Climate Action Team

Manitoba's Road to Resilience

A COMMUNITY CLIMATE ACTION PATHWAY TO A FOSSIL FUEL FREE FUTURE

Climate Action Team

CCPA
CANADIAN CENTRE for POLICY ALTERNATIVES MANITOBA OFFICE

CLIMATE CHANGE CONNECTION
A project of MakeWay

green ACTION centre

Manitoba's Road to Resilience: A Community Climate Action Pathway to a Fossil Fuel Free Future

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Acknowledgements

This document was developed by the Climate Action Team (CAT) with input from other subject matter experts and interested members of the public.

Manitoba's Climate Action Team (CAT) is a coalition of Manitoban environmental organizations working to create a road to resilience in our province. The group came together following the Intergovernmental Panel for Climate Change (IPCC) 1.5 Report that was released in October 2018. That report made it clear how little time we have to drastically cut greenhouse gas emissions.

CAT is a collaboration of the following organizations:

- Canadian Centre for Policy Alternatives (CCPA)
- Climate Change Connection (a charitable project of MakeWay)
- Green Action Centre
- Manitoba Energy Justice Coalition
- The Wilderness Committee

Our vision is to build a collaborative and resilient zero-carbon society that operates within the constraints of nature.

Contributors

The following people contributed to the development, design, and content of this document:

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THE WINNIPEG FOUNDATION

Collaboration

During the development of this document, the fundamental elements of each of the four technical chapters (Buildings, Transportation, Food & Agriculture, Energy) were presented to subject matter experts for review and discussion. The Food & Agriculture chapter concepts were also shared at *The Future of Feasting* Fall Supper event at Red River College in Winnipeg in November 2019. This event included a supper of locally-sourced food, 8 breakout workshops and a panel discussion. Key concepts of the other three technical chapters were distributed to and discussed with contributions from business, academic, environmental, and social justice subject matter experts. Those discussions were conducted in early to mid-2020 via Zoom due to COVID-19 restrictions.

This is the start of what we hope will be an ongoing process. We want people to consider these ideas, to discuss them with their communities, to add to them, and to find ways to make the ideas become realities.

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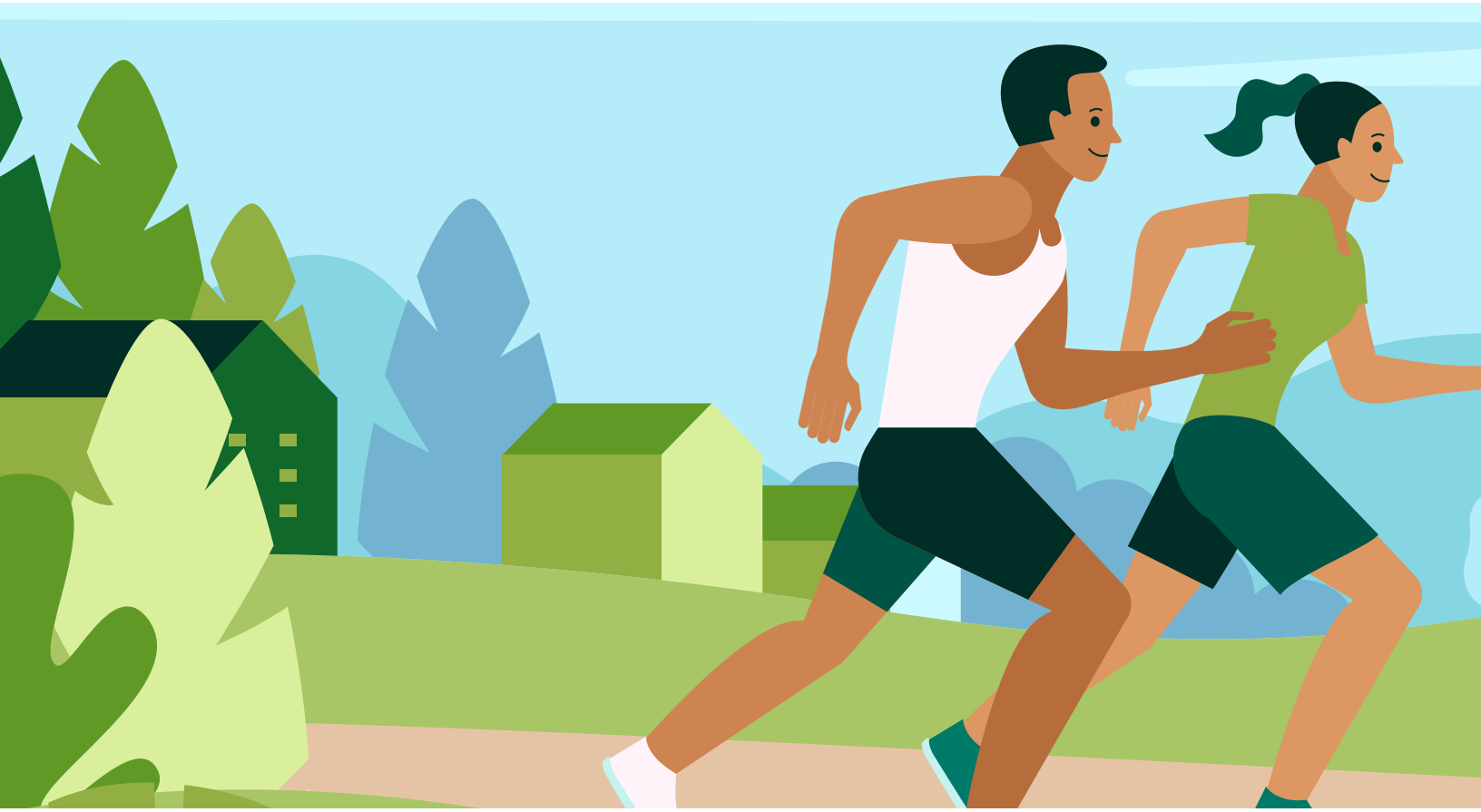
Imagine a resilient Manitoba…

In towns and cities, neighbourhoods are thriving. There are few vehicles. Most people are walking or cycling in pleasant, quiet surroundings. People know each other and depend upon each other.

Each town or neighbourhood has a centre hub that is within walking or biking distance to most residents. That centre is where people find their local markets and shops. Most of the essentials are nearby: groceries, pharmacy, clinic, recreation, education, theatre, and church. There are green spaces everywhere and an ample and healthy tree canopy.



Anything that isn't nearby can be easily and conveniently reached by public or shared transportation. All vehicles are electric. All buses run on a frequent schedule and are really only necessary to go from town or neighbourhood hub to hub. Since people live close to where they work and since most essential requirements are made locally, there isn't much need for vehicles. Most people get around by walking or cycling. Many passenger vehicles are shared.

People live in neighbourhoods that are usually a mix of high, low, and medium density. The buildings are efficient and what little heating and cooling is required is provided with a variety of energy sources: hydroelectric, passive solar, biomass, and geothermal. Most buildings are interconnected on a district heating and cooling system.

Entrepreneurs, small businesses, social enterprises, and cooperatives form the backbone of a dynamic local economy. The economy is diverse and self-reliant. It uses local materials, capital, and labour to provide meaningful employment, meet local needs, and promote local trade. Everyone has access to a livable wage. The economy is built on stability and not on perpetual growth.

There are gardens everywhere. People either grow their own or buy food from nearby producers. Producers grow food without synthetic fertilizer in a system that rejuvenates depleted soils, promotes health, and creates opportunities for meaningful work.

What people value most is their individual and collective well-being rather than material consumption. We prize simpler lifestyles centered on sharing and mutual support.

Our democracy is strong. People participate in neighbourhood governance and they have opportunities for their voices to be heard. City and provincial governments support diverse, transformative programs to enhance our well-being and inclusion.

Much of the transformation that has been achieved is due to the true reconciliation that has occurred. Indigenous culture is recognized, respected, and encouraged. In fact, it is the adoption of that indigenous worldview that has been most responsible for this transformation; everything is connected, there is no waste - only outputs and inputs, everything is a circle.

This vision of a possible future was inspired by *A Resilient Winnipeg* by Mark Burch

Introduction

The Need

Given the current global political reality, there is serious doubt that the world will take the dramatic action required to reduce greenhouse gas emissions and remove carbon from the atmosphere at the scale and timeframe required by the ***IPCC 1.5°C Report.***

Many Manitobans recognize the primary consequences of climate change (severe weather, floods, droughts, fires). Those same Manitobans see that those consequences have costs that are rising. What many people may not realize is that our ability to function and survive as a society is at risk.

Other disturbances (food shortages, climate migration, global conflicts) are exacerbated by climate change. The consequences of these disturbances may first be felt elsewhere, but we will feel them here due to their impacts on the global economy, supply chain, and availability and cost of obtaining financial credit. As long as we are dependent upon imported food and global supply chains for energy and essential goods, we are at risk. We are best off if we can *provide for our essential needs ourselves*.

Most governments are mainly concerned with being re-elected. Under the pretext of being "practical", they have chosen not to publicly discuss the urgency and scale of work required to adequately address the climate crisis. It is up to civil society (the community) to think at this level and to show the way (or at least a way). We can "think the unthinkable."

The objective of this document is to provide **a pathway to full decarbonization in Manitoba** - zero greenhouse gas emissions by 2050.

As we build that pathway we will be building our local resilience. **Resilience means providing for our essential needs ourselves without fossil fuel.**

To achieve true and adequate resilience, these are **Manitoba's essential objectives:**

Food – Feed ourselves locally without fossil fuel fertilizers or diesel for machinery

Shelter – Heat all of our buildings (old and new) affordably without natural gas

Transportation – Move all goods and people without gasoline or diesel

Our hydroelectric resource will be a big part of building that resilience:

Energy - Develop and use our electricity resource effectively, efficiently, and affordably to meet those other three objectives

We must become resilient. That is where our pathway leads.

Audience

This pathway document is intended to define a set of recommendations for consideration by, and to stimulate a dialog among, concerned and informed Manitobans. The intention is that elected representatives, civil servants, and public policymakers will develop implementation plans to achieve the recommendations.

There are three key audience groups:

Public – The public needs to support the pathway & demand its implementation

Practitioners – Professionals & civil servants need to detail and implement the pathway

Policymakers – Elected officials need to set policy and regulation to support the pathway

The structure of the pathway (see below) allows for the contents to be broken up into "bite size" pieces - to be consumed by the appropriate audience at the appropriate times.

Chapters

This document has **seven chapters** after this introduction: **Four technical chapters** focused on greenhouse gas emission reduction and building resilience and **three foundational chapters** devoted to economic, generational, cultural, and ecological justice.

Technical Chapters

1. **Buildings** – How we can heat and cool all of our buildings (old and new) without natural gas.
2. **Transportation** – How we can move all goods and people without gasoline or diesel.
3. **Food & Agriculture** – How we can feed ourselves locally without fossil fuel fertilizers or diesel for machinery. This chapter includes ways to manage livestock and organic nutrients to build soil carbon.
4. **Energy** – How we will be able to generate and distribute sufficient local energy necessary to meet the requirements of the three chapters above.

Each of the four technical chapters will have two sections:

The Big Picture – This provides an overview of the current context of that topic area (i.e. the size of the problem, current greenhouse gas (GHG) emission levels, and reduction timetables).

The Pathway – This provides the key topics that need to be addressed and strategies that need to be implemented to reach zero emissions and full resilience in the topic area. Within this section will be suggestions for policy and regulation changes to give us levers to make change happen. Key Performance Indicators (KPI) will also be suggested. Such metrics will help us understand how we are doing and will help manage our progress toward the objectives.

Many of the policy suggestions in this document were derived from two Canadian Centre for Policy Alternatives (CCPA) publications:

- *Change Starts Here: Manitoba Alternative Provincial Budget 2020*
- *Imagine a Winnipeg...2018 Alternative Municipal Budget*

Foundational chapters

These chapters provide the foundation upon which the pathway must be constructed.

5. **Human Impacts** – How we can (and must) address the injustices of climate change. People who are most affected by climate change usually have contributed least to the causes. In this chapter, we deal with a variety of issues including health impacts, generational injustice, cultural injustice, and economic injustice.
6. **Economy & Green Jobs** – How we can ensure that we address economic inequality as we put people to work implementing this Pathway. *(See **Green New Deal**)*
7. **Natural spaces / Wilderness** – How we can ensure a livable, sustainable ecological system that functions throughout Manitoba.

Guiding Principles

This document is guided by the following principles:

- **Indigenous leadership:** Seek out and incorporate direction from elders and indigenous knowledge-keepers. Seek out and ensure free, prior, and informed consent. Comprising less than 5% of the world's population, indigenous people protect 80% of global biodiversity.
- **A Just Transition for workers:** Provide a path for displaced workers in fossil-fuel dependent industries to find employment in alternative ways.
- **Democratize energy and natural resources:** Ensure public ownership and control over renewable energy and publicly-funded responses to climate change.
- **Recognize the right of nature to exist:** Persist and maintain nature's vital cycles and support human life on earth. Protecting, reclaiming, and expanding natural areas is key to carbon sequestration and fighting climate change. Biodiversity must be protected and enhanced.
- **Holism:** Recognize that our economy, society, natural environment, and culture are interrelated. Action to reduce greenhouse gas (GHG) emissions must take a holistic approach.
- **Social justice:** Populations socially excluded by discrimination based on race, gender, ability, sexual orientation, religious affiliation, and age must be part of climate resilience so no one is left behind.

