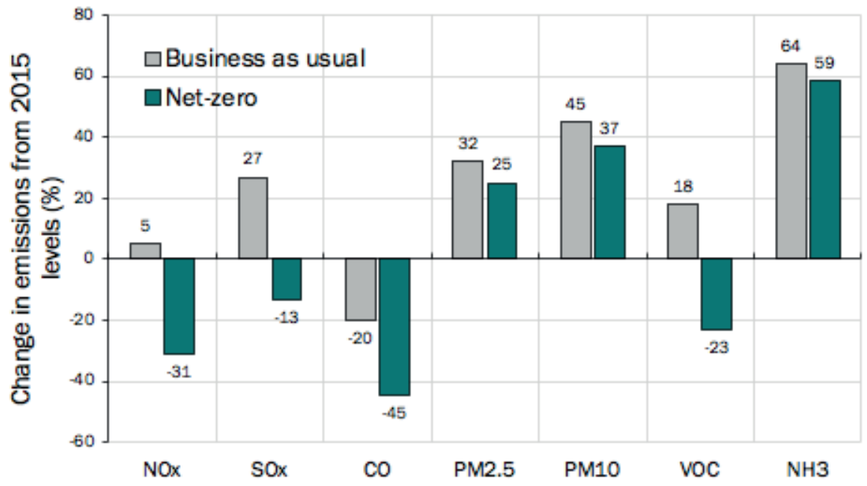
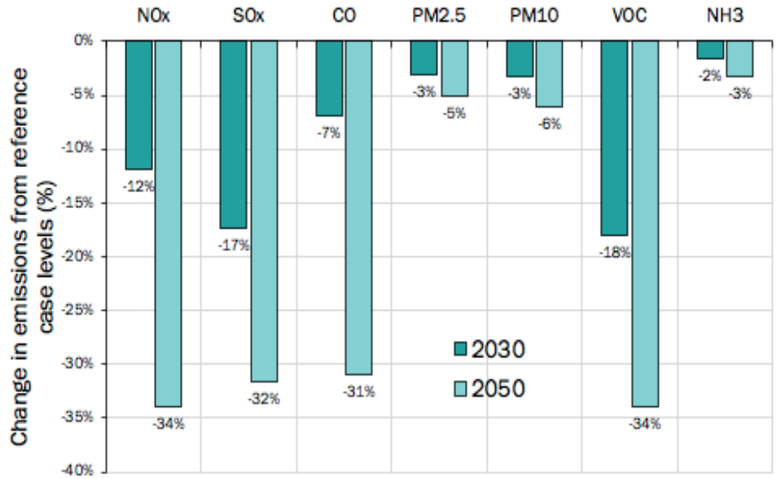


Figure 4, below, presents the projected change in CAC emissions comparing the net-zero policy scenario with the BAU scenario, showing emissions reductions at two time points: 2030 and 2050.

Figure 4: Change in CAC Emissions from BAU Scenario



In a scenario where Canada achieves net-zero GHG emissions in 2050, the associated reduction in CAC emissions leads to significant health benefits, including reductions in premature mortality due to chronic or acute exposure.

Table 1, below, summarizes the health benefits under a scenario leading to net-zero emissions by 2050 compared to the BAU case. Results show that air quality improvements lead to approximately $30 billion to $100 billion[85] in avoided costs[86] and approximately 5,000 to 11,000 annual avoided premature deaths in 2050.

This is an estimated cumulative impact of 112,081 lives saved from air-pollution related mortalities between 2030 and 2050 under a scenario where Canada meets our 2050 net-zero climate target.[87] That is approximately the current population of the City of Waterloo, Ontario.[88]

Table 1: Health gains from reaching net zero

	2030		2035		2040		2045		2050	
	Mean	90% CI*	Mean	90% CI	Mean	90% CI	Mean	90% CI	Mean	90% CI
Savings (billion 2015 $)	16.1	7.8-25.5	26.3	12.7-41.6	42.6	20.6-67.5	52.7	25.4-83.6	63.1	30.5-100.1
Lives saved (per year)	2136	1451-2823	3485	2358-4617	5655	3820-7496	7013	4741-9295	8397	5687-11118
Hospital admissions prevented (per year)	436	218-651	717	359-1072	1150	572-1722	1438	698-2171	1800	871-2720
Emergency room visits prevented (per year)	1647	803-2482	2582	1271-3878	4007	1971-6020	4940	2383-7465	6038	2914-9123

* There is a 90% probability that the value is within this range

85 2015 CAD.
86 Based on valuation of all health endpoints by Health Canada, including mortalities, hospital emissions, emergency room visits, and illnesses, symptoms, and poor-air-quality-restricted days.
87 90% confidence interval: 75,839 – 148,466.
88 Data from Statistics Canada: Census Profile, 2016 Census, Waterloo, Ontario.

Economic Recovery

The Economic Risks of Fossil Fuel Investments

Although the familiar can feel safe at a time of crisis, what worked in the past will not necessarily provide stability in the future. Fossil fuels have contributed much to the Canadian economy in terms of jobs and taxes but negative impacts have seldom been added to the balance sheet.

Internal regulatory documents obtained in 2018 via a Freedom-of-Information Act request estimated that cleaning up Alberta's fossil fuel industry could cost $260 billion, with only $1.6 billion having been collected by the government in liability securities.[89] Additionally, given the health impacts of both climate change and air pollution outlined above, it can be assumed that the externality costs borne by the public healthcare system as a result of burning fossil fuels are considerable.

Some of the chronic conditions associated with air pollution require years of ongoing management and health care, which means that health costs associated with air pollution are higher than lives lost alone. Similarly, there are social and health-related costs of climate change impacts -- including floods, wildfires, heat emergencies, Lyme Disease, and mental health stressors -- which will only increase as the planet continues to warm. Looking towards the future, the health risks and costs associated with fossil fuel combustion negate the benefits they offer.

The purely financial case for a transfer of public funds to fossil fuel companies is similarly weak. Former Governor of the Bank of Canada Mark Carney stated, "Firms that align their business models with the transition to net zero [emissions] will be rewarded handsomely... Those that fail to adapt will cease to exist." [90] He and others have been warning for year that many of the world's proven fossil fuel reserves will become stranded assets, meaning that the world's oil and gas companies are badly overvalued by the market.[91] This is known as the "carbon bubble"--and private sector investors are quickly realizing that they do not want to be invested in it when it bursts. The twin ethical and financial case for fossil fuel divestment has generated a worldwide movement, with health institutions accounting for US$42 billion dollars worth of funds divested between 2008 and 2018 as reported by the Lancet Countdown on Health and Climate Change.[92]

89 De Souza M, Jarvis C, McIntosh E, et al. (2018) Alberta regulator privately estimates oilpatch's financial liabilities are hundreds of billions more than what it told the public. *National Observer.*
90 Reguly E.(2020, Jan 3). Next stop, Ottawa: Mark Carney comes home with a mixed record at the BoE as questions surround his political ambitions. *Globe and Mail.* https://www.theglobeandmail.com/business/article-mark-carney-ends-his-high-flying-career-as-bank-of-england-governor/
91 The Huffington Post. (2014, Oct 16). Mark Carney Slams Bankers, Warns Most Of World's Oil Can't Be Burned. *The Huffington Post.* https://www.huffingtonpost.ca/2014/10/16/mark-carney-carbon-bubble-bankers_n_5997420.html
92 Watts N, Amann M, Arnell N, et al. (2019). The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate. *The Lancet,* 394: 1836-1878. DOI: 10.1016/S0140-6736(19)32596-6.

Given the amount of energy required to extract and process many Canadian reserves, there is a strong risk that our fossil fuel reserves will be among the first to be stranded as a result of existing trajectories of technological progress and climate-friendly international policy change.[93] A growing number of investors understand this: BNP Paribas, France's largest bank, announced it would stop funding oilsands projects three years ago;[94] Europe's largest bank, HSBC, announced it would stop funding oilsands projects two years ago;[95] and Dutch lender ING Groep NV has also announced it would not finance any of Canada's oilsands or major pipeline projects.[96]

Given what this means for medium- or long-term prospects of stable jobs, and taking into account unstable markets largely controlled by foreign policymakers, even on a purely financial basis the balance of risk and reward does not favour transferring public money to support the expansion and regular operation of fossil fuel extraction projects.

If the federal government's recovery spending is aimed at trying to preserve the status quo by funding the fossil fuel economy of the past – for instance, through direct corporate bailouts to the failing fossil fuel industry or spending on highway expansion -- there is no reason to believe that money will exist in the near- to medium-term to make the investments we need to transform our economy to fight the climate crisis.

The federal government can only spend so much. We can either make courageous choices now, or sign ourselves up to be climate laggards. Bailouts to fossil fuel companies will prevent Canada from meeting its climate targets[97] and risk increasing the negative health consequences, health and societal costs, and cascading crises faced by future generations.

In order for stimulus spending to take us from crisis to lasting safety, it must stabilize both the ecological and social elements that underpin health. It must do so by envisioning a world aligned with net zero by 2050, and inject money into the infrastructure and human requirements to build it. What follows below is a treatment plan: a blueprint for a healthy, sustainable recovery.

93 Mercure J-F, Pollitt H, Viñuales JE, et al. (2018) Macroeconomic impact of stranded fossil fuel assets. *Nature Climate Change*. DOI: https://doi.org/10.1038/s41558-018-0182-1.
94 Bisserbe, N., & Kent, S., (2017, Oct 12). BNP Paribas to Stop Financing Shale, Oil Sands Projects. *The Wall Street Journal.* https://www.wsj.com/articles/bnp-paribas-to-stop-financing-shale-oil-sands-projects-1507730419>
95 Twidale, S., & White, L., (2018, April 20) HSBC to stop financing most new coal plants, oil sands, arctic drilling. *Reuters.* https://www.reuters.com/article/us-hsbc-strategy-fossil-fuels/hsbc-to-stop-financing-most-new-coal-plants-oil-sands-arctic-drilling-idUSKBN1HR1NR
96 Lou, E. (2017, June 28). ING bank says it will not finance major Canadian pipeline projects. *Reuters.* https://www.reuters.com/article/canada-ing-groep-pipelines/ing-bank-says-it-will-not-finance-major-canadian-pipeline-projects-idUSL1N1JP17O
97 Office of the Auditor General (2018). *Perspectives on Climate Change Action in Canada—A Collaborative Report from Auditors General - March 2018* https://www.oag-bvg.gc.ca/internet/English/parl_otp_201803_e_42883.html#

Building Back Better

The first wave of federal spending in response to the economic impacts of COVID-19 supported the social determinants of health by seeking to ensure adequate income for people to keep food on the table and remain housed. The government did this chiefly in the form of support for individuals via the Canada Emergency Response Benefit (CERB), and help for businesses through the Canada Emergency Wage Subsidy and other programs designed to help businesses stay afloat and incentivize them to keep workers on their payroll. These measures have made possible the physical distancing required to flatten the curve of the coronavirus crisis.

Going forward, an extended and long-term period of physical distancing will likely be required along with the possibility of a prolonged economic recovery period. A gradual increase in climate-related disruption is also to be expected, with potential impacts on crops and other weather-dependent means of generating a livelihood. Given the number of Canadians who will find themselves in work-related transitions as a result of the pandemic, as well as the need for a nimble population in upcoming decades expected to hold the overlapping challenges of increasing automation as a result of artificial intelligence, changing opportunities related to a low-carbon transition, and increasing climate-related impacts, the government should consider transitioning the CERB into a longer-lasting and more comprehensive income support program to offer individuals increased security and opportunities for long-term planning.[98]

The government has signalled that it will execute on a second massive wave of spending timed for the period when public health officials deem it safe for Canadians to begin to congregate. This funding is intended to help pull us out of our current financial crater by stimulating the economy and creating employment opportunities for the unprecedented number of Canadians who are without work.

Economic Benefits of Climate Action

As part of the new research CAPE commissioned for this report, Navius Research has also simulated key economic impacts of an emissions scenario in line with Canada's climate target of net-zero emissions by 2050. The "clean" portion of the economy has also been quantified.[99]

98 Forget, Evelyn. (2011). The Town with No Poverty: The Health Effects of a Canadian Guaranteed Annual Income Field Experiment. *Canadian Public Policy.* 37. 283-305. 10.2307/23050182.
99 The definition used to quantify the clean economy in this analysis is based on the methodology in a 2019 analysis Navius Research completed for Clean Energy Canada: https://www.naviusresearch.com/publications/clean-energy-economy/

Clean gross domestic product (GDP) and employment are attributed to one of three categories:

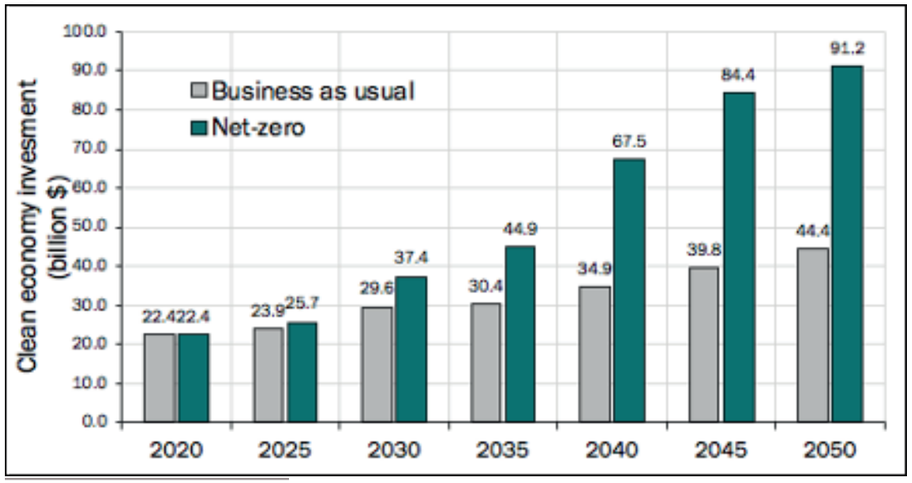
- Direct - This category includes GDP and employment of:
    1. sectors producing clean energy services (e.g. renewable electricity generation and transit); and
    2. value-added associated with the use of clean technologies in other sectors. For example, an electric vehicle may be used to provide courier services. Likewise, a clean building may be used to provide real estate services.
- Construction and services - This category includes construction and services required to install a given clean energy technology.
- Manufacturing - This category includes any manufacturing value-added (e.g. manufacturing an electric vehicle, if it occurs in Canada).

Clean investment is defined in this study as:

- Any investment into a sector that produces clean energy services. These sectors include renewable electricity generation, nuclear electricity generation, electricity transmission and distribution, bioenergy supply, transit, and rail.
- Investment into a technology or process determined to be clean. These technologies can occur in any sector of the economy (e.g. electric trucks in the trucking sector). Household consumption of clean technologies is reported as "investment".

Navius Research's simulation found that clean investment increases from 2020 to 2050 in both the business-as-usual and net-zero policy scenarios, although more significantly in the net-zero scenario. In this scenario, investment in the clean economy increases from $22.4 billion in 2020 to $91.2 billion in 2050, compared to clean investment of $44.4 billion in 2050 in the BAU case (see **Figure 5**, below).[100] This is a three-fold increase in clean investments in the net-zero scenario over this time period, compared to a one-fold increase in the BAU case scenario.

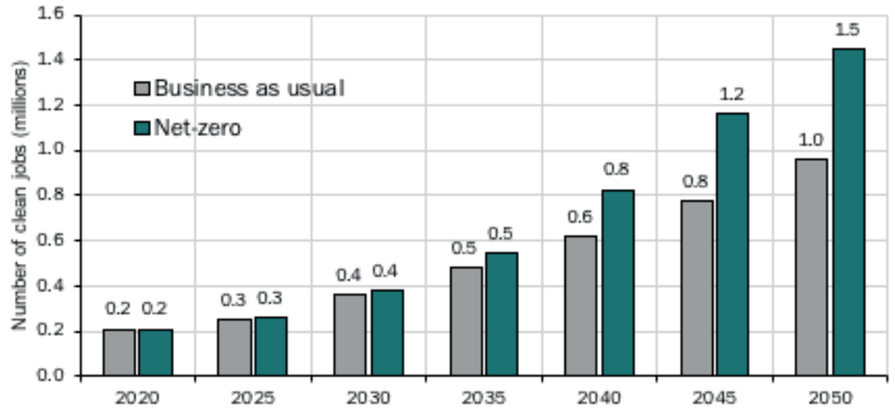
Figure 5: Clean economy investment in Canada



100 CAD 2015

In a scenario where Canada achieves our net-zero GHG emissions target in 2050, total jobs increase from 19.5 million full-time equivalent positions in 2020 to 23.6 million in 2050. Of these, clean jobs increase from 210,000 full-time equivalent positions in 2020 to 1.5 million in 2050 (see **Figure 6**, below**).** This corresponds to 500,000 more clean jobs in 2050 in the net-zero scenario than in the BAU scenario.

Figure 6: Number of clean jobs in Canada



Investments in a Healthy Future

In order to create a future where Canada meets its climate targets and produces 1.5 million clean Canadian jobs, saving over 100,000 Canadian lives from improvements to our air quality alone, the federal government must seize upon the opportunity to create a healthy recovery through investments in a clean economy.

In response to COVID-19, and in an effort to put us on a path to a safer and healthier future, we recommend these investments that put Canada on the path to meeting our greenhouse gas emissions reduction targets:

A. Investments and regulatory changes leading to decarbonization of:[101]
    - electricity generation by 2040,
    - public transit by 2040,
    - light-duty vehicles by 2050 (including new vehicles by 2030),
    - heavy-duty vehicles by 2050,
    - residential and commercial buildings by 2050, and
    - healthcare by 2050.
B. Investments in Protecting and Connecting to Nature

Further details for the successful and expedient implementation of all of these are outlined below.

Decarbonizing Energy, Transportation, Buildings, and Healthcare

In order to drive the deep decarbonization in the short-to-medium term that will be necessary for Canada to meet its climate emissions targets, we must first ensure our electricity production is clean, in order to provide a platform to decarbonize other areas of the economy through electrification.

We already have the technological solutions to nearly zero out emissions in electricity generation, personal vehicle transportation, and buildings. In an effort to reduce our emissions as quickly as possible, many of our recommendations are focused on these areas.
Along with these investments, we must also invest in reducing emissions in areas of the economy that are more difficult to decarbonize -- such as heavy-duty vehicles and industrial processes -- as quickly as possible.

These investments will help create the domestic need that will ensure Canada has a world-leading cleantech sector that brings solutions to market here at home, and then exports them internationally to help other countries drive down their emissions.

101 These timelines are aligned with Navius Research's 2050 net-zero emissions scenario.

Tom Rand, managing partner of ArcTern Ventures, describes the importance of a robust domestic cleantech market in setting up domestic companies to reduce emissions internationally:[102]

> *There's a good reason why Canadian focus is on exports, exports, exports. It speaks to how our economic self-interest and environmental aspirations are directly connected. Climate do-nothings complain Canada makes up less than 2% of global emissions, so why bother? The flipside of that argument can only be to aggressively affect the other 98%! There's no better way to do that than to export innovation solutions that out-compete fossil-fuels: better energy storage, cheaper solar, cellulosic ethanol that beats gasoline, etc. These Canadian technologies will lower the cost of compliance in India, Pakistan, China, Brazil, Indonesia, and elsewhere. [...]*
>
> *[W]ithout a domestic market, [our cleantech sector] won't capture the much larger global prize. The first thing a Chilean (or Pakistani, or Brazilian, or...) partner will demand is, 'Show me that it's working at home.' If you can't do that, there's no deal.*

While the focus of this report is federal stimulus that will drive down our emissions and create jobs, the actions articulated below will also help domestic companies reduce emissions abroad through exporting their products, services, and innovations.

Net-Zero Electricity Generation

Goal: Achieve 100% carbon neutral electricity by 2040

As we work toward net-zero electricity generation, Canada is starting from a strong base. Due mainly to the prevalence of hydroelectricity, particularly in British Columbia, Manitoba, and Québec, most of the power we generate in Canada is already emissions-free.

Phasing out unabated coal power is among the most critical macro-level targets for countries seeking to improve planetary health, and Canada should rightfully be proud of its track record on coal-power phase-out. In 2014, the last coal-fired power plant in Ontario closed, making it the single largest greenhouse-gas reduction measure in North American history.[103] However, Alberta, Saskatchewan, and Nova Scotia all continue to rely heavily on coal-fired plants.

The government estimates the accelerated national phase-out of unabated coal power that was announced in 2018 to result in cumulative emissions reductions of approximately 100Mt, and estimates the environmental benefits from avoided climate change damage and improved health outcomes at $4.9 billion over the period of 2019 to 2055.[104] The federal government then levered this commitment on the international stage to co-found the Powering Past Coal Alliance at COP23, which is catalyzing coal phase-out work internationally. Canada's work on coal-power phase-out is, in fact, a perfect example of the outsized impact that Canadian leadership at the intersection of health and the environment can have on international climate-friendly policies that benefit us all.[105]

102 Rand T (2020). *The Case for Climate Capitalism.* Toronto, ON.
103 Harris M, Beck M and Gerasimchuk I. (2015). *The End of Coal: Ontario's coal phase-out*. International Institute for Sustainable Development. https://www.iisd.org/sites/default/files/publications/end-of-coal-ontario-coal-phase-out.pdf
104 Environment and Climate Change Canada. (2018). *Backgrounder: Proposed amendments to coal-fired electricity regulations and proposed natural-gas-fired electricity regulations*. Ottawa, ON. <https://www.canada.ca/en/environment-climate-change/news/2018/02/proposed_amendmentstocoal-firedelectricityregulationsandproposed.html>
105 Powering Past Coal Alliance. (2020). *Declaration.* https://www.canada.ca/en/services/environment/weather/climatechange/canada-international-action/coal-phase-out/alliance-declaration.html

That said, in many cases the strategy to complete the national coal-power phase-out envisions a path through natural-gas-fired power. This is a dangerous route: not only does methane, the primary component of natural gas, have 84 times the warming potential of CO_2 over a twenty-year period,[106] but the upstream extraction and transport system is leaky,[107] leading to further near-term warming risks. Additionally, an increasing proportion of natural gas in Canada is being produced via hydraulic fracturing, which has been woefully understudied from a health perspective, but nevertheless for which evidence is accumulating of negative impacts on local human and environmental health.[108]

Renewable Energy

A transition that proceeds as directly as possible from coal-fired to renewably generated electricity is required, making investments in this sector a prime target for stimulus funds. Since recovery funding is meant to stimulate economic growth and support income by providing jobs quickly, a significant portion of these funds should be directed toward work with the provinces to fund new clean energy generation and related energy storage projects.

The most cost-effective investments that will lead to net-zero electricity generation are in renewable energy, including wind and solar power. Solar photovoltaic (PV) and wind energy costs dropped an extraordinary 88% and 69% respectively between 2009 and 2018.[109] Wind energy is now the lowest-cost option for new electricity supply (Ibid).