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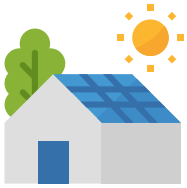
Buildings



The Big Picture

The United Nations Environment Program (UNEP) 2018 Emissions Gap Report calls for a 45% reduction in total annual emissions from 2010 levels by 2030, and net zero emissions worldwide by 2050. Figure 1 shows Manitoba's emissions from its building sector, and how this must change to meet the UNEP 2030 and 2050 goals.

Figure 1: Manitoba Climate Pollution from Building with UNEP Goals

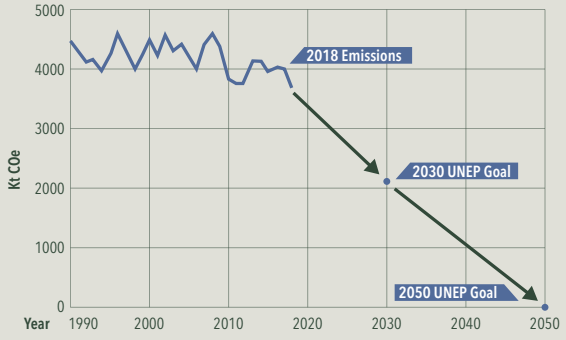


Figure 2: Manitoba Climate Pollution from Building Sub-Sectors

Sub-Sector	Emissions 2018 (tCO2e)
Manufacturing	1,520,000
Residential	1,220,000
Commercial / Institutional *	632,000
Construction	125,000
Mining	120,000
Agriculture / Forestry	49,000
Buildings Total (2018)	**3,666,000**
UNEP Basline Year (2010)	*3,845,000*
UNEP 2030 Goal (-45% of 2010)	*2,115,000*
Cut Required by 2030	**1,551,000**

*Historically very low number, explanation requested from the federal government.

Achieving the first UNEP goal in Manitoba's building sector requires a 42% reduction from current (2018) levels by 2030, from 3,666,000 to 2,115,000 tCO2e .

This requires year-over-year reductions of 4.7% for nine years in a row to 2030, then further reductions to reach the second UNEP goal of net zero by 2050. Failure to achieve these goals puts additional pressure on other sectors to make up the difference.

Climate pollution from Manitoba buildings comes almost entirely from the burning of natural gas for indoor space heating and hot water. As illustrated in Figure 2, different sub-sectors create a wide range of climate pollution each year.

Challenges

Achieving a 4.7% reduction in climate pollution from our buildings nine years in a row will be made more difficult if the following factors remain unchanged:

- Population and economic growth leading to the construction of more buildings
- Overwhelming current market preference for new buildings heated with natural gas
- Cheap natural gas makes the economics of electrical heating and efficiency improvements more challenging
- Continuing preference for larger new homes that require more energy than smaller varieties
- Legislated mandate for Efficiency Manitoba does not focus their efforts on GHG reduction or allow them fo encourage electrification of transportation or transition to efficient electric heat

[1]All Figures: Derived from data contained at Environment Canada, Canada's Greenhouse Gas Inventory

[2]tCO2e – Tonnes of carbon dioxide equivalent. This is a means of normalizing greenhouse gas emissions data. For example, on a 100-year timescale, nitrous oxide (NOx) has about 300 times the global warming potential (GWP) of CO2. So, 1 tonne of NOx emission is equivalent to 300 tonnes CO2e.

Climate Pollution from Manitoba Buildings – Historical Overview

Buildings produced 3,670,000 tCO2e or 17% of Manitoba's total climate pollution in 2018. This is 17% lower than the amount emitted by Manitoba buildings in 1990, even though tens of thousands of new buildings were constructed in that timeframe. Improvements to equipment standards, building codes, and Manitoba Hydro's Power Smart efficiency programs all played major roles in this achievement. While nearly all other categories of climate pollution in Manitoba have increased since records began in 1990, buildings are a rare bright spot in our results to date.

The primary reason for our better performance in the buildings sector is a 28% drop in climate pollution from residential buildings from 1990-2018. Improvements in federal efficiency standards, Manitoba's building code, and Manitoba Hydro's Power Smart programs all contributed to this result. Climate pollution from all other building sub-sectors has either increased or stayed relatively constant.

NOTE: The amount reported from commercial and institutional sources in 2018 was 50% less than previous years, and this sub-sector has never produced less than 1,000,000 tCO2e since 1990. An explanation has been requested from the federal government.

The Pathway

What needs to be considered and what changes need to be implemented in order to achieve the objective of climate change resilience for our built environment in Manitoba?

We need to immediately start converting all of our buildings, old and new, away from natural gas for heat. Natural gas is 70% to 90% methane. On a 20-year timescale, methane has more than 80 times the global warming potential compared to carbon dioxide. Also - reducing natural gas consumption keeps money in Manitoba.

Objective 1:

To be truly resilient, we must heat all of our buildings – old and new – affordably without natural gas.

Ultimately, this requires a switch in the source of heat energy to electricity, biomass, passive solar, and geothermal. But we cannot simply "switch fuels". We must make our buildings more efficient. As it currently stands, Manitoba Hydro could not supply the power required to keep us warm on a cold January night if all of the buildings currently heated with natural gas were heated solely with resistive heat. We need to dramatically reduce the amount of energy they require for heating and cooling.

Currently, there is not a high demand for energy efficiency. The market isn't pulling for it and industry isn't pushing it.

Market pull – Home buyers need to understand that energy efficient homes are quiet and comfortable.

- **Building Energy Labelling** – Building energy performance needs to be made visible to buyers. (See above)
- **Enlist and engage realtors** – Realtors would be the best source of information to help us understand what is needed to change the market.

Industry push – Builders have a recipe for construction that has been successful for years. They need to develop a new recipe of skills, materials, and techniques to build high energy performance into their buildings and remain profitable. Once they have this new recipe, they should market this capability and advertise its availability.

- **Training** – They need training in new high performance construction techniques.
- **Demonstration projects** – Builders need to see examples of how it can be done.
- **Supply chain** – Components and supplies consistent with high energy performance must be affordable and readily available.

Energy Need

Manitoba Hydro estimates that switching an average home from natural gas to electricity will require an additional 12,000 kWh per year per household. This translates to an increased need for electric energy of 3,384 million kWh - or about 10% of Hydro's current amount generated. Hydro will also need to be able to deliver an additional ***7,000 MW of power*** to electrically heat the buildings that are currently heated with natural gas. This compares with the approximately 6,000 MW of "dependable" power that Manitoba Hydro can deliver currently. (See more in the *Energy & Electricity* chapter).

City / District Planning / Zoning

We need to make changes in the form of our cities to encourage buildings that are more energy efficient:

- **Densification** – Encouraging more multi-family residences will generally reduce the per person or per unit heating and cooling load of our building stock.
- **Co-location** – Co-locating buildings that serve different functions provides opportunities for energy sharing in district heating systems. For example, locating heat generating facilities (e.g. ice rinks, data centres) near heat using buildings (e.g. residences).

Efficiency Manitoba (EM)

We feel that many of the initiatives we recommend for buildings should be taken on by Efficiency Manitoba. There are two significant changes required to make this refocusing of EM happen:

- **Efficiency Manitoba mandate** – The Efficiency Manitoba Act (Bill 19) should be amended, or regulations enacted, to direct the corporation to focus on greenhouse gas emission reduction with respect to energy usage. This will enable the corporation to implement programs to increase the efficient use of electricity for heat. By "efficient use" we mean, only using electricity to heat buildings that have been built or enhanced to meet a high energy performance standard and where the electric heating system includes a heat pump (ground-source, water-, or air-source). It will also allow them to encourage adoption of biomass for heat in appropriate areas and to investigate provision of utility-owned district heating systems.
- **Efficiency Manitoba funding** – We recommend that the Manitoba Government levy the carbon tax at the same level as the rest of Canada in accordance with the *Pan-Canadian Framework on Clean Growth and Climate Change*. An appropriate amount of this revenue should be directed to Efficiency Manitoba to fund programs to electrify transportation and shift away from natural gas. A portion of the carbon pollution levy revenues must go to mitigate the impact of the levy on lower- and middle-income individuals and households through direct payments to preserve or enhance social equity. The ***Eco-fiscal Commission estimates that 12.5%*** of carbon pollution levy revenues can offset the impact on households in the lowest 40% of income levels.

Better Performing Buildings

In order to be able to provide the energy required to heat our buildings (old and new) affordably without fossil fuels, the buildings need to have exceptional energy performance. New buildings must be built to a high standard and existing buildings need to be retrofitted with a focus on improving the building envelope. These are some recommendations for achieving these improvements.

- **Building standards** – New buildings need to be as energy-efficient as possible. We need to move toward a Passive House level of design and construction as the code minimum requirement. Building codes originate from Ottawa. Although the federal government has announced their intention to improve these standards, we fear that this process, as currently announced, will be too slow. As a first and local step to prepare our industry for changes coming anyway, we should start incremental changes now. Toronto and BC are phasing in building standards that will make Passive House-style buildings the norm by the early 2030s. Toronto has their ***Zero Emissions Buildings Framework*** and BC has their ***BC Energy Step Code*** for municipalities. Coincident with this incremental approach, we need to establish and announce a timetable for when the Passive House Standard (or something equivalent) will become Canada's building code standard.

- **Building Material Selection and Sourcing** – Construction materials generate a lot of greenhouse gas emissions in their harvesting, transporting, and manufacturing. Conversely, we can use building materials as carbon capture and storage mediums; we can turn buildings from a major climate change problem into a climate drawdown solution. Check out Chris Magwood's ***Opportunities for CO2 Capture and Storage in Building Materials.***

- **Total Cost of Building Ownership (TCBO)** – Calculations to justify energy-efficient elements on new builds or for deep-energy retrofits should be based on TCBO rather than simple payback.

- **Permitting** – Many aspects of the design and construction of sustainable buildings have not been regularly seen by permitters or inspectors. We should have a permitting office focused on helping innovative construction project applicants be successful in getting necessary permits and passing inspections for efficient buildings. Such a permitting office is part of BC's Energy Step Code.

- **Building energy labelling** – Making the performance of buildings visible is an important step to change what the market values. The federal government has signalled that building energy labelling requirements are coming. Winnipeg has a Building Energy Disclosure Project. Programs like this need to be province-wide, expanded to residential buildings, and made mandatory.

- **Retrofit incentives** – Increasing the efficiency of existing building stock will be our largest, most expensive, and most challenging undertaking. The challenge relates to the diversity of forms and current state of these buildings. Efficiency Manitoba has included deep energy retrofits in their ***3-Year Plan.*** The province and EM should work with Natural Resources Canada to continue development and deployment of their ***Prefabricated Exterior Energy Retrofit (PEER)*** approach to energy retrofits. Carbon tax funds could be used to upgrade and replace heating, cooling, and ventilation equipment, replace natural gas furnaces and boilers with low-carbon alternatives, and to increase the energy efficiency of building envelopes. Efficiencies could be gained, for example, by subsidizing the upfront capital costs of non-fossil fuel heating systems like heat pumps and geothermal installation. The CCPA, in their ***2020 Alternative Provincial Budget,*** estimates that this would generate 3,500 high-quality jobs for Manitobans. Public building retrofits alone will reduce greenhouse gas emissions by 100 kT of CO2e per year.

- **Retrofit Financing** – Homeowners need to be able to finance deep energy retrofits and that financing needs to stay with the house rather than the homeowner. Manitoba Hydro's Pay As You Save (PAYS) financing program did that but it no longer exists. It needs to be reintroduced so that repayment of the loan is tied to the energy bill for the house rather than its mortgage. A source of capital for such loans could be Green Bonds such as ***Ontario Green Bonds.***

- **Air Leakage Testing** – Red River College (RRC) is a global leader in the field of air leakage testing for large buildings. The province should work with RRC to enable the private sector to provide this testing for all existing buildings. RRC currently offers a 3-day training course on Large Building Airtightness Testing. The province should help with training and deployment costs.

- **Training in efficient building techniques** – People in building professions and trades need to be trained in Passive House construction techniques. This training should be organized and subsidized by the province.

Fuel Switching

- **Heat pumps (geothermal and water-source)** – Heat pumps greatly improve the efficiency of electricity for heat. Manitoba Hydro has shown that a switch from pure resistive electric heating to geothermal produces annual savings of about 15,800 kWh per household per year. Of Hydro's 485,000 residential customers in 2018, there were about 140,000 single-detached and about 9,000 multi-detached (duplexes and the like) homes that were heated electrically. Simple math would estimate a saving of at least 2,350 million kWh if all these electrically-heated homes were connected to geothermal. Additionally, about 10,000 of the approximately 68,000 commercial & industrial customers in Manitoba heat their buildings electrically. They would enjoy similar improvements in efficiency with geothermal. Additionally, as buildings become closer to Passive House levels of efficiency, the need for ground-source or water-source (i.e. lake or river) geothermal heating will be reduced.