New renewable energy projects (especially small-scale wind, solar, and micro-hydro)[110] can often begin construction fairly quickly and create many jobs. They are also well suited for important investments in renewable projects that will help remote Indigenous communities move away from diesel power generation.[111]

Government partnerships with the private sector to make investments in large-scale projects would also be prudent, particularly now as current interest rates lowered by the Bank of Canada in response to the pandemic make financing these projects more affordable.[112] Support for this sector should be immediate and in the form of direct investments, grants, and loans. The Canadian government could institute and invest the funds to capitalize a Green Bank as other jurisdictions like New York[113] and Connecticut[114] have done, which would have the funding and mandate to invest directly in renewable energy projects, while working with the provinces to deploy smart grid technologies and drive non-emitting electrification of our energy.

Since this structure would take time to set up, the government may instead prefer to work through pre-existing entities to quickly expand their mandates and staff them for greater subject-matter expertise and capacity, such as the Infrastructure Bank, programs administered by relevant departments, or some mix of these.

In a recent open letter[115] by more than 200 recipients of Canada's Clean 50 award asked the federal government to support the cleantech sector by immediately expanding funding to the Business Development Bank of Canada, Sustainable Development Technology Canada, Export Development Canada, and Western Economic Diversification and regional economic development programs with a mandate to ensure the funds will get deployed.

In the last few years, the government has put forward several infrastructure programs administered by Natural Resources Canada, including the Emerging Renewable Power Program,[116] Smart-Grid Program,[117] and the Low Carbon Economy Champions Fund,[118] that focused on encouraging renewable energy production. Further renewable energy investments could be implemented through subsequent funding phases of these funds.

The federal government should focus special attention on investments in renewable energy in remote Indigenous communities. In their recent election platform, the Liberal Party of Canada committed to ensuring that Indigenous communities that currently rely on diesel are powered by clean, reliable energy by 2030.[119] Now is the time to speed these timelines by greatly expanding investment in already-existing government programs that fund feasibility studies, and capacity building for Indigenous community members, businesses and Indigenous economic development corporations. The Pembina Institute has suggested that these program budgets should, at minimum, be increased by at least ten times their current value as they are already underfunded and oversubscribed.[120]

Clean energy analysts Ralph Torrie and Céline Bak recently developed a ten-year electricity

106 IPCC. (2014). *Climate Change 2014 Synthesis Report; Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* 2014. [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
107 Government of Canada. (2018). *Canada's methane regulations for the upstream oil and gas sector.* https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/proposed-methane-regulations-additional-information.htm
108 Macfarlane R., and Perrotta K. (2020). *Fractures in the Bridge: unconventional (fracked) natural gas, climate change and human health.* Canadian Association of Physicians for the Environment. https://cape.ca/wp-content/uploads/2020/01/CAPE-Fracking-Report-EN.pdf
109 L Lazard Ltd. (2018). *Lazard's Levelized Cost of Energy Analysis – Version 12.0.* https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf
110 Smart Prosperity Institute (2009). *Building a Green Economic Stimulus Package for Canada.* https://institute.smartprosperity.ca/sites/default/files/publications/files/Building%20A%20Green%20Economic%20Stimulus%20Package%20for%20Canada.pdf
111 Lovekin D., Dronkers B. (2015). *Innovation and resiliency on the microgrid.* Pembina Institute. https://www.pembina.org/blog/innovation-and-resiliency-on-the-microgrid
112 The Bank of Canada. (2020). *COVID-19: Actions to Support the Economy and Financial System.* https://www.bankofcanada.ca/markets/market-operations-liquidity-provision/covid-19-actions-support-economy-financial-system/
113 NY Green Bank. (2020). *About.* https://greenbank.ny.gov/About/About
114 Connecticut Green Bank. (2020). *About us.* https://ctgreenbank.com/about-us-2019/
115 See: <https://clean50.com/cleanreset/>
116 Natural Resources Canada. (2020). *Emerging Renewable Power Program.* https://www.nrcan.gc.ca/climate-change/green-infrastructure-programs/emerging-renewable-power/20502
117 Natural Resources Canada. (2019). *Smart Grid Program.* https://www.nrcan.gc.ca/climate-change/green-infrastructure-programs/smart-grids/19793
118 Government of Canada. (2019). *Low Carbon Economy Challenge* https://www.canada.ca/en/environment-climate-change/services/climate-change/low-carbon-economy-fund/challenge.html
119 The Liberal Party. (2020). *Clean, reliable energy.* https://www2.liberal.ca/our-platform/clean-reliable-energy/
120 Lovekin D. (2020). *Rebuilding Canada's economy includes energy resiliency in remote communities.* Pembina Institute. https://www.pembina.org/blog/rebuilding-canadas-economy-includes-energy-resiliency-remote-communities

decarbonization scenario for Canada.[121] They suggested the magnitude of the investments in renewables necessary to achieve this net-zero scenario would be $57 billion for 28.5 GW of wind capacity, and $30 billion for 15 GW of solar capacity if investments in electricity transmission infrastructure are made, thereby sending a signal to investors of the intent to decarbonize Canada's grid.

Storage

The main impediment to powering our electric grids entirely with solar and wind power is the variable nature of these sources. In order to increase our ability to generate a larger percentage of our electricity through renewable sources, the federal government should also invest in storage and long-distance transmission.

Energy storage allows us to store renewable energy when we produce more than we need, in order to use it when we are not producing as much. Other countries are developing bulk-system energy storage projects, such as lithium-ion battery, compressed air energy storage and variable-speed pumped hydro.

Industry has asked that the federal government establish an Emerging Energy Storage Program focused on large scale, long-duration transmission-connected energy storage to support project financing and the ability to access low-cost capital.[122]

In their aforementioned net-zero electricity generation scenario, Torrie and Bak suggested the magnitude of the investments in storage necessary to achieve it would be $5 billion.

Electricity Transmission

Along with investments in clean energy generation, the federal government must also invest in the long-distance electricity transmission infrastructure necessary to move clean energy to areas of the country that are currently reliant on high-carbon electric generation. Alberta and Saskatchewan rely on coal for electricity generation, despite the fact that neighbouring provinces generate more hydroelectricity than they can use, mainly exporting it to the United States. Nova Scotia and New Brunswick similarly rely on coal despite their proximity to Québec, which also exports its surplus hydroelectric power mainly to the United States.

After declining more than 90% over the last 15 years, Ontario's emissions from electricity generation are set to double by 2023 and almost triple by 2030, according to forecasts in Ontario's Independent Electricity Systems Operator's latest 20-year planning outlook.[123] As

121 Torrie R., Bak C. (2020). *Building Back Better with a green power wave*. Corporate Knights. https://www.corporateknights.com/channels/energy/building-back-better-green-power-wave-15881589/

122 Energy Storage Canada (2019). Written Submission for the Pre-Budget Consultations in Advance of the 2020 Budget. https://static1.squarespace.com/static/54485dc4e4b0f7bd2239a06b/t/5de6d3c6954b2a4c18f64b48/1575408583469/2020+Pre-Budget+Submission+from+Energy+Storage+Canada+-+August+2%2C+2019.pdf

123 Independent Electricity Systems Operator (2020). *Annual Planning Outlook: A view of Ontario's electricity system needs.* Toronto, Ontario.

planned nuclear refurbishments and retirements are executed, that electricity generation is set to be replaced by gas-fired electricity generation, as the Ontario government cancelled more than 750 early-stage wind- and solar-energy contracts immediately after the election in 2018. This cost the province $231 million[124] in penalties along with thousands of jobs. Ontario could in part remediate the greenhouse gas emissions impacts of this through importing hydroelectric power from Québec rather than increasing gas-fired electricity generation.

In order to decarbonize electricity, the Canadian government should continue to invest in similar projects as the Birtle Transmission Line,[125] which allows clean hydroelectric power to flow from Manitoba to Saskatchewan. Informed by work undertaken by the Regional Electricity Cooperation and Strategic Infrastructure (RECSI), Torrie and Bak have articulated the following shortlist of projects for a carbon-free Canadian electricity generation grid, totalling $8.3 billion:[126]

- Add a 500 kilovolt connection between B.C. and Alberta to facilitate clean power flow to and from Alberta, $2–2.8 billion
- Strengthen the intra-provincial grids in Alberta and Saskatchewan to facilitate the growth of wind energy supply, $1.3 billion (transmission only)
- Add a new high-voltage connection between Manitoba and Saskatchewan, $2 billion
- Build an additional Nova Scotia/New Brunswick tie line to facilitate the flow of Québec hydropower to the Maritimes, $500 million
- Upgrade the current interconnection and build a new 2,000 MW high-voltage, direct-current (HVDC) connection between Ontario and Québec to facilitate the supply of hydropower to Ontario and provide Ontario with access to seasonal reservoir storage in Québec, $1.7 billion

Recommendation #2

The federal government should make the necessary investments in renewable energy production, energy storage capacity, and long-distance transmissions lines to put the country on track for net-zero electricity generation by 2040.

Supporting Transitioning Energy Workers

Due to the recent downturn in the fossil fuel industry, Canada now has a vast number of former fossil fuel workers with highly transferable skills. Government stimulus funds must create training opportunities to provide these workers and others with the skills needed for them to help build Canada's clean economy.

124 Financial Post (2019). *Doug Ford's cancellation of green energy deals costs Ontario taxpayers $231 million.* https://business.financialpost.com/commodities/energy/doug-fords-cancellation-of-green-energy-deals-costs-ontario-taxpayers-231m

125 Government of Manitoba (2020). *News Release: Transmission Line to Reduce Greenhouse-Gas Emissions and Create More Reliable Power Supply.* https://news.gov.mb.ca/news/index.html?item=46897&posted=2020-03-02

126 Torrie R., Bak C. (2020). *Building Back Better with a green power wave*. Corporate Knights. https://www.corporateknights.com/channels/energy/building-back-better-green-power-wave-15881589/

Iron and Earth, a Canadian non-profit organization led by skilled trades workers with experience in Canada's oil industry, has developed a four-point Workers' Climate Plan to ensure that fossil fuel workers are active and included participants in this transition.[127] The first point of their plan is building up Canada's renewable energy workforce by rapidly upskilling energy sector workers through short-term training programs and expanding apprenticeship programs. The second, which directly connects the need for clean energy investments outlined above, is a call to build up the manufacturing capacity of renewable energy products through the retooling and advancement of existing manufacturing facilities. The third is positioning existing energy sector unions, contractors, manufacturers, and developers within the renewable energy sector through incubator programs and multi-stakeholder collaboration initiatives. The fourth is integrating renewable energy technologies and industrial-scale energy efficiency projects into existing non-renewable energy infrastructure.

We must also recognize that just as the impacts of climate change are distributed unequally, the impacts of the current economic recession and related job losses have been distributed unequally. Women were more likely to lose their job during the beginning stages of the recession and are now having a harder time than men returning to Canada's labor force as persistent childcare issues weigh, and jobs in the male-dominated goods sector return faster than those in the service industry.

According to Statistics Canada, total employment increased by just 1.1 per cent for women in Canada in May 2020, compared with 2.4 per cent for men.[128] Men were also more likely to have recovered jobs lost in March and April due to temporary COVID-19 shutdowns.[129] The service-sector, which generally requires face-to-face interaction and has thus been harder hit, is traditionally more female dominated.

Among parents with at least one child under the age of 6, men were roughly three times more likely to have returned to work than women. Women with children under 18 were also more likely to be working less than half of their usual hours.[130] It seems clear that there will be no recovery for many women until childcare gaps are addressed.