- **Air-source heat pumps** - Air-source heat pumps improve efficiency of electric heat systems but even the most efficient systems are no better than purely resistive systems when outside temperatures dip below about minus 15°C.

- **District heating** - Heating can usually be delivered more efficiently if heat from a single source is shared amongst a number of buildings, a town centre, or a neighbourhood. A crown corporation such as Efficiency Manitoba or Manitoba

Hydro should be involved in the ownership and development of such District Heating systems. Such systems would distribute biomass and geothermal heat. Geothermal could be provided in such a system by boring horizontal wells under streets and lanes.

- **Geothermal Heat as a Utility** – Rather than individual home and building owners bearing the full cost of installing geothermal, those costs should be borne by a public utility.

- **Geothermal Under Street and Lane** – Every time a roadway is opened up for sewer work, geothermal piping should be included in the installation. This piping will be added to the geothermal utility network. There is a lot of heat to be obtained from waste water. Alternatively, by using horizontal drilling, geothermal loops could be installed under existing streets and lanes without having to dig them up.

- **Biomass for heat** – Biomass is not automatically a sustainable energy source - but it can be in some rural and remote circumstances. Central district heating systems that use agricultural straw could be adopted by many rural towns. These systems could be owned and operated by producer cooperatives. Many remote, boreal forest communities are located near stands of forest wood that has been killed by forest fire but still contains energy. Such a biomass plant is in operation in Northlands Dënesųłiné First Nation in Lac Brochet, Manitoba. All of these proposals would provide local employment and keep more money in the province. As part of Manitoba's ban on coal burning, many Hutterite Colonies are now heated with straw biomass from their own operations. The University of Winnipeg and Providence College in Otterburn also have biomass-for-heat systems.

- **ERV / HRV** – As building envelopes improve they become more air-tight. This requires active fresh air exchange systems such as Energy Recovery Ventilation (ERV) and Heat Recovery Ventilation (HRV). These systems are now required in most new buildings but should be much more common in existing buildings. Pay-As-You-Save (PAYS) financing should be available for these systems.

- **Solar Walls** – The fresh air that is drawn into heating systems can be pre-heated by the sun. Solar walls are hollow, black-coloured plenums installed on exterior walls. Air is drawn in at the bottom of the wall. It is heated by the sun as it is drawn up inside the solar wall before the air enters the building's heating system on the roof.

- **Hydrogen** – We do not support hydrogen as a transportation fuel source; batteries are more efficient for transportation. However, hydrogen is being considered as a sustainable heat source. Most hydrogen is currently derived from natural gas but it would be sustainable if it were generated by electrolysis using electricity from solar, wind, or hydro. Hydro power could also be employed to generate hydrogen in off-peak times when there is a surplus of water behind the dams. ***Renewable Hydrogen Canada*** is undertaking a pilot project to mix such "renewable hydrogen" into the natural gas distribution system. However, pure hydrogen causes embrittlement of steel. To become an alternative in the natural gas distribution system, steel components would need to be replaced with other materials.

Energy storage

In order to deliver extra power when needed to meet times of peak demand, we may consider ways to store energy and keep it in reserve.

- **Battery storage** – The ***Tesla PowerWall*** has been designed for home usage. It is intended to be used in conjunction with renewable home energy generation such as solar panels. It is also useful for providing power during electrical service interruptions.

Metrics / Key Performance Indicators (KPI)

Key Performance Indicators (KPI) are those few essential metrics that will give us the best indication of progress towards our goals. Some of these may not yet exist and may need to be developed. We would like to track all of these metrics over time to reveal trends.

- Building floor space area heated by natural gas as percentage of total building heated area (this should be broken down into building types)

- Building floor space area heated electrically with heat pump assistance as percentage of total building heated area (this should be broken down into building types)

- Building floor space area heated with unassisted resistance electric as percentage of total building heated area (this should be broken down into building types)

- Km of natural gas distribution pipeline in service

- Cost differential between natural gas and electricity in dollars per kilowatt hour ($/kWh) equivalent

- Number (and type) of certified Passive House buildings

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Transportation

The Big Picture

The United Nations Environment Program (UNEP) 2018 Emissions Gap Report calls for a 45% reduction in total annual emissions from 2010 levels by 2030, and net zero emissions worldwide by 2050.

Figure 1: Climate Pollution from Transportation with UNEP Goals

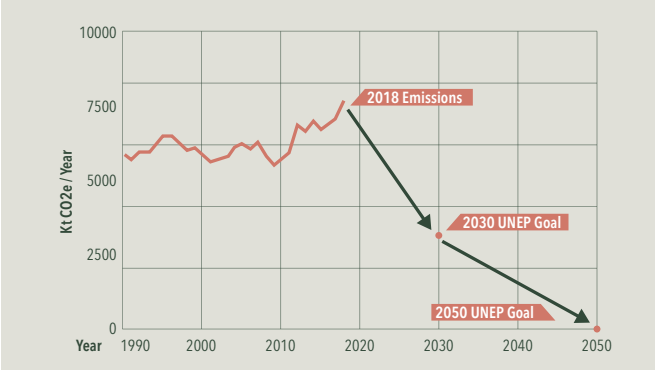


Figure 1: Figure 1 shows Manitoba's historic emissions from transportation, and how this must change to meet the UNEP 2030 and 2050 goals

Figure 2: Manitoba Climate Pollution from Transportation Sub-Sectors

Sub-Sector	Emissions 2018 (tCO2e)
Road Transportation	
- Light Duty Gasoline Trucks	2,330,000
- Heavy Duty Diesel Vehicles	2,010,000
- Light Duty Gasoline Vehicles	1,110,000
- Heavy Duty Gasoline Vehicles	520,000
Other Transportation	
- Agriculture & Forestry	938,000
- Railways	881,000
- Domestic Aviation	481,000
- Manufacturing, Mining, Construction	305,000
- Pipeline Transport	304,000
- All Other Sources	401,000
Transportation Total (2018)	**9,280,000**
UNEP Basline Year (2010)	*6,972,000*
UNEP 2030 Goal (-45% of 2010)	*3,835,000*
Cut Required by 2030	**5,445,000**

*Historically very low number, explanation requested from the federal government.

Achieving the first UNEP goal in Manitoba's transportation sector will require a 59% reduction from current (2018) levels by 2030, from 9,280,000 tCO2e to 3,835,000 tCO2e. The required reduction has increased because our transportation emissions have increased by over 2,300,000 tCO2e since the 2010 baseline year.[4] Year-over-year reductions of 6.5% are now required for nine years in a row to achieve the UNEP 2030 goal. Further reductions will be needed to achieve the UNEP goal of net zero emissions by 2050. Failure to achieve these goals puts additional pressure on other sectors in Manitoba to make up the difference.

Climate pollution from Manitoba's transportation sector comes from different fuels used in a diverse range of sub-sectors, as shown in Figure 2.

Manitoba Climate Pollution from Transportation – Historical Overview

Transportation sources produced 9,280,000 tonnes CO2e or 42% of Manitoba's total climate pollution in 2018. This is 31% more than the amount emitted in 1990 by transportation sources. The transportation sector is Manitoba's largest source of annual climate pollution and has been every single year since official records began.

Road transportation accounts for two-thirds of climate pollution in the transportation sector. Increased emissions from heavy-duty diesel trucks and light-duty gasoline trucks are the primary cause of our rising climate pollution in this sector.

[3] tCO2e – Tonnes of carbon dioxide equivalent. This is a means of normalizing greenhouse gas emissions data. For example, on a 100-year timescale, nitrous oxide (NOx) has about 300 times the global warming potential (GWP) of CO2. So, 1 tonne of NOx emission is equivalent to 300 tonnes CO2e.

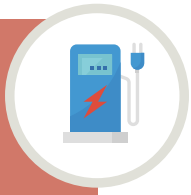
[4] All Figures: Derived from data contained at Environment Canada, Canada's Greenhouse Gas Inventory

Since 1990, pollution from light-duty trucks such as sport utility vehicles, crossovers, minivans, and pick-up trucks has doubled. Significant growth in Manitoba's successful long-haul trucking industry has contributed to a quadrupling of climate pollution from heavy-duty diesel trucks. Some regulatory reform and efficiency efforts have prevented this growth from being even higher. Pollution from smaller vehicles such as sedans and compacts has decreased by 28%. This is in part due to improved efficiency but is mostly because consumers are preferring larger vehicles to smaller ones by a 2:1 margin. Overall, climate pollution from road transportation has doubled in Manitoba from 1990-2018.

Performance in other transportation sub-sectors is mixed. Since 1990 emissions from domestic aviation and agriculture/forestry have held steady, railway pollution has gone up 46%, and pipelines now produce 64% less climate pollution thanks to conversions of pumping stations to electricity instead of natural gas.

Objective 2:

To be truly resilient, we must move all goods and people without gasoline or diesel.



Challenges

Achieving a 6.5% reduction in climate pollution nine years in a row from our transportation sector will be made more difficult if the following factors continue unchanged:

- Population and economic growth leading to more people and businesses buying more vehicles
- Continuing preference for larger, less efficient fossil fuel vehicles such as SUV's, pickup trucks, crossovers, and minivans versus smaller more efficient options
- Lack of choice among electric vehicle types other than passenger cars (e.g. pickup trucks)
- Continued preference for low-density urban design, causing longer, more frequent vehicle trips
- Funding cuts to public transit leading to declining service, higher fares, and lower ridership
- Incomplete active transportation networks combined with 5-6 months of winter weather

Electrifying vehicle transportation will require a lot of energy and power. According to the ***Manitoba Hydro 2016 Electric Load Forecast,*** (pg 55) if all the vehicles in Manitoba were to be powered by electricity, it would require an additional 8,792 GWh of energy and 1,099 MW of peak power. This could be accomplished with the ***Conawapa dam*** project (~ 7,000 GWH and 1,500 MW) and about 500 MW of wind generation. (We aren't necessarily proposing this solution. It just provides the scale of the challenge.)

The Pathway

What needs to be considered and what changes might need to be implemented in order to achieve the objective of climate change resilience for transportation in Manitoba?

The first solution strategy for making transportation sustainable is to reduce the need for transportation. This involves more high-speed internet for virtual travel for medical needs, education, and business. Minimize travel by moving things closer together - densification in urban areas, and being able to provide for more of our needs locally instead of importing so much. Reduce the need for car ownership by enlarging carshare availability. Minimize vehicle transportation by doing more active transportation. Reduce the number of vehicles by making public transportation (urban and inter-urban) more available and attractive. Make all vehicles that are needed battery electric. Eliminate "free" parking. And finally we should adopt innovative approaches for transportation to remote northern communities and for powering farm and other off-road equipment.

We suggest the following elements are all necessary to achieve this objective:

Reduce Need for Transportation

The most effective way to reduce greenhouse gas emissions from transportation is to reduce the amount of travelling we do and the amount of goods that travel long distances.

City Planning

The need to travel by motor vehicle is reduced if people start off closer to their destination. This requires policymakers, developers, and consumers working together.

- **Cluster development** – Neighbourhoods need to be functional communities. People need to have access to essential amenities near where they live (e.g. grocery, pharmacy, convenience store, café, restaurant, medical, school, place of worship, recreation).
- **Densification** – There needs to be more people per unit area, especially near community centres. Zoning and permitting need to encourage multi-family dwellings and smaller units. This includes reviewing minimum parking requirements. People should also be closer to where they work. This means reviewing zoning to allow attractive residential development closer to commercial and light industrial areas.
- **Walkability / Bike-abilty / Bus-ability** – Being close isn't enough - roadways need to be safe and attractive for cycling; neighbourhoods need sidewalks & cut-throughs to bus routes, and street design needs to address accessibility concerns.
- **Citizen support** – As these city planning adjustments are proposed and made, citizens need to be open-minded. We need to resist NIMBY-ism (Not In My Back Yard). We need to embrace the fact that our cities need to change.

Virtual travel

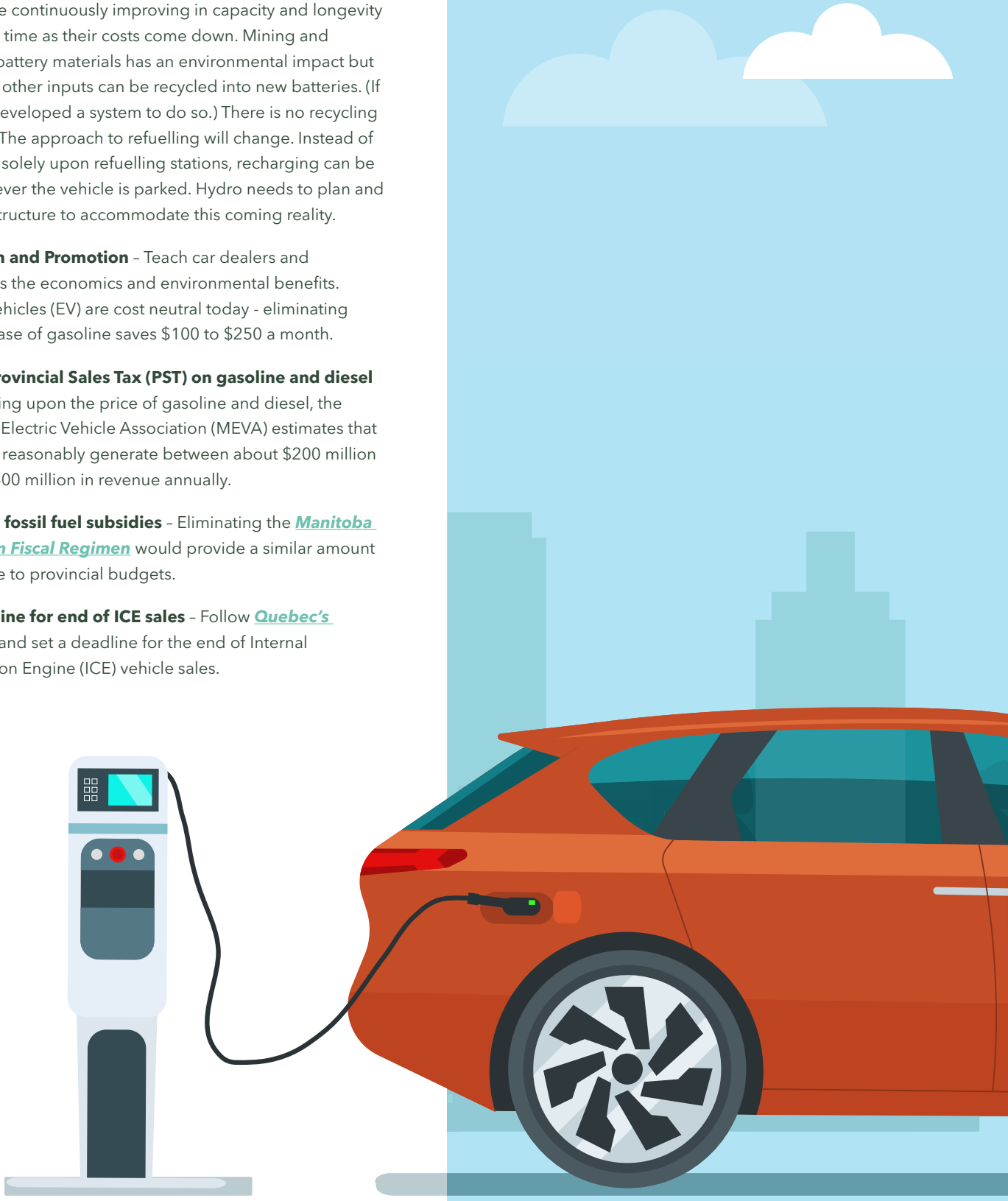
With computer and cellphone communication, we can reduce the need to travel considerably.

- **"Tele-commuting"** – Much of the work done in offices can be done from home. The work needs to be suitable and employers need to be flexible. This can also reduce the amount of office space required for a business and can therefore reduce cost.
- **Video conferencing** – With all of the new and improving platforms (e.g. Zoom, GoToMeeting, Google Hangouts, Slack) "virtual meetings" can be at least as productive, if not more, than in-person. Since the meeting is on your desktop, travel time to and from are eliminated. File and screen sharing encourages collaboration. Travel costs are dramatically reduced especially for teams that are international. Members can even participate on their smartphones from wherever they are.

Electrification

The ultimate fuel for vehicle transportation is electricity. Batteries are continuously improving in capacity and longevity at the same time as their costs come down. Mining and refining of battery materials has an environmental impact but lithium and other inputs can be recycled into new batteries. (If Manitoba developed a system to do so.) There is no recycling fossil fuels. The approach to refuelling will change. Instead of depending solely upon refuelling stations, recharging can be done wherever the vehicle is parked. Hydro needs to plan and build infrastructure to accommodate this coming reality.

- **Education and Promotion** – Teach car dealers and consumers the economics and environmental benefits. Electric Vehicles (EV) are cost neutral today - eliminating the purchase of gasoline saves $100 to $250 a month.
- **Collect Provincial Sales Tax (PST) on gasoline and diesel** – Depending upon the price of gasoline and diesel, the Manitoba Electric Vehicle Association (MEVA) estimates that this could reasonably generate between about $200 million to over $400 million in revenue annually.
- **Eliminate fossil fuel subsidies** – Eliminating the ***Manitoba Petroleum Fiscal Regimen*** would provide a similar amount of revenue to provincial budgets.
- **Set deadline for end of ICE sales** – Follow ***Quebec's example*** and set a deadline for the end of Internal Combustion Engine (ICE) vehicle sales.



- **Corporate Average Fuel Economy (CAFE) standards** – The cost to produce the drivetrain of passenger electric vehicles (EV) with the same range (500 km) as internal combustion engine (ICE) vehicles is coming down rapidly. ***It is expected that by 2022, the production cost of both vehicle types will be equal.*** Building codes should make recharging stations mandatory and straight-forward to install and get approval. Other provinces (e.g. Quebec) have used rebates to accelerate acceptance. However, the biggest impediment currently is that dealers don't want to sell them. This can be overcome with ***Corporate Average Fuel Economy (CAFE)*** standards that require a manufacturer to sell electric vehicles to offset their SUV sales.

- **School buses** – Allow no more diesel school bus purchases immediately. A Quebec company, ***Lion Electric,*** builds and sells electric school buses. Their initial cost is higher but total cost of ownership is lower and the ***air quality around schools is much better.***

- **Goods transport** – In November 2017, Tesla unveiled the ***Tesla Semi.*** Analysis indicates that the costs and performance of these vehicles promises to make them very profitable to operate. The Tesla Semi is expected to be in limited production soon. In preparation, we need to ensure that our licensing, insurance, charging regulations, and infrastructure are planned and implemented so that we are prepared. The Manitoba Trucking Association has proposed that the Manitoba government work with them and their members to conduct vehicle trials on a ***Lion Electric delivery truck*** now.

- **Electric buses** – ***New Flyer makes electric buses*** and sells them around North America - but not in Winnipeg. As with other electric vehicles, their initial cost is higher but they are cheaper over their lifespan due to their reliability, longevity, and lower operating cost. However, Winnipeg Transit and Manitoba Hydro need to work together to plan and build a recharging strategy and capability.

Public Transit

Embracing public transit can result in a number of benefits in addition to greenhouse gas reduction. For each full bus, we could take approximately 40 cars off the road, lessening traffic, and reducing the strain on our roads.

- **Frequent Service Transit Network (FSTN)** – According to Jarret Walker's book ***Human Transit,*** frequent service means that a bus is coming every 15 minutes or better, all day - and ideally, every day. The new Winnipeg Transit Master Plan includes recommendations for frequent service on some routes. This needs to be implemented and expanded in the coming years. However, current Winnipeg city budgets are reducing transit service in Winnipeg instead of expanding it.

- **Routing** – Besides having service that is frequent, routes need to be simple. Destinations need to be "on the way" and not at the end of some deep side-trip or loop. This involves transit route planning that is integrated with city planning. It is impossible to provide satisfactory bus service in many newer housing developments just because of the street design. People in these developments can only get adequate bus service if they can walk or cycle to adjacent FSTN routes by sidewalk, cycle path, and cut-throughs.

Active Transportation

A transportation mode with no direct greenhouse gas (GHG) emissions.

- **Bike infrastructure** – Surveys indicate that the thing that prevents most people from cycling more regularly is the ***feeling that it is unsafe.*** As cycling infrastructure improves, more people cycle.

- **Route-finding and connections** – There needs to be a network of routes that riders feel are safe and attractive all the way from where they are to where they want to be. The network needs to be completely connected with routes that are easy to find and follow.

- **Education** – Cyclists who follow ***CAN-Bike*** recommended practices are safer on the road but most motorists and even most cyclists do not recognize good cycling behaviour when they see it. It needs to be taught and such training is not readily available.

- **Motorists** – Driver training needs to include awareness of CAN-Bike recommended practices and teach consistent driving behaviours.

- **Cyclists** – Cyclists don't know what they don't know. Riding a bike is not the same as driving a car. Just because a person has a driver's licence doesn't mean they know how to conduct themselves safely on a bicycle on a roadway in traffic. There needs to be more awareness and availability of CAN-Bike training.

No More Free Parking

Free parking isn't free. Because "free" parking encourages people to use their cars, the city needs to spend money on roadway construction, expansion, and maintenance. Big parking lots are also very unfriendly to pedestrians - they discourage people from walking or taking a bus.

- **Parking tax** – There should be a tax on big parking lots. This would offset the costs they cause due to the traffic they generate. It also makes downtown more competitive.

Carshare / Rideshare

Many people don't need to own vehicles. With carshare programs like ***Peg City Car Co-op,*** people only pay for the time and distance they use the vehicle for. The limitation is the distance from where you are to the closest Peg City Car Co-op car.

- The number of cars and their distribution could be dramatically enhanced if public service fleet vehicles (municipal and provincial government, Manitoba Hydro, other crown corporations) were made available to the carshare network in off hours. This could also be a revenue source for the fleets.

Self-Driving Vehicles

The imminent arrival of self-driving vehicles will be a truly disruptive technology. There will be less reason to own a vehicle. We will look upon our vehicles less as a manifestation of our ego and more as a utility that is just something to get us (and stuff) moved from A to B. It will also have a profound impact on transportation jobs - we will need fewer drivers.

- **Passenger vehicles** – Carshare use will explode when autonomous vehicles enter the carshare fleet. It will no longer matter where you live. The shared car will come to you. You won't have to worry about parking. Cars will park themselves - or not at all. People who still own cars may commute to work and then their car will return home to park. Or you may use one carshare vehicle to get to your destination and another to get home.

- **Goods transport** – It will be possible to run trucks in convoys. Because of communication between vehicles, they will be able to travel much closer together. This "slipstreaming" reduces drag enormously. It will change the economics to the point where truck transport will be cheaper than rail and much more flexible and timely.

- **Uber-type transit** – Autonomous buses will be much less expensive to operate - although the absence of a driver may present personal safety issues. It may become feasible to use carshare vehicles as, at least part of, the feeder network to get people to the Frequent Service Transit Network (FSTN).

Air Travel / Remote Communities

Many remote communities in Manitoba do not have all-season road access. They depend upon the annual construction of the ***24,000 km winter road network.*** These roads depend upon frozen muskeg, streams, and lakes. Climate change is shortening the average number of days these are open each year and making them less reliable. In the not-to-distant future, there will be a year when some or all of the network can't be built. What will happen to communities that rely on those roads for their heating fuel, construction material, and food supplies?

- **Airships** – ***Dr. Barry Prentice*** of the University of Manitoba has been working on this problem for over a decade. He proposes ***airships.*** These are basically self-propelled gas bags. They don't require a runway and can be used all year long. Although airships will soon be commercially available, they will require public policy and infrastructure support - Air Canada and WestJet didn't build the airport.

Off-Road Vehicles

- **Farm equipment** – Today's farm tractors can run on biodiesel. This biodiesel can be produced on-farm or by a producer cooperative. David Rourke, founder and former President/ CEO of ***AgQuest Research,*** estimates that 5 to 10% of a canola crop would provide enough biodiesel to produce the crop itself. Manufacturers like John Deere are also experimenting with electric and self-driving tractors and other equipment. With self-driving electric technology, you may not need a separate, heavy tractor. It may be more practical to put the motor directly on self-driving implements themselves.

- **Construction & forestry** – We are not aware of any serious progress toward electrification or autonomous vehicle development in this area, However, all vehicles must move away from fossil fuels.

Metrics / Key Performance Indicators (KPI)

Key Performance Indicators (KPI) are those few essential metrics that will give us the best indication of progress towards our goals. Some of these may not yet exist and may need to be developed. We would like to track all of these metrics over time to reveal trends.

- Number of electric vehicles registered in Manitoba as a percentage of all registered vehicles by vehicle category (e.g. light truck, heavy truck, passenger vehicles)
- Number of Rideshare vehicles in the province (e.g. Peg City Car Coop)
- Number of transit routes with Frequent Service
- Number of kilometers of protected bike lanes

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Food & Agriculture

The Big Picture

The United Nations Environment Program (UNEP) 2018 Emissions Gap Report calls for a 45% reduction in total annual emissions from 2010 levels by 2030, and net zero emissions worldwide by 2050. Figure 1 shows Manitoba's historic emissions from its agriculture sector, and how this must change to meet the UNEP 2030 and 2050 goals.

Figure 1: Manitoba Agriculture GHG Emissions with UNEP Goals

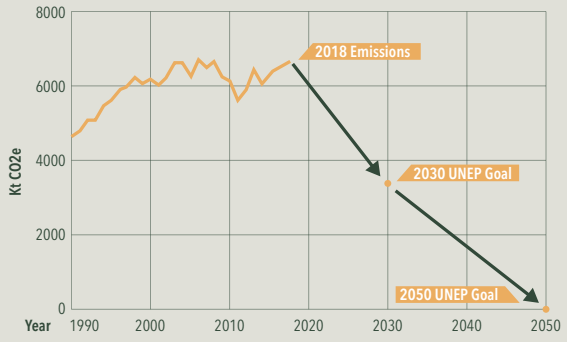

Figure 2: Agricuture Sub-Sector GHG Sources

Sub-Sector	Emissions 2018 (tCO2e)
Fertilizer Use:	
- Direct Soil Sources	2,600,000
- Indirect Soil Sources	600,000
- Liming, Urea & Other	310,000
Fertilizer Use Total:	*3,510,000*
EntericFermentation	*2,400,000*
Manure Management	*740,000*
Field Burning	*20,000*
Agriculture 2018 Total	**6,670,000**
UNEP Basline Year (2010)	6,160,000
UNEP 2030 Goal (-45% 2010)	3,390,000
Cut Required by 2030	**-3,280,000**

Achieving the first UNEP goal in Manitoba's agriculture sector requires a 49% reduction from current (2018) levels by 2030, from 6,670,000 to 3,390,000 tonnes of CO2 equivalents (tCO2e). [5]

This requires year-over-year reductions of 5.5% for nine years in a row to 2030, then further reductions to reach the second UNEP goal of net zero by 2050. Failure to achieve these goals puts additional pressure on other sectors to make up the difference.