So while skills-training that acts as a top-up for workers in the fossil fuel industry is important and worthy of funding, the government must also fund skills training that transitions people from sectors that are dissimilar, so that people formerly in the service sector have opportunities to transition to the clean economy jobs of the future. There is also evidence to suggest that skills-training programs offered exclusively to women can be of benefit.[131]

Recommendation #3

The federal government should fund skills training programs to support the just transition of workers into renewable energy.

127 Iron and Earth. (2016). *Workers Climate Plan Report: A Blueprint for sustainable jobs and energy.* https://d3n8a8pro7vhmx.cloudfront.net/themes/5640eaf72213934458000001/attachments/original/1480293178/Iron_and_Earth-WCP_Nov_2016_vers_2.pdf?1480293178
128 Statistics Canada (2020). Labour Force Survey, May 2020. Ottawa, ON. https://www150.statcan.gc.ca/n1/daily-quotidien/200605/dq200605a-eng.htm
129 *Ibid.*
130 *Ibid.*
131 Boost. (2017). The benefits of 'women specific' training courses. https://www.boostbusinesslancashire.co.uk/inspiration/the-benefits-of-women-specific-training-courses/

Net-Zero Transportation

Goal: Achieve 100% zero-emissions in transit by 2040, and in light- and medium-duty vehicles by 2050, while building cities that support active transportation.

Transportation accounts for approximately one quarter of Canada's greenhouse gas emissions.[132] In addition to harming the climate, these emissions contribute to 25% of Canada's air pollution, posing serious and immediate risks to human health.[133] The health impacts of air pollution include comorbidities such as asthma and diabetes that put people at greater risk of more severe COVID-19 symptoms. Canada also had the highest pediatric asthma rate amongst countries of comparable income level in a recent review, with nitrogen dioxide (NO_2) from traffic responsible for approximately 1 in 5 new cases of asthma in children.[134] Meanwhile, transitioning from passive transport to active transport modalities saves lives and healthcare-related costs through improved activity levels. It also enriches community life and relieves depression and anxiety.[135] Compared to many international locations, Canada's active transport rates are very low,[136] making investment in low-carbon, active travel a very high-impact target for stimulus funds.

Personal Vehicles

Canada's auto production is among the top 15 in the world at over 2 million light-duty vehicles per year.[137] However, Canada's auto manufacturing is not well positioned to grow with the global transition to electric. Changing this protects our industry and its related jobs as the global market transitions, while providing opportunities to clean our air and keep children out of emergency departments with asthma exacerbations.

Zero Emissions Vehicle Jobs

Nearly every automaker has committed to major investments in developing a spectrum of new electric vehicles.[138] Globally, light-duty electric vehicle sales have grown over 60% per year since 2012, to over 2 million in 2018.[139]

132 Natural Resources Canada. (2020). *Energy and Greenhouse Gas Emissions (GHGs).* Government of Canada https://www.nrcan.gc.ca/science-data/data-analysis/energy-data-analysis/energy-and-greenhouse-gas-emissions-ghgs/20063
133 Environment and Climate Change Canada. (2020). Canada's official greenhouse gas inventory. Ottawa, ON. https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html
134 Achakulwisut P, Brauer M, Hystad P, et al. (2019). Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO2 pollution: estimates from global datasets. *The Lancet Planetary Health*. 3: e166-e178. DOI: 10.1016/S2542-5196(19)30046-4.
135 Howard C, Rose C and Hancock T. (2017). *Lancet Countdown 2017 Report: Briefing for Canadian Policymakers.* Lancet Countdown and Canadian Public Health Association. https://storage.googleapis.com/lancet-countdown/2019/10/2017-lancet-countdown-canada-policy-brief.pdf
136 Howard C, Rose C and Hancock T. (2017). *Lancet Countdown 2017 Report: Briefing for Canadian Policymakers.* Lancet Countdown and Canadian Public Health Association. https://storage.googleapis.com/lancet-countdown/2019/10/2017-lancet-countdown-canada-policy-brief.pdf
137 Sharpe, B., Lutsey, N., Smith, C., and Kim, C. (2020). The Power Play: Canada's Role in the Electric Vehicle Transition. International Council on Clean Transportation. https://www.pembina.org/reports/canada-power-play-zev-04012020.pdf
138 *Ibid.*
139 *Ibid.*

Over the next decade, automakers will be investing heavily in preparing to manufacture low- and zero-emissions vehicle technologies. Last year, Reuters analyzed investment and procurement budgets announced by automakers over the past two years and found that $300 billion is currently devoted to electric vehicle (EV) technologies.[140]

While the shift to low- and zero-emissions medium- and heavy-duty vehicles is less advanced than for passenger vehicles, this is also changing quickly: as of the end of 2018, there were 421,000 electric buses in China alone.[141]

The federal government should implement (or in some cases, expand existing) investments to attract and expand good, middle-class, zero-emission vehicle jobs:

- Investment in loans, grants and tax incentives for ZEV manufacturers to create new electric vehicle manufacturing facilities or retrofit existing facilities;
- Investment in loans, grants and tax incentives for the remainder of the ZEV supply chain, battery recycling, and charging infrastructure; and
- Investment in ZEV research and development, including funds to launch strategically placed ZEV accelerators connected to Canadian universities.

The federal government should expand investment in ZEV automotive innovation and directly fund major research projects to bolster this sector and provide direct and spin-off jobs. Projects funded should include:

- new product research and development (e.g., advanced ZEV technologies, advanced lightweight components and materials);
- leading-edge engineering and design, and prototype development;
- advanced ZEV product testing;
- the development of new ZEV production methods and process technologies; and
- new, expanded, or retrofitted facilities to produce leading-edge ZEV and powertrains.

Recommendation #4

The federal government should invest in electric vehicle manufacturing, research and development, the electric vehicle supply chain, and skills-training for our workforce to transition into these areas.

140 Lienert,P., Shirouzu, N., & Taylor, E. (2019, January 10). Exclusive: VW, China spearhead $300 billion global drive to electrify cars. *Reuters.* https://ca.reuters.com/article/businessNews/idCAKCN1P40G6-OCABS
141 Eckhouse, B. (2019 May, 15). The U.S. Has a Fleet of 300 Electric Buses. China Has 421,000. *Bloomberg.* https://www.bloomberg.com/news/articles/2019-05-15/in-shift-to-electric-bus-it-s-china-ahead-of-u-s-421-000-to-300

Charging Infrastructure

Many new car buyers in Canada lack home charging access, particularly those living in apartments and condominiums. Given that more than 90% of charging typically happens at home, the federal government should increase its planned investments to ensure that every resident in Canada has access to home charging. Focusing government investment in access to home chargers is key.

This is indeed the focus of the federal government's current EV charging infrastructure funding program, which is specifically targeted at owners and occupants of multi-unit residential buildings. This program is currently budgeted for $130 million in funding over five years to cover half the cost of EV charging installation for eligible transit, workplace, fleet, on-street, and multi-unit residential projects. We endorse this proposal.

There are also multiple highway legs in Canada that require additional charging stations in order for rural uptake of electric vehicles to happen at scale. Investments in the construction of this infrastructure would put people to work immediately and should be prioritized.

Recommendation #5

The federal government should invest in zero-emission vehicle charging/refueling infrastructure, particularly for apartment, condominium buildings, and along highways.

ZEV Sales Mandate

As noted in a recent report conducted jointly by the Pembina Institute and International Council on Clean Transportation, the predominant action Canada can take to spur electric vehicle manufacturing is to grow its domestic electric vehicle sales market. Globally, 80% of EVs are manufactured in the region they are sold.[142]

The most effective, low-cost, and transformative public policy for Canada to increase EV sales to quickly ensure a robust market for zero-emission vehicles and infrastructure is to adopt a national ZEV sales mandate similar to what General Motors has proposed[143] and

142 Sharpe B., Lutsey N., Smith C., and Kim C. (2020) Power Play: Canada's Role in the Electric Vehicle Transition. International Council on Clean Transportation and the Pembina Institute. https://www.pembina.org/reports/canada-power-play-zev-04012020.pdf
143 General Motors (2018). *General Motors Calls for National Zero Emissions Vehicle (NZEV) Program*. Press Release.*https://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2018/oct/1026-emissions.html#:~:text=General%20Motors%20supports%20a%20nationwide,then%2025%20percent%20by%202030.*

what Quebec,[144] British Columbia,[145] California,[146] New York,[147] New Jersey,[148] Massachusetts, and other U.S. states already have: requiring automakers to sell a certain percentage of ZEVs, with a credit trading system to improve overall market efficiency.

Analysis by Navius Research Inc estimates that a strong national ZEV policy framework including a ZEV mandate and subsidies for electric vehicle manufacturing could grow to account for $152 billion of Canadian GDP and employ 1.1 million workers by 2040.[149]

The federal government should adopt a zero-emission vehicle (ZEV)[150] sales mandate that will require automakers to meet an escalating annual percentage of new light-duty zero-emission vehicle sales:

- 10% in 2023,
- 30% in 2025, and
- 100% by 2030.

This would be a more aggressive timeline than the sales mandate in British Columbia, which is currently the most aggressive in the country. However, electric vehicle sales in BC are already indicating that their timelines are not aggressive enough; they were already bumping up against their 2025 target last year.[151] The above timelines would still be less aggressive than Norway, whose goal is to phase out new fossil fuel light-duty vehicles by 2025.

When we account for the lifecycle of the internal combustion engine vehicles sold prior to 2030, these targets would lead Canada's entire vehicle fleet to be effectively entirely replaced with zero-emission vehicles by 2050.

Recommendation #6

The federal government should implement a national zero-emissions vehicle sales mandate that ratchets up gradually to 100% of light-duty vehicles sold by 2030.

144 Environnement et Lutte contre les changements climatiques (2017). *The Zero-Emission Vehicles (ZEV) Standard Comes into Effect - Automakers will have to offer more rechargeable electric and hybrid vehicle models in Québec*. Government of Québec. Press Release. Montréal, QC. http://www.environnement.gouv.qc.ca/infuseur/communique_en.asp?no=3907
145 Ministry of Energy, Mines and Petroleum Resources (2019). New act ensures B.C. remains leader on clean energy vehicles. Press Release. Government of British Columbia. https://news.gov.bc.ca/releases/2019EMPR0018-001077
146 California Air Resources Board. (2019). Fact Sheet: The Zero Emission Vehicle (ZEV) Regulation. https://ww2.arb.ca.gov/sites/default/files/2019-06/zev_regulation_factsheet_082418_0.pdf
147 Department of Environmental Conservation. (2018). Low and Zero Emission Vehicles. New York State Government. https://www.dec.ny.gov/chemical/8575.html
148 Department of Environmental Protection (2020). NJ Low Emission Vehicle Program. Government of the State of New Jersey. https://www.state.nj.us/dep/cleanvehicles/LEV.pdf
149 Sharpe, B., Lutsey, N., Smith, C., and Kim, C. (2020). The Power Play: Canada's Role in the Electric Vehicle Transition. International Council on Clean Transportation.
150 This term is inclusive of hydrogen fuel-cell electric vehicles as well as electric vehicles.
151 CTV News Vancouver Island (2019 November, 29) B.C. has highest per-capita EV sales in North America: province. https://vancouverisland.ctvnews.ca/b-c-has-highest-per-capita-ev-sales-in-north-america-province-1.4707309

In today's market, ZEVs are more expensive than their gasoline counterparts. The federal government and some provincial governments have closed this gap through consumer incentives. Additionally, prices are anticipated to fall with increased production and technological improvements in the next few years.[152]

Unfortunately, even when the sticker price of an EV is at par due to financial incentives, the cost of leasing the vehicle is often much higher.[153] Because banks have little historical data on what the value of an EV will be at the end of the lease period, they base the lease price on worst-case actuarial assumptions that the EV will experience maximum depreciation over the course of the lease. This leads to monthly payments for EV leases that can be double the price of the fossil fuel equivalent. We endorse Torrie and Bak's proposal of a federal government guarantee of EV automotive loans over a period of three years to enable banks to collect data on the real residual value of EVs so that their lease prices are more affordable for consumers.