Climate pollution from Manitoba's agricultural activities comes almost entirely from three different sources: fertilizers, fermentation from livestock digestive processes, and manure management. Fertilizer use (including fossil-fuel based varieties), animal manure and other applications (such as urea and lime) contributed the largest amount at 3,510,000 tCO2e or 53% of sector emissions in 2018. Enteric fermentation from ruminant animals such as beef and dairy cattle produced 36% of all agricultural climate pollution at 2,400,000 tCO2e. Climate pollution from manure storage and management was the third largest source in 2018 at 740,000 tCO2e or 11%.[6]

Climate Pollution from Agricultural Operations – Historical Overview

Agriculture produced 6,670,000 tCO2e or 31% of Manitoba's total climate pollution in 2018. This is 43% higher than in 1990 when records began, and 9% higher since 2010 (the UNEP baseline year for 2030 and 2050 emissions reduction targets).

Emissions from the three main agricultural emission sub-sectors (fertilizers, livestock, and manure management) have increased since 1990, but the only one to increase significantly since 2010 has been fertilizers. Climate pollution from direct and indirect soil sources, plus anhydrous based fertilizers and liming

[5] tCO2e – Tonnes of carbon dioxide equivalent. This is a means of normalizing greenhouse gas emissions data. For example, on a 100-year timescale, nitrous oxide (NOx) has about 300 times the global warming potential (GWP) of CO2. So, 1 tonne of NOx emission is equivalent to 300 tonnes CO2e.

[6] All Figures: Derived from data contained at Environment Canada, Canada's Greenhouse Gas Inventory

applications went up by 600,000 tCO2e or 23% from 2010-2018. Emissions from manure management have increased by 6%. Climate pollution from "enteric fermentation" comes from the digestive processes of ungulate animals, such as sheep, goats, beef, and dairy cattle. Emissions from this sub-sector have declined by 200,000 tCO2e or 8% since 2010, primarily due to changes in provincial herd size. Field burning, more commonly known in Manitoba as stubble burning, used to cause over 100,000 tCO2e each year but new regulations in 2004 dropped this to around 20,000 tCO2e where it remains to this day.

Soil Carbon Sequestration

Agricultural practices can actually reduce atmospheric carbon. Depending upon the farming practices employed, atmospheric carbon can either be added to (sequestered) or removed from agricultural soils. Studies by soil scientist ***Rattan Lal*** have shown that improved agricultural and land management practices can bring the concentration of atmospheric CO2 down by 156 ppm. If we are at around 420 ppm now and ***we should be at 350 ppm,*** this, combined with elimination of fossil fuel burning, could solve climate change.

However, we currently do not have a reliable means to quantify this positive or negative carbon sequestration in Manitoba. There are some technological developments that may provide this metric (e.g. ***CIBO Technologies, Indigo Ag***).

Challenges

Achieving a 5.5% reduction in climate pollution from Manitoba's agricultural operations for nine years in a row will be made more difficult if the following factors remain unchanged:

- Government tendency to ignore potential role of agriculture in reducing climate pollution
- Increasing use of fertilizer for crop production
- Provincial goal of increasing livestock herd sizes for beef/hogs
- Subsequent increases in manure generation from larger herd sizes

A word about agricultural exports…

It's easy to understand why Manitoba exports so much of our agricultural production. We are extremely fortunate to live in such a fertile land. A 1,200 acre farm using current organic farming practices can produce enough bread in a year to give every person in Manitoba a loaf of bread each day for 6 days. We would need 73,000 acres to feed every Manitoban a loaf of bread per day all year. We currently have 10 million acres of cropland in production in Manitoba. So, our food production capability generates the equivalent of more than 130 loaves of bread per Manitoban per day.

We have the luxury to choose what we want to eat. The challenge is how to use this land resource in a more sustainable, regenerative way for the benefit of all. We have the capability and perhaps the obligation to provide food for others as well as ourselves. While we have a vibrant primary commodity export opportunity, we currently import a lot of our table food. There is no reason that Manitoba can't put more of our production onto our own tables – it's a matter of priority and policy.

The Pathway

What needs to be considered and what changes might need to be implemented in order to achieve the objective of climate change resilience for food in Manitoba?

We suggest that the key will be more local production, processing, & distribution of natural, nutritious food.

Objective 3:

To be truly resilient, all of the food that we eat must be produced without synthetic fertilizer and without diesel for the machinery.

We suggest the following elements are all necessary to achieve this objective:

Consumption

Rule of Five "N"s

What we demand as consumers will mean success or failure for this transition. When making food choices, we need to **follow the Rule of Five "N"s:**

- **Nearby** – Buy food produced by farmers that live close by to greatly reduce the pollution created from transporting food all around the world. This includes food you grow yourself.
- **Naked** – Choose food that doesn't have a lot of packaging.
- **Nutritious** – Buy food that is high in nutrients and low in preservatives and other chemical additions.
- **New Now** – Eat Canadian fruits and veggies at the time of year they grow or that have been harvested and preserved. Growing seasons can be extended in greenhouses for example, but not if this requires fossil fuel for heating.
- **Natural** – Choose food that is produced through holistic means, with no chemical inputs.

Price

As consumers, we need to consider the overall value above price. However, we need to explore strategies to enable nutritious food to be competitively priced and affordable. Those of us who have sufficient income should buy locally produced food before imports, even if we pay a premium. By expressing and exercising this preference, we can influence the market to increase local food availability, and through economy of scale, potentially reduce their costs.

Less food waste

According to Second Harvest, ***over half (58%) of all food produced in Canada is wasted,*** and 32% of this wasted food is avoidable. We need to identify where food is wasted in the system and reduce its causes. For example, we can reduce a lot of food waste by changing our expectations as consumers. Perhaps reducing serving sizes in restaurants might reduce waste. We also need to better understand what is edible. For example, packaged food with "Best Before" dates are often treated as inedible as soon as the date passes (although food may not be as fresh, ***it is safe to eat after the stamped "Best Before" date).***

Alternative fertilizers

The main source of greenhouse gas emissions from agriculture is from the application of fossil fuel fertilizers. Anhydrous ammonia is a rich source of nitrogen which has been a big contributor to the record yields producers have enjoyed in the last few decades. However, depending upon when it is applied, it may release nitrous oxides (300x CO2 as a greenhouse gas) and its production uses a lot of energy and requires hydrogen for its chemistry. There is a 4R program (Right product, Right time, Right place, Right Rate.) required in the application of any fertilizer. We also need alternatives.

Green Anhydrous

Production of anhydrous ammonia requires heat energy and hydrogen. In the current system, most of this hydrogen is collected by "cracking" natural gas. Hydrogen can also be generated from electrolysis of water. Similarly, the heat required for the process can be generated from non-fossil fuel sources (e.g. methane collected from landfills).

Biological Nitrogen

"Green manure" is based on the symbiotic relationship between bacteria and legume plants. These are often purpose-grown cover crops. Typically they are tilled under and incorporated into the soil while green and shortly after flowering. This provides nutrients to the soil and builds soil health. Legumes planted as green manure will provide soil nitrogen.

Other research is working on free-living nitrogen fixers that could supply some of the nitrogen in non-legume crops like wheat and corn. Multi-species crop mixtures can help to maximize the biological nitrogen in mixtures such as pea-oat or pea-canola intercrops.

Compost

Any residential, industrial, commercial, and institutional organic waste that cannot be prevented needs to be collected, composted, and returned to the soil to be used as an excellent soil amendment for farming, gardening, and landscaping. This includes home composting and residential collection. Collection will also be necessary for organic waste from locations with significant volumes such as apartment blocks, restaurants, and grocery stores. Collection vehicles must be electric.

Wastewater Treatment

Phosphorous from sewage is causing eutrophication of our lakes. Winnipeg is currently upgrading its wastewater treatment to extract phosphorous from sewage. Phosphorous can be collected from wastewater in the form of struvite crystals. This should be recycled as fertilizer.

Animal Manure

Manure from ruminants is a natural contributor to soil carbon. See the *Production* section below.

Production

Organic, Permaculture, Regenerative Agriculture

We need to adopt, encourage, and enhance farming principles and practices that increase biodiversity, enrich soils, improve watersheds, enhance ecosystem services, and do not depend upon fossil fuels. We need to capture (sequester) carbon in soil. In other words, we need wholesale adoption of ***Permaculture, Regenerative Agriculture,*** and other organic farming, agroecology, and agroforestry practices.

A key aspect of this is production of animals for food and use of their waste for fertilizer and soil health. Current livestock production at the industrial scale is not the answer - production in feedlots is too concentrated, and uses feed that will increase animal size without adding nutrition – for the animal or us. However, animal husbandry on a sustainable scale can make productive use of land (including marginal land), provide nutrition for a growing population, and recycle nutrients to help sequester carbon and improve crops and soil health.

More table food, Less primary commodities

Agricultural production needs to focus on providing more of the food we put on our table and less on production of primary commodities for export.

We need to ensure that locally produced food is made available to consumers. We need to connect the producer to the customer more closely. The local food needs to be brought as close to the consumer as possible. This means going beyond the Farmers Market approach and into retail food chains and stores. This would include promotion and enhancement of ***Community Supported Agriculture (CSA).***

Home and Community gardening & food preservation

People who have yards should be encouraged and enabled to produce more of their own food. We need to encourage gardening clubs like ***Manitoba Master Gardeners Association*** and other learning opportunities.

Municipalities need to allocate and provide greenspace for community gardens. They also need to provide some essential services to these gardens and gardeners (e.g. Spring tillage, water collection & distribution, compost facilities & management, security fencing & lighting, garden club organization, learning opportunities). Learning opportunities include workshops on food preservation, canning, and dehydration.

An additional benefit from gardening and producing our own food is that it improves our mental health (See *Human Impacts* chapter). It helps people connect with nature and fresh air. It is also an active approach to deal with anxiety about climate change and other impending impacts.

Remote Communities and Traditional foods

Indigenous people and other remote area residents need access to hunting, fishing, and gathering. We need to protect our wild spaces. We need to promote growing more food locally in remote communities. We must consider replicating the example of ***Growcer*** in Churchill or ***Meechim Farms*** in Garden Hill First Nation.

Alternative fuels for equipment

(From the *Transportation* chapter) Today's farm tractors can run on biodiesel. This biodiesel can be produced on-farm or by a producer cooperative.

Manufacturers like John Deere are also experimenting with electric and self-driving tractions. With self-driving electric technology, you may not need a separate, heavy tractor. It may be more practical to put the motor directly on self-driving implements themselves.

Policy & Regulations suggestions

- **Task Force** - Implement a task force to determine the actions required to make farming practices compatible with the ***IPCC 1.5°C Report*** targets and timeframe. This will mostly focus on eliminating fossil fuel use and maximizing carbon sequestration while producing food. This task force will discover that Regenerative Agriculture/agroecology with or without integration of livestock will be key. It will have many variations: organic, low input zero till, with and without integration of grazing ruminants - big, small, or in-between, depending on product grown. Adaptive grazing with ruminants on perennial pastures will sequester the most carbon, but the market for meat will limit this option.

- **Education** - Educate Manitobans in the science and urgency regarding solutions to human-made global heating. This education should include the importance of grazed ruminants as a source of nutrition and a necessary part of rebuilding soils and maximizing carbon drawdown.

- **Farmland Size/Sale/Ownership** - Prevent farmland grabs by non farmers. This includes foriegn and multinationals who "steal" farmland for large-scale farms. Seriously consider capping farm size. Potential carbon credits coming into farmland will distort farmland values. Seriously look at options to reduce the average farmer age from 58 to 40. Carefully research farm size to determine if there are optimums in regard to integrating ruminants and minimizing energy use. Generally examine present policy to ensure mixed farms are not dis-advantagous, particularly in regard to AgriInsure, AgriStability and AgriInvest programs.

- **Ban Fossil-fuel Based Fertilizer** - Declare a date after which all fossil fuel based fertilizers will be banned. This date must be before 2030. Implement programs and practices before this date to ensure production can continue without these fertilizers.

- **Farm Equipment Fuels** - This ban will include all fossil fuel powered cars, trucks, trains, tractors, combines, sprayers, and swathers. Promote the use of straight vegetable oil for farm equipment, as well as long term use of electric and hydrogen powered vehicles.

- **Prairie Farm Rehabilitation Administration (PFRA)** - Create a new PFRA to accelerate the implementation of all the necessary steps to make farms a major part of the solution to meeting the ***IPCC 1.5°C Report*** targets and timeframe.

- **Self-sufficiency** - Strive to facilitate Manitobans' ability to grow or otherwise provide their own food; at least the basic staples both in terms of raw ingredients and table foods.

- **Ensure that "sustainable" practices really are sustainable** - Many farmers, ranchers, and processors are labelling their efforts as "sustainable," when at best they are simply more sustainable. Practices are not sustainable as long as they use fossil-fuel based resources. Be careful not to be distracted with band-aid incremental approaches which ultimately get in the way of the paradigm shift we need.

- **Invest in research and innovation** - We need to develop better regenerative farm practices, better renewable hydrogen & NH3, better batteries, better artificial photosynthesis, better biological farming solutions, better societal outcomes, and progressive taxation.

- **Act with a sense of emergency** - These changes are essential for the next generation to survive in peace and with the means to meet their own essential needs.

Metrics / Key Performance Indicators (KPI)

Key Performance Indicators (KPI) are those few essential metrics that will give us the best indication of progress towards our goals. Some of these may not yet exist and may need to be developed. We would like to track all of these metrics over time to reveal trends.

- Percentage of food purchased in Manitoba from local sources
- Cattle herd raised with rotational grazing as percentage of all cattle
- Quantity of fossil fuel based fertilizer applied per year
- Crop acreage fertilized with fossil fuel fertilizers as percentage of all crop acres
- Yield per acre (all crops regardless of fertilizer) per kg of fossil fuel based fertilizer
- Measure of Soil Carbon per acre in all forage acreage and all cropped acreage
- Quantify Straight Vegetable Oil (SVO) powered farm equipment
- Number of "PFRA" staff on the ground

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Energy & Electricity

The Big Picture

The United Nations Environment Program (UNEP) 2018 Emissions Gap Report calls for a 45% reduction in total annual emissions from 2010 levels by 2030, and net zero emissions worldwide by 2050.

Figure 1: Climate Pollution from Electricity with UNEP Goals

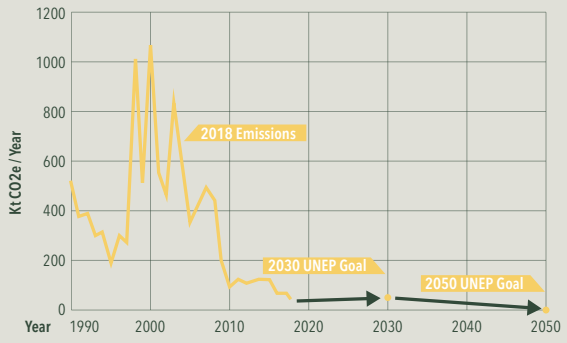


Figure 2: Manitoba Climate Pollution from Electricity

Category	Emissions 2018 (tCO2e)
All Thermal Generation	41,000
Hydro-electricity	0
Wind / Solar / Biomass	0
Electricity Total (2018)	**41,000**
UNEP Basline Year (2010)	**91,000**
2030 Target (-45% of 2010)	**50,000**
Cut Required (Goal Met)	**(9,000)**

Over 70% of Manitoba's energy consumption comes from the burning of fossil fuels. Refined petroleum products such as gasoline, diesel, and aviation fuel account for 43%, followed by natural gas for space heating and hot water in buildings at 28%. Opportunities to reduce climate pollution from these sources are discussed in the chapters on Buildings, *Transportation* and *Food & Agriculture*. **In many ways, Manitoba's electric resource is a key part of the solution to the challenges in those other chapters.**

Electricity accounts for 24% of all energy consumed in Manitoba, and nearly all of it (95%+) is generated without burning fossil fuels. Figure 1 shows our historic climate pollution levels from electricity, and highlights how this sector has already met and exceeded the UNEP 2030 goal.[7] Figure 2 demonstrates that in 2018 climate pollution from electricity generation in Manitoba was already 9,000 tCO2e[8] under the UNEP 2030 target of 50,000 tCO2e. Further reductions from Manitoba's electricity sector will help offset any shortfalls in climate progress from other sectors.

Meeting the UNEP 2050 goal of net zero emissions requires annual reductions of less than 1,400 tCO2e per year in each of the next thirty years.

Manitoba Climate Pollution from Electricity – Historical Overview

Electricity generation in Manitoba produced 41,000 tCO2e of climate pollution in 2018, accounting for less than 0.2% of our provincial total (21,800,000 tCO2e). This is 92% less than the 519,000 tCO2e released in 1990, and one of the few categories where our province has met and exceeded the first UNEP goal of a 45% reduction from 2010 levels by 2030.

These dramatic improvements were the result of deliberate actions to phase-out fossil fuels from Manitoba's electricity grid. While we have relied upon hydro dams for the bulk of our electricity for decades, as of 1990 Manitoba still had coal-fired stations in Selkirk MB and in Brandon MB. In the early 2000's

[7] All Figures: Derived from data contained at Environment Canada, Canada's Greenhouse Gas Inventory

[8] tCO2e – Tonnes of carbon dioxide equivalent. This is a means of normalizing greenhouse gas emissions data. For example, on a 100-year timescale, nitrous oxide (NOx) has about 300 times the global warming potential (GWP) of CO2. So, 1 tonne of NOx emission is equivalent to 300 tonnes CO2e.

the Selkirk plant was converted to natural gas, and in later years the Brandon plant was reduced to emergency use only. When the Bi-pole 3 transmission line was completed in 2018, the Brandon coal plant was no longer needed and closed a month later. There are some combined-cycle natural gas turbines in Manitoba but they are rarely used.

There are four Indigenous communities in Northern Manitoba that are not yet connected to the electricity grid and rely upon diesel generators for their electricity.

The ability to provide electricity to nearly an entire province without burning fossil fuels is a remarkable achievement, creating many important opportunities for our province that will be explored in greater detail below.

We must also acknowledge the severe and on-going social and environmental devastation that hydro dams have caused to nearby Indigenous people, their communities, traditions, and the lands they call home. The Pathway has neither the ability nor the mandate to properly address this crucial truth, but we recognize the lasting impacts of hydro-electric development in Manitoba's north as one of the defining issues that must be heard and addressed if proper reconciliation with Indigenous peoples is to occur.

Challenges

With Manitoba's electricity sector already over 95% fossil-fuel free, the challenges ahead relate to the sustainability of our electrical grid and best use of the energy it creates. These challenges include:

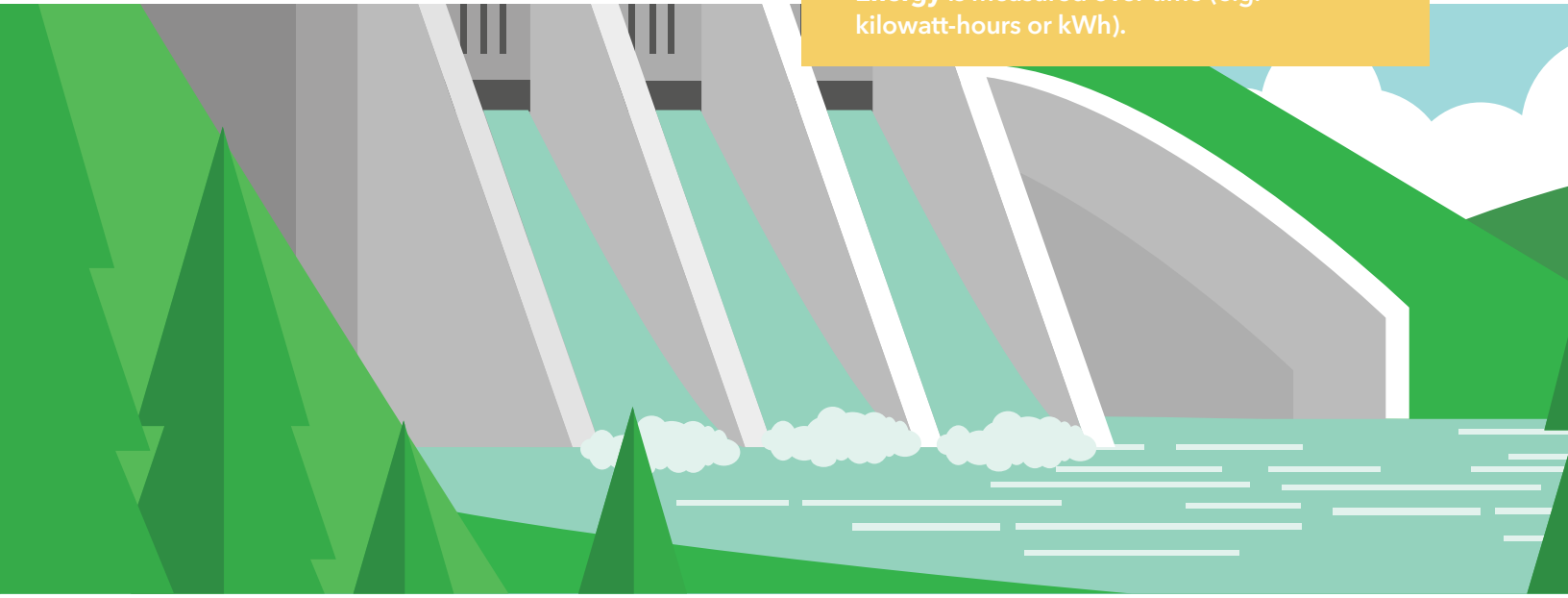
- Grid vulnerability to the risk of drought and extreme weather events, made worse by climate change
- On-going annual subsidies to the fossil fuel industry and inadequate pricing of climate emissions, leading to artificially low prices for high-carbon energy and hampering the transition to fossil fuel-free electricity
- Barriers to sharing carbon credits with export customers

More Energy and Power

As we electrify transportation and space heating, we will need to maximize our electrical generation capability and maximize the efficiency of our use of this resource.

For context, the 2019-2020 Manitoba Hydro annual report says electricity consumption in Manitoba was 22,002 million kWh and that Hydro exported 9,629 million kWh to customers outside the province for a total of 31,631 million kWh (Energy). Meanwhile, Hydro's total electrical capacity is 5,615 megawatts or MW (Power).

Energy is measured over time (e.g. kilowatt-hours or kWh).



- **Electric heating** – Let's look at additional annual generation required to switch residential buildings to electricity.

- **Energy requirement** - If we assume that switching an average home from natural gas to electricity will require Hydro to supply an additional 12,000 kWh per year per household, this translates to an increased need for electric energy of 3,384 million kWh - or about 10% of Hydro's current amount generated.

- **Power requirement** - However, the challenge is in meeting peak power demand. If all of our buildings (with current energy efficiency) were heated with resistance electricity (electric baseboards and furnaces), Manitoba Hydro estimates that we would require an additional ***7,000 MW of generation to meet the demand*** required to keep us warm on the coldest winter night. Hydro couldn't supply that power demand. When the new Keeyask generating station comes online, Hydro's "dependable" power generating capacity will be around 6,000 MW. So, we'd need to more than double our generating capability if we just "switch fuels".

In the Buildings chapter we refer to Hydro's estimate that we would require an additional 7,000 MW of generation to electrically heat the buildings that are currently heated with natural gas. This power must be "dependable". This means it must be available upon demand. In other words, 7,000 MW of "nameplate" solar photovoltaic (PV) would not contribute to meeting the demand at 9 PM on a cold January day. Solar PV has a "dependable" capacity of zero. This is a very important detail when considering potential "peak" capacity challenges resulting from electrification. "Existing Wind" has a ***peak dependable capacity of 52 MW.*** This is 20% of the 258 "nameplate MW" of wind reported for ***Manitoba's St. Leon and St. Joseph Wind Farms.***

- **Vehicle electrification** - In addition to the increased demand for electricity for heating buildings, we also need to plan to supply electricity for vehicles.

- **Energy requirement** - A recent NRCan study, ***Accelerating the Deployment of Zero Emission Vehicles: Atlantic Canada and the Prairies,*** estimates that the conversion of all gasoline powered vehicles in the province to electricity would require between 1,200 million kWh and 2,500 million kWh a year. This would represent a 4% to 8% increase from present.

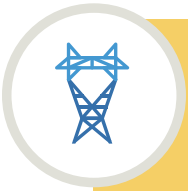
- **Power requirement** - It is much more difficult to plan how much additional power generation vehicle electrification would require. It's quite reasonable to think that on a cold winter night virtually all of our buildings would require energy for heat. But how many vehicles would need to be charged at the same time? It's extremely unlikely that all vehicles in the province would need to be charged at exactly the same time. In fact, with 2-way metering, any fully-charged vehicles that were plugged in can actually supply power back into the grid to meet peaks in demand. It's also possible for vehicle charging plugs to utilize Utility Controlled Charging (UCC). This would allow Hydro to control the time a vehicle is charged.

The Pathway

In most of the world, electricity is a big part of the climate change problem. Here in Manitoba, it's a big part of the solution.

Most electrical generation, in most other parts of the world, is achieved through burning of coal or natural gas. (i.e. thermal generation). In 2018, coal-fired electricity generation accounted for ***30% of global CO2 emissions.*** In Manitoba, most of our electricity comes from hydroelectric generation and a small amount from wind and solar (see *Historical Overview* above). For the most part, the only time Manitobans use electricity from thermal generation is when Manitoba Hydro buys power on the spot market and imports it from out-of-province.