Recommendation #7

The federal government should guarantee electric vehicle automotive loans over a period of three years so that their lease prices are more affordable for consumers.

Public Transit and Rail

Many health benefits are achieved by investing in a high-quality public transport system. Public transit facilitates our ability to visit areas beyond walking or cycling distance, giving people the option of not owning an automobile. This allows them to use active transportation for most of their travel.[154]

Given the active transport required to get to nodes, public transport should be regarded as not only lower carbon, but also better able to prevent chronic disease than single-passenger options. Unfortunately, public transit systems are being financially battered by the effects of the pandemic; the Toronto Transit Commission saw a drop in ridership of 72%.[155]

Canada must invest in public transit with zero-emission technologies, leading to fully decarbonized public transit by 2040. Recovery funds should include this, and the federal government should drop the requirement for matching funds from other jurisdictions in order to do so.

152 Bullard, N. (2019 April, 12). Electric Car Price Tag Shrinks Along With Battery Cost. *Bloomberg*. https://www.bloomberg.com/opinion/articles/2019-04-12/electric-vehicle-battery-shrinks-and-so-does-the-total-cost
153 Torrie, R. & Bak, C. (2020, May 6). Building Back Better with a green mobility wave. *Corporate Knights*. https://www.corporateknights.com/channels/transportation/white-paper-building-back-better-green-mobility-wave-15887635/
154 Daniel K., Perrotta K. (2017). *Prescribing Active Travel for Healthy People and a Healthy Planet: A Toolkit for Health Professionals*. Canadian Association of Physicians for the Environment (CAPE). https://cape.ca/prescribing-active-travel-for-healthy-people-and-a-healthy-planet-a-toolkit-for-health-professionals/
155 Passifiume B., (2020 April 4). Over 2,000 TTC workers off the job due to COVID-19: Source. *Toronto Sun*. https://torontosun.com/news/local-news/over-2000-ttc-workers-off-the-job-due-to-covid-19-source

The federal government should work with the provinces to sharply increase investment in public transit, while electrifying passenger and freight rail.

These investments should include:

- zero-emission transit and school buses and charging infrastructure for local service
- high-capacity streetcars
- higher reliability, faster light rail lines in dedicated rights-of-way
- high-capacity subway lines in dense areas, and
- long-distance electrified rail for regional and commuter mobility.

Canadian companies are leaders in this space, from electric school buses[156] and transit buses,[157] to electric streetcars.[158] These investments will create Canadian jobs now.

Recovery funds should also be directed toward replacing current diesel school buses with electric buses, which will also significantly reduce the air pollution around elementary schools that negatively affects children's lungs.

Recommendation #8

The federal government should invest in public transit systems to ensure they are financially sustainable in the short-term through immediate transfers of funds for operational costs and ensure our public transit systems and school buses are equipped for the future through working with provinces and municipalities to make investments in zero-emission transit technology.

Freight

The Canadian government should also invest in technologies to reduce emissions from our freight sector. This sector already makes up approximately 30% of our transportation emissions, and according to government estimates will exceed emissions from personal vehicles by 2030.[159]

Due to technical challenges related to weight, the mass production of zero-emission class 8 heavy-duty vehicles (semis) has lagged behind personal vehicles. However, companies such as Tesla and Nikola have announced production of electric heavy-duty vehicles next year.[160] Nikola has also announced production of hydrogen fuel-cell electric heavy duty vehicles by 2023.[161] Toyota is also currently testing prototypes of its second version of its hydrogen fuel-cell electric heavy duty vehicle.[162]

156 Lion Electric. (2020). *Electric School Bus*. Retrieved June 12, 2020. https://thelionelectric.com/en/products/electric>
157 New Flyer of America. (2020). *Xcelsior Charge*. Retrieved June 12, 2020. https://www.newflyer.com/buses/xcelsior-charge/>
158 Bombardier. (2018 June 11). *The new streetcar that rides at the pace of the city.* Retrieved June 12, 2020. https://www.bombardier.com/en/media/newsList/details.BT_20180611-the-new-streetcar-that-rides-at-the-pace-of-the-city.bombardiercom.html?
159 The Government of Canada. (2019). *Climate change: second biennial report.* https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/second-biennial-report.html
160 Coppola G., Hull D (2020). Tesla shares soar past $1,000 after Elon Musk seizes on Nikola hype with Semi truck production memo. *Financial Post.* https://business.financialpost.com/investing/tesla-vs-nikola-shares-soar-elon-musk-nikola-hype

Recommendation #9

The federal government should invest in zero-emission heavy duty vehicle purchase incentives and commercial hydrogen refuelling and electric charging infrastructure.

The uptake of hydrogen fuel-cell electric vehicles in particular will drive job creation in Canada, since we are home to a significant concentration of hydrogen and fuel cell companies in various areas of the transportation-related supply chain — including hydrogen production and delivery, refueling stations, and fuel-cell vehicle engineering and manufacturing. The largest cluster of hydrogen and fuel cell companies in Canada is located in British Columbia around Ballard Power, but there are also companies based in Ontario, Alberta, New Brunswick, and Manitoba.[163]

Recommendation #10

The federal government should invest in the hydrogen supply chain, including hydrogen production, logistics, and hydrogen fuel-cell manufacturing.

Walking and Biking

Because of Covid-19, a number of city councils have approved temporary road closures, either partial or complete, as an emergency transportation measure that allows for physical distancing. Municipal governments across Canada are moving quickly to create clearly marked bicycle lanes in order for people to travel safely through cities.

Vancouver, Victoria, Calgary, Winnipeg, Ottawa, Kitchener, Toronto, Montreal and Moncton have all recently extended their cycling networks.[164]

Earlier this year, Infrastructure Minister Catherine McKenna appointed Halifax MP Andy Fillmore to lead the creation of Canada's first ever National Active Transportation Strategy, which is something for which CAPE has been advocating. The federal government should speed this process and invest heavily in active transportation infrastructure projects, even

161 Coppola G., Hull D (2020). Tesla shares soar past $1,000 after Elon Musk seizes on Nikola hype with Semi truck production memo. *Financial Post.* https://business.financialpost.com/investing/tesla-vs-nikola-shares-soar-elon-musk-nikola-hype
162 Eisenstien, P. (2019, January 19) Toyota, Paccar team up on clean hydrogen trucks for polluted LA ports. *CNBC.* https://www.cnbc.com/2019/01/10/toyota-paccar-team-up-on-clean-hydrogen-trucks-for-la-ports.html
163 Sharpe B., Lutsey N., Smith C., and Kim C. (2020) Power Play: Canada's Role in the Electric Vehicle Transition. International Council on Clean Transportation and the Pembina Institute. https://www.pembina.org/reports/canada-power-play-zev-04012020.pdf
164 Buckner D. (2020, June 7). Bike lanes installed on urgent basis across Canada during COVID-19 pandemic. *CBC News.* https://www.cbc.ca/news/business/bike-lanes-covid-pandemic-canada-1.5598164

in the absence of matching funds from provinces and municipalities. Such projects would be for permanent infrastructure like separated bike lanes (or cycle tracks) that will allow people to travel safely while maintaining physical distancing. This investment would lead to job growth in the construction of this infrastructure immediately.

Along with the jobs these projects will support and the emissions reduced, investing in safe, active transportation infrastructure improves health outcomes for Canadians. Installing cycling infrastructure can improve cyclist safety dramatically, which leads to more people choosing to cycle. A study in Vancouver and Toronto found that cycle tracks protected by raised curbs, bollards or concrete barriers on roads without parking are 89% safer on a per-trip basis than roadways with parked cars and no cycling infrastructure.[165] Another recent study conducted in Toronto found that streets with cycle tracks draw 2.57 times more cyclists once cycle tracks are installed. Even though there were more bikes on the roads, there was a 38 per cent reduction in cyclist/motor vehicle collisions than in the two years prior to the installation of the cycle tracks.[166]

This is important in part because regular cycling and walking improves health outcomes. A meta review found that walking or cycling to work was associated with an overall 11% reduction in cardiovascular risk.[167] One study found that every additional kilometre walked per day is associated with a 4.8% reduction in the likelihood of obesity, whereas each hour spent in a car is associated with a 6% increase in the likelihood of obesity.[168] Evidence also suggests that active transportation reduces diabetes, hypertension, pulmonary diseases, several cancers, anxiety disorders, and even cognitive problems.[169]

Recommendation #11

The federal government should work with municipal leaders to sharply increase federal investment in infrastructure that makes our cities and towns more walkable and bikeable, from traffic-calming measures to separated bike lanes.

165 Teschke K., Harris M.A., Reynolds C.C.O., Winters M., Babul S., Chipman M., Cusimano M.D., Brubacher J.R., Hunte G., Friedman S.M., Monro M., Shen H., Vernich L., and Cripton P.A. (2012). Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study. *American Journal of Public Health* 102, 2336_2343. https://doi.org/10.2105/AJPH.2012.300762

166 Ling R., Rothman L., Cloutier M-S., Macarthur C., Howard A. (2019). Cyclist-motor vehicle collisions before and after implementation of cycle tracks in Toronto, Canada. *Accident Analysis & Prevention,* Volume 135, 105360. https://doi.org/10.1016/j.aap.2019.105360

167 Hamer M., Chida Y. (2008). Active commuting and cardiovascular risk: a meta-analytic review. *Prev Med*, 46 (1) pp. 9–13 http://dx.doi.org/10.1016/j.ypmed.2007.03.006

168 Frank LD, Andresen MA, Schmid TL. (2004). Obesity relationships with community design, physical activity, and time spent in cars. *Am J Prev Med*: 27(2):87-96.

169 Daniel K., Perrotta K. (2017). *Prescribing Active Travel for Healthy People and a Healthy Planet: A Toolkit for Health Professionals.* Canadian Association of Physicians for the Environment (CAPE). https://cape.ca/prescribing-active-travel-for-healthy-people-and-a-healthy-planet-a-toolkit-for-health-professionals/

E-bikes make cycling more viable over long distances and provide a cycling option for people of different ages and abilities. However, e-bikes are significantly more expensive than regular bicycles. To address this, the British Columbia provincial government developed a program to provide an incentive of $850 toward the purchase of a new e-bike to people who scrap their fossil-fuel burning vehicles.[170] The City of Edmonton recently put in place a program to provide a rebate of 30% of the purchase price of an e-bike to a maximum rebate of $750.[171]

Recommendation #12

The federal government should invest in an e-bike purchase rebate program.

Net-Zero Buildings

Goal: Achieve 100% zero-carbon pollution in commercial and residential buildings by 2050

The building sector is the third-largest contributor to carbon pollution in Canada, accounting for 13% of emissions. Greenhouse gas emissions from buildings have been growing, mainly due to the use of natural gas for space heating. These utility bills are also among the larger bills that consumers and businesses in Canada pay.

The below initiatives are "win-win-win-win" programs that will reduce pollution; save customers money on their energy bills; put construction workers, electricians, and mechanical contractors to work; and result in a large economic boon for local businesses and domestic manufacturers.

New Buildings

The most effective and straightforward way for governments to ensure the reduction of emissions in the building sector is to require it through building codes. However, this is an area of provincial jurisdiction.

The Canadian government should establish zero-emission building requirements for both new and existing home and commercial buildings in the National Building Code. This is a model code that only has the force of law if it is incorporated into the various provincial and territorial building codes, which should be done.

170 Government of British Columbia (2019). *Move Commute Connect: B.C.'s Active Transportation Strategy.* https://www2.gov.bc.ca/assets/gov/driving-and-transportation/funding-engagement-permits/grants-funding/cycling-infrastructure-funding/activetransportationstrategy_report_web.pdf

171 City of Edmonton (2020). *Edmonton's Electric Vehicle Charger and E-Bike Rebate Program: Participation Guide.* https://www.edmonton.ca/city_government/documents/PDF/ECEBParticipationGuide.pdf

Recommendation #13

The federal government should establish zero-emission building requirements for new and existing homes and commercial buildings in the National Building Code, and work with provinces and territories to adopt these across the country.

The Canadian government should immediately establish tax incentives for energy efficiency and electrification in new residential and commercial building construction. Tax incentives should also be available for new commercial buildings built with new low-carbon forms of key building materials like concrete[172] and mass timber,[173] both to reduce emissions and accelerate innovation in those industries.

In 2009, Toronto was the first city in North America[174] to adopt bylaws that required and regulated construction of green roofs, which are partially or fully covered by a layer of vegetation growing on a waterproofing system. The federal government should encourage the extension of these bylaws to cities across Canada by providing financial incentives to install green roofs on new buildings and retrofit existing ones, while ensuring that these new natural spaces are accessible to building occupants.

Recommendation #14

The federal government should incentivize energy efficiency, electrification, low-carbon building materials, and green roofs for new homes and commercial buildings.

Retrofitting Residential and Commercial Buildings

Approximately three quarters of residential-space heating is provided by fuels - mainly gas, but also wood and heating oil - and the rest by electricity.[175] The key to decarbonizing this sector is electrification.

The federal government should sharply increase planned investment in renovations and energy retrofits to our existing homes and offices, including working with the provinces to support retrofits and upgrades for Canada's entire stock of publicly funded housing and other buildings. This program should target retrofitting all existing residential and commercial buildings by 2050. The government should also expand their current program to include

172 Carbon Cure. (2020). *Carbon Cure*. Retrieved June 12, 2020. https://www.carboncure.com/

173 Roberts D., (2020, January 15). The hottest new thing in sustainable building is, uh, wood. *Vox* https://www.vox.com/energy-and-environment/2020/1/15/21058051/climate-change-building-materials-mass-timber-cross-laminated-clt

174 City of Toronto. (2020). *Green Roof Overview*. https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-overview/

175 Natural Resources Canada. (2020). *Energy and Greenhouse Gas Emissions (GHGs).* Government of Canada https://www.nrcan.gc.ca/science-data/data-analysis/energy-data-analysis/energy-and-greenhouse-gas-emissions-ghgs/20063

multi-unit residential buildings. This spending would immediately support thousands of jobs all across the country.

The Pembina Institute has suggested that the federal government increase residential retrofitting loan maximums in their Green Homes Program -- such as installation of heat pumps to reduce gas use for heating, and thermal retrofits to improve insulation -- from $40,000 to up to $100,000 and provide grants to cover a significant portion of the retrofit cost, ranging from 20% for basic measures up to 40% of total costs for deep retrofits that aggressively drive down emissions.[176]

The Canadian government should also underwrite commercial retrofit loans through the development of a Green Bank, either freestanding or as a new pillar of the Canada Infrastructure Bank. Équiterre and the Pembina Institute have articulated a model whereby such an institution would aggregate energy efficiency loans, securitizing them, and sell them on secondary markets to institutional investors.[177]

Since it is important to target recovery funds in areas that can stimulate the economy and provide jobs quickly, it is important to note that building retrofits can be initiated relatively quickly compared to most new building projects.[178] Also, beyond the jobs created for those installing these products, many of the energy-efficient building products (windows, doors, etc.) are also manufactured in Canada,[179] leading to further economic benefits.

Along with space heating and energy efficiency measures, this enhanced program should cover the costs of households making the switch from gas stoves to electric. Along with emissions inherent in cooking with fossil fuels, gas combustion produces PM2.5 (one of the deadliest air pollutants) and nitrogen oxide, nitrogen dioxide, carbon monoxide, and formaldehyde.[180] All of these pollutants are health risks, particularly if not properly vented.

A meta-analysis reviewing the association between gas stoves and childhood asthma found children in homes with gas stoves have a 42% increased risk of experiencing asthma symptoms (current asthma), a 24% increased risk of ever being diagnosed with asthma by a doctor (lifetime asthma), and an overall 32% increased risk of both current and lifetime asthma.[181] A growing body of research shows that low-level CO exposure can exacerbate cardiovascular illness among people with coronary heart disease and other vulnerable populations. There

176 Pembina Institute. (2020). *Green Stimulus: Pembina Institute principles and recommendations for a 2020 economic stimulus package.* https://www.pembina.org/reports/green-stimulus.pdf

177 Équiterre and the Pembina Institute. (2017). *Federal Policies for Low-Carbon Buildings: A blueprint to implement the PanCanadian Framework buildings strategy.* https://www.pembina.org/pub/federal-buildings-blueprint

178 Smart Prosperity Institute (2009). *Building a Green Economic Stimulus Package for Canada.* https://institute.smartprosperity.ca/sites/default/files/publications/files/Building%20A%20Green%20Economic%20Stimulus%20Package%20for%20Canada.pdf

179 Smart Prosperity Institute (2009). *Building a Green Economic Stimulus Package for Canada.* https://institute.smartprosperity.ca/sites/default/files/publications/files/Building%20A%20Green%20Economic%20Stimulus%20Package%20for%20Canada.pdf

180 Hu T., Singer B.C., and Logue J.M. (2012). *Compilation of Published PM2.5 EmissionRates for Cooking, Candles and Incense for Use in Modeling of Exposures in Residences.* Ernest Orlando Lawrence Berkeley National Laboratory. DOI: 10.2172/1172959.

181 Lin W., Brunekreef B., Gehring U. (2013). Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children. *International Journal of Epidemiology*, Volume 42, Issue 6, December 2013, Pages 1724–1737. https://doi.org/10.1093/ije/dyt150

is also research showing that exposure to NO_2 — even small increases in short-term exposure — exacerbates respiratory problems, particularly asthma, and particularly in children. Ongoing NO_2 exposure has also been linked in research to reduced cognitive performance, particularly in children.[182]

Recommendation #15

The federal government should increase its investment in deep emissions-reducing home and commercial building retrofits and incentivize households making the switch from gas stoves to electric.

Sustainable Building Jobs

We support the Canada Green Building Council, Efficiency Canada, and Pembina Institute's recommendation to provide $500 million for skills-training for Canada's low-carbon building workforce.[183] The transition to zero-emission buildings will provide work for related professionals, contractors, and tradespeople, providing they understand best practices for the design and construction of zero-emission buildings and deep emissions-reducing retrofits. The current slowdown in many sectors that employed people with similar skill sets demands investment in retraining for the jobs being created in the green building sector.

Recommendation #16

The federal government should invest in skills-training for Canada's low-carbon building workforce.

Sustainable Healthcare

The Canadian healthcare system employed approximately 7% of the population in 2019,[184] while generating 11.6% of Canada's GDP.[185] The sector presents unique opportunities and challenges in regard to incorporating it into a healthy recovery.

The healthcare sector has been identified as a significant contributor to climate change; if global healthcare were a country, it would be the fifth-highest carbon emitter in the world.[186]

182 Payne-Sturges D.C., Marty M.A., Perera F., Miller M.D., Swanson M., Ellickson K., Cory-Slechta D.A., Beate Ritz, John Balmes, Laura Anderko, Evelyn O. Talbott, Robert Gould, and Irva Hertz-Picciotto, 2019:
Healthy Air, Healthy Brains: Advancing Air Pollution Policy to Protect Children's Health
American Journal of Public Health 109, 550_554, https://doi.org/10.2105/AJPH.2018.304902

183 Frappé-Sénéclauze, TP. (2020). *Achieving Canada's climate and housing goals through building retrofits.* Pembina Institute.
https://www.pembina.org/reports/federal-buildings-recs-2020.pdf

184 Statistics Canada (2019). *Labour force characteristics by industry, annual.* https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410002301

185 Canadian Institute for Health Information (2019). *National Health Expenditure Trends: 1975 to 2019.* https://www.cihi.ca/en/national-health-expenditure-trends-1975-to-2019

186 Karliner, J., Slotterback, S., Boyd, R., Ashby,B., & Steele, K. (2019). Health Care's Climate Footprint. Health Care Without Harm and Arup. https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf

Canada has the third- highest per-capita greenhouse gas emissions from healthcare in the world. Healthcare is estimated to be responsible for 4.6% of Canada's total greenhouse gas emissions, as well as more than 200,000 tons of other pollutants annually, resulting in an estimated 23,000 years of functional life lost every year due to disability or early death.[187]

With respect to resource consumption, Canadian hospitals have environmental footprints hundreds of times their geographic areas. As examples, the ecological footprints of Lion's Gate Hospital in Vancouver, BC and the London Health Sciences Centre hospitals in Ontario were found to be 719[188] and 384[189] times greater than their respective physical footprints on the land. Despite significant efforts being made by some health institutions to reduce their environmental and GHG footprints voluntarily, it has been broadly recognized that without a federal and provincial mandate to focus spending on more sustainable initiatives, products, and capital items, the symbols of Canadian health care will continue to contribute significantly to environmental degradation and pollution.[190]

Hospital administrations and environmental health organizations across Canada have recognized the necessity of federal and provincial governments to provide funding and support the development of measurement tools, as well as define hard targets for institutions to measure and track their environmental performance (e.g. GHG emissions, waste, green procurement parameters, and toxics use).[191] Currently, health institutions have limitations on their capacity to capitalize on innovation as they are often excluded from federal institutional funding grants for innovative environmental projects.[192]

With an estimated 6-30% of medical acts potentially unnecessary,[193] reduction of consumption remains a cornerstone of sustainable healthcare.

Recommendation #17

The federal government should increase funding for systematic promotion of the Choosing Wisely Canada program for the reduction of unnecessary and potentially dangerous investigations or therapies.

187 Eckelman MJ, Sherman JD, MacNeill AJ (2018) Life cycle environmental emissions and health damages from the Canadian healthcare system: An economic-environmental-epidemiological analysis. PLoS Med 15(7): e1002623. https://doi.org/10.1371/journal.pmed.1002623

188 Germain, S. (2001). The ecological footprint of Lions Gate Hospital. Hospital quarterly, 5(2), 61-66.

189 London Health Sciences Centre (2009). *London Health Sciences Centre's Footprint.*
http://www.lhsc.on.ca/About_Us/Ecological_Stewardship/Footprinting/LHSC_footprint.htm

190 HealthCareCAN (2016). *Green is Green: Improving the Health, Economic and Environmental Impact, Resilience and Sustainability of Canada's Hospitals through Green Infrastructure.* Ottawa, Ontario. https://www.healthcarecan.ca/wp-content/themes/camyno/assets/document/GovSubmissions/2016/EN/GreenisGreen_EN.pdf?target=blank

191 Ribess, J., Varangu, L. (2019). *Climate Change Toolkit for Health Professionals: Module 6 – Taking Action on Climate Change at Health Facilities.* Canadian Association of Physicians for the Environment (CAPE). https://cape.ca/wp-content/uploads/2019/04/Module-6-Final-Solo-April-2-2019.pdf

192 HealthCareCAN (2016). *Green is Green: Improving the Health, Economic and Environmental Impact, Resilience and Sustainability of Canada's Hospitals through Green Infrastructure.* Ottawa, Ontario. https://www.healthcarecan.ca/wp-content/themes/camyno/assets/document/GovSubmissions/2016/EN/GreenisGreen_EN.pdf?target=blank

193 Brownlee S, Chalkidou K, Doust J, et al. (2017). *Evidence for overuse of medical services around the world.* Lancet. 2017;390 (10090):156-168. doi:10.1016/S0140-6736(16)32585-5.