However, we don't have enough generating capacity to just switch fuels. We may not have enough generating capacity to convert all of our vehicles to electric and heat all of our buildings with electricity. We need to be smart about this transition.



Objective 4:

How can we use our electricity resource efficiently, effectively, and affordably to meet the needs of the preceding three chapters?

Limit Natural Gas Distribution

- **Moratorium on expansion of natural gas distribution network** - We must stop expansion of the natural gas distribution system. This will incentivise densification and make sprawl less attractive. This will reduce the need and cost of expansion of other aspects of infrastructure. This moratorium would be a very cost-effective way for Efficiency Manitoba to exceed its annual target for reduced natural gas consumption.

Efficiency Manitoba

- **Efficiency Manitoba mandate** - The Efficiency Manitoba Act (Bill 19) should be amended or regulations enacted so as to direct the corporation to focus upon greenhouse gas emission reduction with respect to energy usage. This will enable the corporation to implement programs to increase the efficient use of electricity for heat. By "efficient use" we mean, in buildings that have been built or enhanced to meet an energy performance standard and where the electric heating system includes a heat pump (ground-source, water-, or air-source). It will also allow them to encourage adoption of biomass for heat in appropriate areas and to investigate provision of utility-owned district heating systems.
- **Efficiency Manitoba funding** - We recommend that the Manitoba Government levy the carbon tax at the same level as the rest of Canada in accordance with the *Pan-Canadian Framework on Clean Growth and Climate Change*. An appropriate amount of this revenue should be directed to Efficiency Manitoba to fund programs to electrify transportation and shift heating away from natural gas.

Vehicle Electrification

The electric vehicle (EV) revolution is well underway and accelerating. Manitoba will need to plan for and implement an energy distribution network to meet this new and growing demand.

This transformation is much more advanced in some other parts of the world (e.g. Norway, Quebec). In those areas, most of the passenger vehicle charging takes place at people's homes and where they work. A trans-Canada network of charging stations was completed by Tesla and Petro-Canada in late 2019. This network allows for coast-to-coast EV motoring. An important deficit may be the numbers of charging stations in multi-family residential buildings.

Another unique aspect of electric vehicles is that they can also be a source of energy storage in an electrical distribution system. When a vehicle is charged and plugged in, they can provide electricity to the grid to meet peak demand times.

Most passenger vehicle recharging will occur at night. So, additional grid infrastructure may not be needed, especially in the next decade.

Electric heat for buildings

Electricity is "high quality energy". This means it is portable and can be used for a lot of purposes – some of which can't be provided for by any energy other than electricity. So, we need to be very prudent with how we use our electric resource.

One of the least efficient ways to heat is with electric baseboards. Electric furnaces are better but still not ideal on their own. However, the efficiency of electricity for heating can be substantially improved by use of heat pumps (See "Buildings" Chapter).

District Heating

Heating is a "low quality use" – heat can be provided by a variety of sources. District heating is a system of pipes that share heat between buildings. This is usually between a central heat plant and residences or businesses. Additionally, operations that produce heat can share heat with operations that require heat. (See "Buildings" Chapter)

Diesel Communities

There are four communities in Manitoba whose electricity is generated from diesel fuel. These are the remote northern First Nations of Northlands Dënesųłiné First Nation (Lac Brochet), Barren Lands First Nation (Brochet), Sayisi Dene First Nation (Tadoule Lake), and Shamattawa First Nation. Due to their remote locations, these communities are not connected to the Manitoba Hydro distribution grid. They depend upon the annual construction of winter roads in order to receive the fuel they need for electrical generation and for heat.

Northlands Dënesųłiné First Nation (Lac Brochet) now uses sustainably sourced burnt wood to supply about 30% of the heat demand for the community. The fuel source is trees within 15 km of the community that were killed by forest fire but which still have unburnt wooden cores. These are harvested by local labour. The logs are transported by sled or barge to a log yard in the community. They are chipped and fed into a boiler plant that heats water and glycol that is distributed by an underground district heating system to the school and a few other nearby buildings.

Metrics / Key Performance Indicators (KPI)

Key Performance Indicators (KPI) are those few essential metrics that will give us the best indication of progress towards our goals. Some of these may not yet exist and may need to be developed. We would like to track all of these metrics over time to reveal trends.

- Electrical energy consumed by transportation as a percentage of electricity consumed
- Electrical energy consumed by heating as a percentage of electricity consumed

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Human Impacts

In this chapter, we identify the various, perhaps not-so-obvious, ways that climate change is and will affect people in Manitoba and beyond.

The human impacts of climate change are dynamic, deeply complex, and pose largely unfamiliar challenges. While some impacts have already been documented, the full extent of the ways in which climate change will alter our communities and health has yet to play out. In this chapter, we explore the human impacts through a lens of climate justice, understanding that climate change does not impact everyone the same. We discuss some of the specific ways in which climate change threatens the health of people in Manitoba. The chapter draws the connection between climate change and reconciliation, and concludes with a note on the urgent need to mitigate the human impacts of the climate crisis.

Climate Injustice

There are inequities related to who has caused the climate crisis and who will suffer most.

In many cases, people that are least responsible for causing climate change are the ones suffering first and worst from its effects. On a global scale, the vast majority of greenhouse gas (GHG) emissions that are driving climate change were contributed by industrialized countries, mostly in the Global North. Meanwhile, people in countries of the Global South with very low carbon footprints are bearing the brunt of the consequences of those emissions. These disproportionate impacts exist globally, but also within our own country and our own province.

In this light, climate change can be understood as a "threat multiplier" because it exacerbates existing inequalities. The following sections discuss the disparities of climate impacts along the lines of class, gender, race, generational differences, and ability. These areas overlap and intersect in ways that can further compound impacts.

Poverty

Within Canada and Manitoba, people with lower income suffer more from the consequences of climate change. Those living in poverty have a higher chance of experiencing the ill-effects of climate change due to increased exposure and vulnerability. Vulnerability represents the degree to which a person is susceptible to, or unable to cope with, adverse effects of climate change. People in lower-income communities are often denied the resources that would allow them to sufficiently cope with environmental change. For instance, during a heatwave people living in apartment buildings without access to air conditioning or accessible green spaces are at much greater risk of suffering from heat stroke or other heat-related impacts.

At the same time, the current capitalist economic system continues to ***widen the wealth gap and reinforce this inequality.*** Thus, climate solutions must address economic inequality as well.

Race & Culture

Injustice due to income and gender is closely associated with disparity due to race. In Canada, Indigenous, Black, and other People of Colour are disproportionately impacted by environmental pollution and climate change - what has come to be known as "environmental racism". Because of systemic racism, these communities also often have less access to the resources and materials required to respond and adapt to climate impacts. Further, Indigenous Nations and other cultures that centre on a close relationship to the land and other beings are further impacted spiritually and culturally by environmental degradation.

First Nation reserves have often been relegated to areas that are not suitable for agriculture (which results in disproportionate food insecurity due to climate irregularities), are on land prone to flood, or are in areas susceptible to forest fire. Indigenous people in cities are ***disproportionately lower income*** due to the lasting and ongoing impacts of colonization, and therefore may lack amenities for coping. This is discussed further in the section below on *Impacts for Indigenous Communities and Reconciliation*.

Intergenerational injustice

Besides the injustice to the poor, the global south, and people from certain ethnic areas mentioned above, youth and the next generations will also suffer disproportionately as climate change unfolds.

Intergenerational justice is the idea that present generations have a duty towards future generations. Climate change raises critical ethical questions: which risks are those living today allowed to impose on future generations? How can available natural resources be used without threatening the sustainable functioning of the planet's ecosystems? How can we balance the rights' claims of those alive today against the rights' claims of future generations?

Agencies like ***UNICEF*** are trying to establish criteria and threshold levels to distinguish between morally permissible and morally unacceptable risk impositions. The intention is to provide decision-makers with clear guidelines. However, defining objective criteria here is extremely difficult.

Many young people have observed the ever-increasing level of atmospheric greenhouse gases. Up until 2019, global annual greenhouse gas (GHG) emissions increased annually. Actions taken to reduce those emissions are not matching up to the pace that science demands for a safe and liveable future. Because of this lack of urgency and action, some groups of youth have taken steps to ***sue governments*** for putting their futures at risk.

Gender disparity

Climate change is not gender neutral. It impacts women and men differently. In some societies, women are responsible for gathering and producing food, collecting water, and sourcing fuel for heating and cooking. With climate change, these tasks are becoming more difficult. As mentioned above, extreme weather events such as droughts and floods have a greater impact on the poor - and poverty rates are highest among children, ***particularly among girls.***

In Canada and Manitoba, a ***review of climate change and gender research*** illustrates the ways that climate change is disproportionately impacting people along the lines of gender. Impacts such as extreme weather events are found to increase rates of sexual and domestic violence and mental health challenges, disproportionately impacting women. There is also increasing evidence of adverse effects on pregnancy outcomes. On the other hand, research suggests that men are more vulnerable to the effects of some impacts such as extreme heat or increasing infectious diseases.

Gender inequality may dramatically limit the resilience and adaptive capacity of women's families and communities. At the same time, it may also restrict options for climate change mitigation. Evidence shows that women's empowerment and advancing gender equality ***is associated with lower carbon emissions,*** and can lead to more environmentally friendly decision making at household and national levels.

Impacts on People with Disabilities

People living with disabilities are also affected differently by climate change. ***Disabilities make the general health threats*** posed by climate events, as well as social, economic, and demographic impacts, worse. A disability is any condition that leads to long-term diminishment, usually lasting at least six months, of a person's capacity to perform activities that a person without any of those conditions could do independently and with minimal trouble. These conditions often manifest as vision, hearing, physical, intellectual, developmental, learning, mental health, speech, or chronic pain challenges. About ***175,000 Manitobans***—close to a seventh of the population—have one or more disabilities. Manitobans with disabilities have higher poverty rates than the provincial average, at ***12.4 per cent in 2017.***

Climate-related literature has a general blind spot in its treatment of disability issues and climate. One widely acknowledged exception is to how people with disabilities ***die at higher rates*** than people without disabilities during extreme weather events, which climate change will exacerbate. Unfortunately, the sustainable planning measures political authorities implement ***often exclude*** concerned people with disabilities, as do recovery efforts after extreme events, and the social movements that advocate for disability and environmental justice are often separate.

Many people with disabilities have practical experience in fields such as risk management, problem-solving, and overcoming barriers that they can offer society due to their lived experiences of scarcity, discrimination, and appreciation of living interdependently. All these insights can help build sustainability and community resilience. Winnipeg's 2018 climate strategy gestures towards this when it mention enhanced public transit, which is a relatively climate-friendly mode of transportation, as a means to improve mobility for people who face barriers to transportation.

Health Impacts

Climate change is projected to cause ill health effects for most people. In 2015, the ***World Health Organization (WHO)*** declared, "Climate change is the greatest threat to global health in the 21st century." This includes both physical and mental health. Mental health impacts can make physical health impacts even worse. There has been growing evidence of climate-related health impacts around the world for some time, and Canada is no exception. Health risks, however, may inspire a paradoxical good for us, as ***some research*** suggests that people think more about how to mitigate and adapt to climate change when communicators appeal to their interest in averting damages to their health.

Physical Health

As terrestrial and aquatic ecosystems deteriorate and temperatures rise higher, food security is threatened due to decreased productivity of fisheries and agriculture. Floods, heat waves, droughts, and fires also raise levels of tropospheric ozone and particulate pollution, ***increasing risk of cardiovascular and respiratory diseases.***

Heat waves, ***defined*** as at least three days of 30°C or higher, are expected to reach an average of six per summer in Winnipeg by the 2051–2080 period and last up to seven days at a time, if warming continues at current rates. ***Higher temperatures can also cause*** bodily overheating, damage to and failure of vital organs like the heart, kidneys and brain, and dehydration. After southern Manitoba had a heat wave over the second weekend in July 2019, ***two people died.***

Climate change is also expected to increase the frequency and number of infectious diseases in Manitoba. For example, climate change has played a role in the ***spread of blacklegged ticks in Manitoba*** over the last decade, a forest-dwelling insect which carries Lyme disease. Other diseases transmitted through water and food are also increasing under climate change.

Mental Health

As people experience more climate change impacts, many are experiencing increases in anxiety, depression, and consequent personal and family stress.

Experience of disasters has been correlated with higher rates of generalized anxiety disorder (GAD). The Fort McMurray fire of May 2016, the costliest disaster in Canadian history, ***led to GAD rates of about 19.8%*** in respondents surveyed six months later, approximately eight times Canada's baseline rate of 2.5%. This phenomenon also occurred in Manitoba,

after the historic 2011 floods; many of the approximately ***7,100 Manitobans,*** mainly Indigenous people, who were evacuated incurred mental health problems from having to prepare for the floods and then leave their homes.