Green Design

As massive employers and land owners, changes in environmental and social performance of our hospitals, pharmacies and clinics impact profoundly their respective towns and cities when they occur. The majority of their GHG emissions are due to energy and utilities consumption built into capital items and infrastructure.[194] Over the last thirty years, architects, engineers and healthcare designers have -- both spontaneously and in response to legislation -- increasingly embraced their roles in the design of structures that promote environmental performance ("greening"), and the safety and healing of patients and healthcare workers alike. Any financial stimulus package should contribute funding to and help systematize the best practices of these successful initiatives across Canadian healthcare.

Promoting energy stewardship in the healthcare sector will simultaneously save costs and reduce the environmental impacts of utilities in healthcare institutions. This could include roof replacement and building upgrades to improve insulation, finishes and moisture barriers, lighting upgrades like installing high-efficiency LED light sources, and higher-efficiency boilers, heating systems and ventilation systems.[195]

The federal government should mandate the environmental standards of the LEED Gold for Healthcare or BomaBest for renovations or new healthcare facilities including a minimum green space integration of 30% (in line with urban climate resilience recommendations), and allow healthcare facilities and regions to apply for green infrastructure funding to fund these projects.

Recommendation #18

The federal government should work with provinces to mandate environmental standards for renovations or new healthcare facilities and allow healthcare facilities and regions to apply for green infrastructure funding.

Purchasing

Equipment, devices, products and capital items repeatedly rank within the top causes of healthcare's eco-health impacts. However, due to long term contracts and the lack of mandatory environmental standards for purchasing contracts of most products in healthcare, this remains an untapped potential for economic and environmental recovery.

Incremental implementation of criteria for third party certification of medical, maintenance, office, electronic and capital devices purchases could reduce healthcare eco-impacts overnight, and have been the cornerstone of success for some of the most successful institutions' long-term environmental gains.[196] Canada needs systematic increases in the proportion of healthcare purchase orders and contracts certified by third party sustainability certifiers such as EcoLogo, GreenSeal, EPEAT, and Energy Star by 10% annually.[197]

Recommendation #19

The federal government should provide funding to provinces to incentivize systematic increases in the proportion of healthcare purchase orders and contracts certified by third party sustainability certifiers.

Healthcare–Related Transportation

The lessons learned during the Covid crisis regarding advantages of tele-medicine in order to decrease unnecessary exposures, time lost, as well as climate and pollution impacts may be the most easily calculated efficiency improvement for healthcare institutions, both environmentally and economically. Even prior to the Covid crisis, organizations such as the Canadian Medical Association, the Canadian College of Family Physicians, The Royal College of Physicians and Surgeons of Canada,[198] and the Lancet Countdown[199] advocated for a wide range of telemedicine implementation to reduce climate pollution.

Additionally, there are opportunities to electrify hospital fleet vehicles. In the Canadian Coalition for Green Health Care's most recent Green Hospital Scorecard, of 101 participating facilities, only one facility reported that low-emission vehicles had been incorporated into their fleet.[200]

Recommendation #20

The federal government should provide funding to provinces tied to incremental pollution reduction targets for healthcare-related transport pollution, targeting financing of zero-emission vehicle substitutes for healthcare fleet vehicles, telemedicine support structures, as well as public and active transit integration.

194 Ribess, J., Varangu, L. (2019). *Climate Change Toolkit for Health Professionals: Module 6 – Taking Action on Climate Change at Health Facilities.* Canadian Association of Physicians for the Environment (CAPE). https://cape.ca/wp-content/uploads/2019/04/Module-6-Final-Solo-April-2-2019.pdf

195 HealthCareCAN (2016). *Green is Green: Improving the Health, Economic and Environmental Impact, Resilience and Sustainability of Canada's Hospitals through Green Infrastructure.* Ottawa, Ontario. https://www.healthcarecan.ca/wp-content/themes/camyno/assets/document/GovSubmissions/2016/EN/GreenisGreen_EN.pdf?target=blank

196 For an example of an environmentally preferable purchasing program, please see info on Kaiser Permanente's program: <http://supplier.kp.org/ep/index.html>

197 My Sustainable Canada. (2012). *Guide de ressources pour les services de restauration des établissements de santé: Passer à une cuisine écologique avec ENERGY STAR®* https://www.greenhealthcare.ca/images/projects/energystar/F_Energy_STAR_Resource_Guide_May31-6_all-print.pdf

198 Canadian Medical Association, Canadian College of Family Physicians and Royal College of Physicians and Surgeons of Canada (2020). *Virtual Care: Recommendations for scaling up virtual medical services.* https://www.cma.ca/virtual-care-recommendations-scaling-virtual-medical-services

199 Lancet Countdown (2017). *Lancet Countdown 2017 Report: Briefing for Canadian Policymakers.* <https://www.cpha.ca/sites/default/files/uploads/advocacy/2017_lancet_canada_brief.pdf>

200 Hospital News (2020). *New zero-emission vehicle initiative in Canada's health sector.* https://hospitalnews.com/new-zero-emission-vehicle-initiative-in-canadas-health-sector/

Toxics reduction

North American healthcare has been implicated in the dispersal of numerous deleterious substances into landfill, wastewater systems and the atmosphere in past decades (e.g. dioxin, mercury, nitrous oxide, and desfluorane). The alternatives and technological paths for reducing the use of toxics already exist.[201] [202] [203]

For example, some anaesthetic gases used for surgical procedures are also potent greenhouse gases, and are often vented into the outside community from Canadian hospitals. Research has shown that desflurane has an atmospheric lifetime of 21 years and traps 15-20 times more heat than other anaesthetic gases such as isoflurane and sevoflurane.[204] [205] Canadian hospitals could restrict the use of desflurane and nitrous oxide anesthetic gases only to cases where they will significantly benefit patients relative to alternative anaesthetic formulations. Also, improved uptake of anesthetic gas capture and reutilization in hospitals around Canada, such as the partnership between the University Health Network in Toronto and Blue-Zone Technologies,[206] can also further reduce the ecological impacts of the delivery of medically necessary anesthetic care at the same time as reducing costs in the purchasing of anesthetic gas products.

Canada needs a systematic accounting and reduction of toxic substances released by health institutions in healthcare delivery, tied to mandatory incremental reduction goals of known classes of toxic substances (e.g. heavy metals, pesticides, anaesthetic gases, and endocrine disrupting chemicals).

Recommendation #21

The federal government should provide the provinces with financial support for the systematic accounting and reduction of toxic substances released by health institutions in healthcare delivery, tied to mandatory incremental reduction goals.

Waste reduction

No Canadian healthcare system-wide accounting has been performed to date to tabulate waste management practices at private and public sector health care institutions. Nor has there been systematic accounting of healthcare supplier waste management practices to date. However, solid waste audits performed in healthcare institutions in Québec over the last decade estimate that solid waste component of the Québec hospital and long-term care system to be in the realm of 100,000 tons with an additional 10,000 tons of biomedical waste.[207] [208]

The federal government should fund a national healthcare system-wide solid, liquid and air (including carbon) waste accounting to enable waste reduction initiative planning and impact assessments. The Canadian Coalition for Green Healthcare already produces an annual Green Hospital Scorecard, which could serve as a model.[209]

Recommendation #22

The federal government should fund a national healthcare system-wide solid, liquid and air waste accounting to enable waste reduction initiative planning and impact assessments.

Protect and Connect to Nature

"In order to arrest this emergency, and as we decarbonize our economies, we must bring one of our most powerful allies into the fight now—nature."

– Inger Andersen, Executive Director of the UN Environment Programme

The UN Environment Programme has estimated that nature-based solutions for climate change, which protect, sustainably manage and restore natural ecosystems while addressing societal challenges, have the potential to reduce global greenhouse gas emissions by more than a third of the 2030 Paris Agreement goals.[210]

Furthermore, increasing human access to nature, whether it be outside our windows, in city parks or on forest trails, also has many direct health co-benefits. For example, people who spend time surrounded by green spaces instead of urban environments enjoy measurable improvements in stress-hormone levels,[211] work satisfaction,[212] immune-system function,[213] physical activity levels,[214] and powers of attention.[215] In addition, studies have found that

201 Yasny JS, White J. (2012) Environmental implications of anesthetic gases. *Anesth Prog*.59(4):154-158. doi:10.2344/0003-3006-59.4.154
202 The World Health Organization (2018). *Health-care waste.* https://www.who.int/news-room/fact-sheets/detail/health-care-waste
203 Synergie Santé Environnement. (2019). *Gestion des déchets: Biomédicaux et Pharmaceutiques.* http://gmr.synergiesanteenvironnement.org/files/2019/02/biomdicaux-vfinale-copie.pdf
204 Langbein, T., Sonntag, H., Trapp, D., Hoffmann, A., Malms, W., Röth, E. P., ... & Zellner, R. (1999). Volatile anaesthetics and the atmosphere: atmospheric lifetimes and atmospheric effects of halothane, enflurane, isoflurane, desflurane and sevoflurane. *British Journal of Anaesthesia,* 82(1), 66-73.
205 Sherman, J., Le, C., Lamers, V., & Eckelman, M. (2012). *Life cycle greenhouse gas emissions of anesthetic drugs.* Anesthesia & Analgesia, 114(5), 1086-1090.
206 Cuttler M., (2019). How some doctors want to cut greenhouse gas emissions in the operating room. *CBC News.* https://www.cbc.ca/news/health/anesthetic-greenhouse-gases-1.5170662
207 Recyc-Quebec. (2009). Portrait de la gestion des matières résiduelles dans le sous-secteur institutionnel au Québec.https://www.recyc-quebec.gouv.qc.ca/sites/default/files/documents/portrait-gmr-ici-04-09.pdf
208 Synergie Santé Environnement. (2019). *Gestion des déchets: Biomédicaux et Pharmaceutiques.* http://gmr.synergiesanteenvironnement.org/files/2019/02/biomdicaux-vfinale-copie.pdf
209 Green Health Care. (2019). *Green Hospital Scorecard.* https://greenhealthcare.ca/ghs/
210 UN Environment Program. (2019). *The UN Environment Programme and nature-based solutions.* https://www.unenvironment.org/unga/our-position/unep-and-nature-based-solutions
211 Song, C., Ikei, H., & Miyazaki, Y. (2016) Physiological Effects of Nature Therapy: A Review of the Research in Japan. *Int. J. Environ. Res. Public Health*, 13, 781.https://www.mdpi.com/1660-4601/13/8/781
212 Shin,WS. (2007). The influence of forest view through a window on job satisfaction and job stress, *Scandinavian Journal of Forest Research*, 22:3, 248-253, DOI: 10.1080/02827580701262733
213 Li, Q., Morimoto, K., Kobayashi, M., Inagaki, H., Katsumata, M., Hirata, Y., … Krensky, A. M. (2008). Visiting a Forest, but Not a City, Increases Human Natural Killer Activity and Expression of Anti-Cancer Proteins. *International Journal of Immunopathology and Pharmacology,* 117–127. https://doi.org/10.1177/039463200802100113
214 Ward, JS., Duncan, JS., Jarden, A., & Stewart,T. (2016). The impact of children's exposure to greenspace on physical activity, cognitive development, emotional wellbeing, and ability to appraise risk, *Health & Place*, *Vol 40,* 44-50, 1353-8292, https://doi.org/10.1016/j.healthplace.2016.04.015
215 Donovan, GH, Michael, YL., Gatzoilis, D., Mannetje, A., & Douwes, J. (2019). Association between exposure to the natural environment, rurality, and attention-deficit hyperactivity disorder in children in New Zealand: a linkage study. *The Lancet Planetary Health,* Vol. 3, Issue 5, e226 - e234 https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(19)30070-1/fulltext

increasing urban forest density can greatly improve air quality and provide cooling effects, reducing both air pollution-related and heat-related illness and death[216]. Therefore, we recommend government recovery funds be directed towards improving the accessibility, quality and quantity of protected nature in our local and broader environments.

Increasing nature in our cities

Given that over 80 per cent of Canadians live in cities, greening our urban environments will have a significant impact on how our populations weather the effects of climate change.

The urban heat island effect is a well-known consequence of urbanization. During hot and sunny weather, dry and exposed surfaces can reach temperatures 10-15°C warmer than the surrounding air[217]. Combined with heat cities independently produce through sources like vehicles and air conditioning, this raises temperatures on average 1–3°C warmer than surrounding rural areas, increasing the risk of adverse health impacts during heat waves.

Therefore, government funding to increase urban tree cover, which provides local shading and cooling effects, would be a valuable intervention. Though Environment Canada suggests a minimum urban forest canopy target of 30 to 40 per cent, recent estimates in cities like Vancouver and Hamilton are only of 18%[218] and 21%[219] tree cover respectively, with declining tree health in some jurisdictions. Best practices to ensure the longevity and functionality of our street-tree population, like widening tree wells and connecting them underground to increase root zones, as well as planting native and larger tree species that increase shading, should also be considered.

Funding priority should also be given to improving, enlarging and establishing new urban green spaces, as well as enhancing the accessibility and resilience of waterfront lands, which act as a buffer during flooding events and a natural draw for people pursuing outdoor recreation.

During the pandemic, local green space has become increasingly important as a resource for safe recreation and mental health outside the home, as public health directives limit access to indoor gathering places and many national and provincial parks have closed or reduced their services. This rediscovery of nearby nature could prove valuable. In fact, a 2015 study of Toronto neighbourhoods estimated that an additional 10 trees per block improved people's health perception in ways comparable to increasing their personal income by $10,000/year[220] or being 7 years younger.

216 Zupancic, T, Westmacott, C, and Balthuis, M.(2015). The Impact of green space on heat and air pollution in urban communities: A meta-narrative systematic review . The David Suzuki Foundation and Green Belt Retrieved from https://www.ecohealthontario.ca/resources;
217 Government of Canada. (2020). Reducing urban heat islands to protect health in Canada. https://www.canada.ca/en/services/health/publications/healthy-living/reducing-urban-heat-islands-protect-health-canada.html#a2.2
218 City of Vancouver and Vancouver Park Board. (2018). Urban Forest Strategy - 2018 Update. https://vancouver.ca/files/cov/urban-forest-strategy.pdf
219 City of Hamilton. (2019). *Urban Forest Strategy: Draft Goals and Actions*. https://www.hamilton.ca/sites/default/files/media/browser/2019-08-12/urban-forest-strategy-public-workshop-june19-presentation.pdf
220 Kardan, O., Gozdyra, P., Misic, B., Moola, F., Palmer, LJ, Paus, T., & Berman, MG. (2015). Neighborhood greenspace and health in a large urban center. *Scientific Reports* 5, 11610 (2015). https://doi.org/10.1038/srep11610

To help urban populations adapt to the physical and mental health challenges that will also come with climate change, barriers to accessing green space must be reduced. Funding should also be directed to park trail upgrades, making parks close to urban centres accessible by public transit, and expanding the network of green corridors for active transport.

Recommendation #23

The federal government should work with municipal and provincial governments to invest in urban tree cover, new urban green spaces, improvement and expansion of existing urban green spaces, park trail upgrades, and green corridors.

Increasing access to nature within our parks systems

In some areas of our country, funding to maintain and enhance our parks systems has been chronically inadequate to meet the growing demand of Canadians for safe, high-quality nature experiences. For example, in British Columbia the provincial budget for parkland was recently estimated at merely $2.80 per hectare[221]— compared to $30 per hectare in Alberta —despite costly threats from climate-change-related phenomena like wildfires, trail washouts from flooding and the spread of invasive species.[222]

This lack of funding prioritization does not take into account the significant economic benefits to human health of park visits. Research calculates that the mental health benefits of visits to protected natural areas globally total US$6 trillion per year.[223] Furthermore, every government dollar spent on provincial parks returns an estimated six dollars to the economy.[224] Studies also show that children[225] and adults[226] who are more connected to nature behave in more pro-environmental ways, which is essential for the future of conservation and mitigation of climate change. Indeed, recent cuts during the pandemic to parks funding like those in Alberta[227] that would remove entire sites from protection and public use are a step in the wrong direction.

Therefore, government stimulus funding should be directed to initiatives that enhance the accessibility and quality of our parks systems like trail surface upgrades, educational and

221 BC Parks Foundation. (2019). How British Columbians Can Help British Columbia. https://bcparksfoundation.ca/blog/how-british-columbians-can-help-british-columbia/
222 Natural Resources Canada (2020). Climate Change Impacts on Forests. https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/impacts/13095
223 Buckley, R., Brough, P., Hague, L., Chauvenet, A., Fleming, C., Roche, E., Sofija, E., & Harris, N. (2019). Economic value of protected areas via visitor mental health. *Nature Communications.* 10, 5005. https://doi.org/10.1038/s41467-019-12631-6
224 Canada Parks Council. (2011). *The Economic Impact of Canada's National, Provincial & Territorial Parks in 2009.* http://www.parks-parcs.ca/english/pdf/econ_impact_2009_part1.pdf
225 Rosa, CD., Profice, CC., Collado, S. (2018). Nature Experiences and Adults' Self-Reported Pro-environmental Behaviors: The Role of Connectedness to Nature and Childhood Nature Experiences. *Frontiers in Psychology.*9, 1055, 1664-1078, DOI=10.3389/fpsyg.2018.01055 https://www.frontiersin.org/articles/10.3389/fpsyg.2018.01055/full
226 Geng L, Xu J, Ye L, Zhou W, Zhou K (2015) Connections with Nature and Environmental Behaviors. *PLOS ONE* 10(5): e0127247. https://doi.org/10.1371/journal.pone.0127247
227 Alberta Parks. (2020). *Optimizing Alberta Parks*. https://www.albertaparks.ca/albertaparksca/news-events/

other programs that focus on fostering nature-connectedness, technology-enhanced interpretive trails[228] and subsidized transportation to national and provincial parks.

Recommendation #24

The federal government should invest in initiatives that enhance the accessibility and quality of our national and provincial parks systems.

Finally, as we emerge from the pandemic and demand for access to national and provincial parks increases, consideration may also be given to the implementation of rotating pass systems to ensure that a broad range of people enjoy safe access to our parks.

Protecting, sustainably managing and restoring natural ecosystems

According to the most recent estimates, natural ecosystems in Canada, including forests and wetlands, sequester an estimated 28 megatonnes of carbon dioxide per year,[229] or approximately 4% of our annual emissions. Other valuable ecosystem services of these areas include the preservation of clean air, water and soil, flood regulation, recreation, and the ability for local Indigenous knowledge of these areas to complete our understanding of climate change.[230] Recognizing this, the Liberal government vowed to commit $3 billion in funding to natural climate solutions during the 2019 federal election campaign.[231]

Unfortunately, if wild spaces are improperly managed they can become net carbon emitters. Due to climate-change-related impacts such as increasing wildfires and insect infestations, in addition to slash burning and clear-cutting of old-growth forests, Canada's managed forests have emitted more greenhouse gases than they have absorbed each year since 2001.[232]

Therefore, we propose government funding for a broad range of measures that preserve, manage and restore our natural ecosystems while reducing the effects of climate change, including:

- conserving and expanding more forested and wild spaces, with a focus on old-growth forests that are most effective at carbon sequestration
- carbon offset programs that invest in tree planting within forestry lands
- establishing national ambient air quality standards.
- increasing manual silviculture practices within the forestry industry and elimination of widespread spraying with the herbicide glyphosate after clear-cutting, which kills broadleaf trees and reduces their ability to act as natural fire barriers[233]
- consultation of Indigenous knowledge keepers about best forestry practices
- maintaining protected status for greenbelt lands
- coastal wetland restoration and protection
- ongoing support for environmental monitoring and regulation of fossil-fuel extraction projects.

Recommendation #25

The federal government should invest in a broad range of measures that preserve, manage and restore our natural ecosystems.

228 Dickson, C. (2019, June 8). Interactive path in B.C.'s Interior blends traditional storytelling and technology. *CBC*. https://www.cbc.ca/news/canada/british-columbia/shuswap-story-trail-1.5167293

229 Environment and Climate Change Canada. (2016). *National Inventory Report 1990–2016: Greenhouse Gas Sources and Sinks in Canada*. Government of Canada. http://publications.gc.ca/collections/collection_2018/eccc/En81-4-2016-1-eng.pdf

230 Parks Canada. (2018). *Eight things you should know about natural solutions to climate change.* https://www.pc.gc.ca/en/nature/science/climat-climate/huit-eight

231 The Liberal Party. (2020). Natural Climate Solutions. https://www2.liberal.ca/our-platform/natural-climate-solutions/

232 Natural Resources Canada. (2020). *Indicator: Carbon emissions and removals.* https://www.nrcan.gc.ca/our-natural-resources/forests-forestry/state-canadas-forests-report/how-does-disturbance-shape-canad/indicator-carbon-emissions-removals/16552

233 BC Wildlife Federation. (2019). *BCWF Formal Position on the Glyphosates and Other Systemic Herbicides.* https://bcwf.bc.ca/bcwf-formal-position-on-the-glyphosates-and-other-systemic-herbicides/

Conclusion

Just as the world missed the window to prevent the majority of the morbidity and mortality associated with COVID-19, we are past the time period where we could have prevented the majority of climate-related damage to health and health systems. However, in our recent national mobilization to flatten the pandemic curve, we have demonstrated the value we place on human life: we have dramatically transformed our day-to-day existence in order to protect our health.

It now falls to us to simultaneously plan for a forward-looking economic recovery from the pandemic, and to plank the curve of our carbon emissions. This will improve health for all through outcomes like improved physical activity levels and reduced air pollution, and secure the future safety of young Canadians by reducing climate impacts.

There are reasons for optimism.

The global oil and gas sector is in the midst of profound shifts, the cost of renewables is plummeting, and we already have the technology to decarbonize our electricity generation, transportation, and building sectors, which together make up over half of Canada's greenhouse gas emissions.

Canada is well-placed to choose a future in which clean energy drives a prosperous, connected economy and our activities stop contributing to climate change. A future built on bold and inclusive solutions that improve the quality of life for everyone living in Canada and leave no one behind.

People across our country have proven that they are ready and willing to make major sacrifices and changes to fight the spread of the novel coronavirus. Those required for us to do our part in a healthy response to climate change now seem far more achievable in comparison.

Creating a cleaner, more livable planet is a matter of shifting public money away from fossil fuels that harm planetary health and benefit the few, to investments that improve equity and help both planet and people thrive.

We have the plan to decarbonize, save lives, and create jobs. We now need the political leadership to make this vision our reality.