Eco-anxiety is a more specific form of anxiety. As of 2020 it is not a clinically recognized diagnosis in Canada, but the ***Canadian Mental Health Association*** (CMHA) defines it as "a deep fear of environmental doom and human catastrophe [that] can bring on the same kinds of symptoms as anxiety—like panic attacks and sleeplessness—and depression." It can affect Manitobans of any age and for any cause. ***In an interview with CBC,*** one Winnipeger names their former overuse of plastic as cause of their eco-anxiety. Other common factors include government inaction, rising greenhouse gas emissions, and climate change induced disasters. ***Younger Manitobans are worried about environmental problems,*** including climate change, borne of their increasing sensations of powerlessness as they do not see other people, governments, and organizations in their lives doing enough to stop them. Rates of several anxiety and mental disorders have ***risen recently among young Manitobans.***

Impacts for Indigenous Communities and Reconciliation

In Canada, and here in Manitoba, we must understand climate change and impacts in the context of the histories and ongoing institutions of colonialism. Given that the Canadian economy relies on extracting resources including oil and gas from Indigenous lands, and the burning of those resources is driving climate change impacts upon Indigenous communities, the movement for Indigenous self-determination is linked to the movement for action on climate change.

Reconciliation is a very large, complex, and necessary task between the state and Indigenous Peoples, which thus far has been promised by Canadian governments with little action. Continuing to engage in a patriarchal manner with Indigenous Peoples, Canada still fails to meet its global obligation to ratify the United Declarations on the Rights of Indigenous Peoples and fails to adequately approach and honour its moral and ethical obligation to Indigenous Peoples of this land. At the same time, the government contends that Canada is a panacea of *multiculturalism* engaging in reconciliation. 'Multiculturalism' as a proud banner of Canadian identity has successfully made invisible not only the violence and role of settlers, but also Black People, Indigenous People, and People of Colour, and their role in strengthening social and political commitments to climate change.

Setting an agenda for Nation-to-Nation relationships between Crown and First Nations, Inuit, and Metis Governments, fulfilling national obligations and commitments to the recognition and implementation of Indigenous Peoples rights must be part of our response to climate change.

Potential Positive Impacts of Climate Change

While the negative certainly outweighs the positive when it comes to the human impacts of climate change, the crisis does present some opportunities.

Explicit advantages for Manitoba may affect sectors such as agriculture and energy. As global temperatures rise, the tropical jet stream increasingly moves and merges northward over Manitoba's clay-rich soil, ***increasing the length of our growing season.*** A changing growing season may also allow for different crops to be grown in Manitoba, though this will be challenged by increasing drought and flooding. A decline in the number of very cold days (below -30°C) in winters in the future may also provide certain benefits with respect to infrastructure, transportation, and health and safety.

With the transition to renewable energy, the Prairie provinces also provide ample opportunity for corporate and community driven green energy production.

Mitigating the Human Impacts of Climate Change

This brief overview of the human impacts of climate change has illustrated the critical need for both adaptation and for mitigation to lessen future impacts. A climate justice approach to how we think about human impacts of climate change broadens our ability to conceptualize necessary supports and focus within our communities, rather than exclusively at the international level.

The COVID-19 pandemic has laid bare the inequality of the systems in our society, and in some ways has elevated community reaction to human impacts of climate change. The pandemic and resulting recession has also created an opportunity for government investment and stimulus spending to be directed towards renewable energies and climate adaptation.

As a country that has benefited from industrialization and contributes disproportionately to the causes of climate change, we must ask ourselves: are we holding ourselves, our communities, and our representatives accountable to human impacts of climate change?

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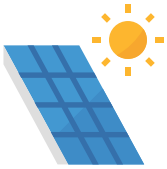
Economy & Green Jobs



As the previous chapters indicate, climate change is intertwined with most aspects of economic life. Proceeding as though we can treat climate policy as a distinct area, walled-off from industry, commerce, finance, employment, infrastructure, housing, or a host of other areas is a recipe for contradiction and failure.

Despite the fact that government agencies quite often work at cross purposes to one another, governments play an important coordinating role when it comes to existential threats, or emergencies that require an "all-hands-on-deck" approach. Governments can, and have, oriented society's wheels in a single direction, in order to maximize the effectiveness of the considerable engine power generated by the public and private sectors. Think about World War II, The Great Depression, or—more unevenly—governments' responses to the COVID-19 pandemic.

The Effort Required

This is what is required in order to mount what increasingly looks like a last-ditch, all-out effort to keep global average temperature increase below 1.5 degrees. We could have done this much more gradually, and with much less disruption to our lives and economies had we started on the path decades ago, when the warnings first became urgent. A variety of corporate actors and their allies in government worked ***diligently and effectively to prevent this,*** concealing internal scientific research that connected the burning of fossil fuels to atmospheric warming, and casting doubt on the increasing scientific consensus on anthropogenic climate change. As a result, they have put us in a situation where small-scale, moderate reform will unquestionably fail. The scale of the problem is too large, and the timelines too short.

Analysis of what it will take on a global level, just to move to net zero emissions by 2050 as the ***Intergovernmental Panel on Climate Change (IPCC) instructs*** that we must, suggests a massive but manageable scale, focusing on investments in clean, renewable energy, and energy efficiency. ***A recent study*** drawing primarily on data from the International Energy Agency reveals that clean energy and efficiency investments in 2018 were around US$570 billion—in the neighbourhood of 0.7% of global Gross Domestic Product (GDP). The estimates indicate that in order to meet the IPCC's target, we'll need to collectively increase that to US$2.6 trillion per year in the first year, and then keep it at 2.5% of global GDP. Mobilizing $2.50 per hundred dollars of GDP every year, from both public and private sources, is not a lot in exchange for a livable planet. While the scale of infrastructural change that will be required is vast, building the green infrastructure required is not beyond our capabilities.

Addressing climate change is not only a question of taking what we are and what we have, and somehow removing the greenhouse gases - addressing climate change means rebuilding energy infrastructure, and reevaluating the ways in which we move, eat, and shelter. It also means re-thinking some questions, like where do we find meaning in life, to whom do we owe responsibility, how we satisfy need and desire, and who gets to set the conditions for our collective future? We live in a society that encourages certain answers to those questions, and those answers bear some responsibility for putting us on a path to climate disaster.

Green Jobs

First, and by now most obviously, we know that a transition away from fossil fuels requires us to think about the implications for people's work. Transition needs to be coordinated through policies that provide people with good quality jobs and secure livelihoods. This isn't only a question of justice, though that, in conjunction with science-driven targets, clearly ought to be the guiding principle of transition. The transition will be much easier if we ensure that working people don't get thrown under the bus along the way. The example of France's Gilets Jaunes movement, which rose up against Emmanuel Macron's proposed carbon tax, is instructive. Transition must be fair, and must offer people a vision of a better future, not a future of deprivation and insecurity.

There is plenty of scope to do so, since there is no shortage of work to do in building a sustainable, low-carbon economy. This work can be safe, secure, and provide a decent livelihood if we so choose. Targeted investments in building and transportation infrastructure would go a long way toward this. Since Manitoba starts from the enviable position of very low-carbon energy generation via Manitoba Hydro, our first steps need to be on energy efficiency, and the CCPA ***Manitoba Alternative Provincial Budget 2020*** shows some useful starting points. As previous chapters have shown, two of our biggest carbon problems are transportation, followed by buildings. Building safe, convenient, and fast public mass transit and active transportation infrastructure can be a foundation for hundreds of good new jobs in design, planning, materials development, and construction. Bringing our old housing and building stock in line with the dual demands of cold Manitoba winters and low carbon emissions is also a huge job generator. Upgrading and retrofitting the energy efficiency and the heating, cooling, and ventilation of homes, apartments, commercial, and public buildings is necessary to bring down our emissions, and can put thousands to work. The problem is not a lack of work.

Policy Option

- Restore the 50/50 provincial transit cost-sharing agreement with the City of Winnipeg.
- Invest in mass transit to develop a Frequent Service Transit Network, and in active transportation infrastructure.
- Invest in a large-scale energy retrofit program for residential, commercial, and public buildings. Retrofit investment yields 3-4 times the number of jobs per dollar invested than average infrastructure.

Some of this transition is happening already. Between 1977 and 2007, ***California's energy efficiency policies generated 1.5 million jobs.*** Jobs in energy efficiency ***grew almost three times as quickly*** as overall employment in Canada in 2018, and provided good jobs for 436,000 Canadian workers. If left to the market, the scale of transition will be too small, and the character of transition will reproduce and accelerate the inequalities that are already intolerable.

Investing in the Future

Investments in alternative energy and for energy efficiency are not enough now, nor are they trending in a way that we can be confident they will be. According to the International Energy Agency (IEA), investment in renewable power, and renewables for heat and transport totalled ***US$310 billion globally in 2019,*** down along with the rest of the energy sector from 2018. Meanwhile, $511 billion was ploughed into up-, mid-, and downstream oil and gas. As a share of total energy investment, renewables have been relatively constant at one-third, though the IEA also reports that 90% of new energy capacity installed in 2020 was in renewables, resulting in a small bump in that share in 2020. They anticipate a decline by 2022 as a number of key policy incentives sunset in that year. That flatness suggests that markets are not driving investment to renewables or to efficiencies, and out of fossil fuels, in anywhere near the required volumes. A concerted, publicly-driven, and integrated investment in energy transition is an absolute necessity.

In addition to increasing investment, we need to make sure a transition serves the many, rather than the few. As Seth Klein, ***drawing on the lessons of past industrial transitions,*** put it: "There will be a transformation—a response to the climate crisis—and whether it occurs in a manner that is just and fair or unjust and repressive remains an open question. Past industrial revolutions have cared little for those whose lives were turned upside down by change." That means ensuring that investments in green infrastructure come along with adequate funding for the "seven R's" necessary to protect workers, distilled by the ***Labour Education Centre*** from their analysis of four previous energy transitions.

The "seven R's" necessary to protect workers during this transformation:

1. **Relocation** of workers within the same employer.
2. **Rehabilitation** of the closed or abandoned worksites
3. **Re-employment** in local area jobs.
4. **Re-training** for a new Profession.
5. **Retirement**
6. **Redundancy** Payments
7. **Reinvestment** in Affected Communities

Policy Option

- Engage with Manitoba labour organizations and businesses to map out the implications of energy transition for provincial employment, and develop a just transition strategy that protects workers and provides the training necessary to build a green workforce.

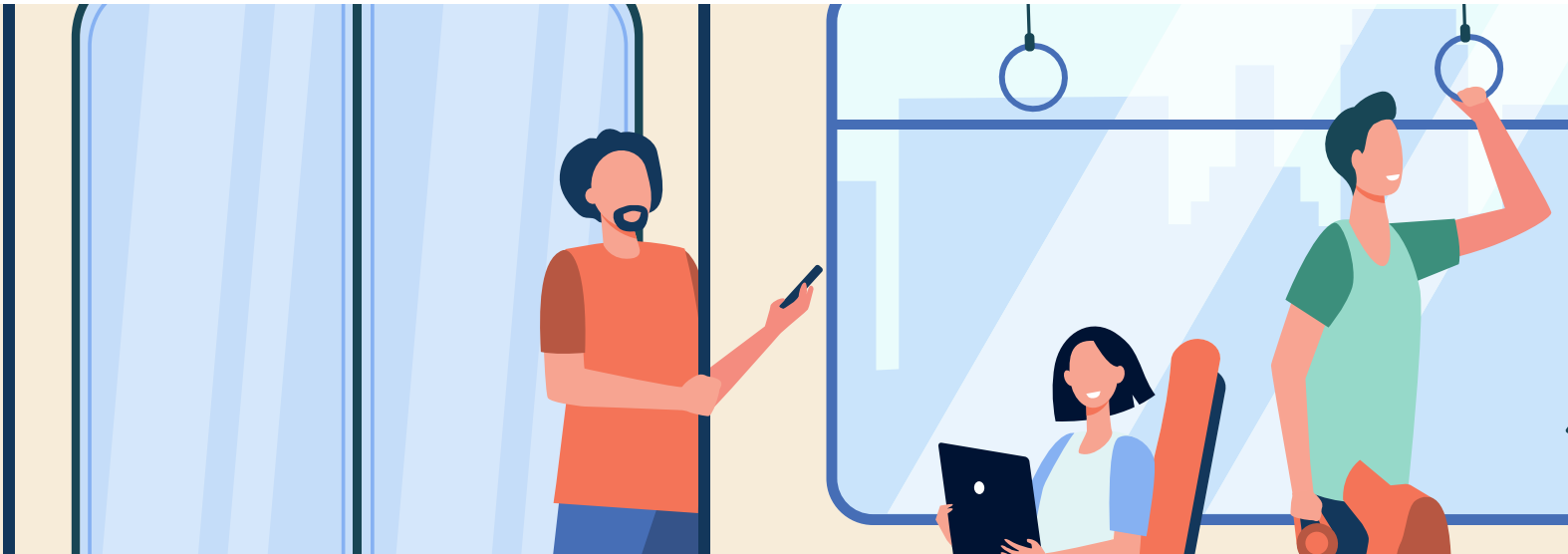
Protecting workers is one crucial element of a just transition. The Human Impacts chapter compels us to think about how both climate change and energy transition will affect different groups of people in different ways, often exacerbating existing inequalities. This includes thinking about future generations, about people on the other side of the planet, and about non-human life as well. If the answer to the question "to whom do we owe responsibility" includes these groups, then our socio-economic system must change fundamentally, since it often flourishes for some at the expense of others.

The End of Endless Growth

Climate change means that we have to contemplate the future viability of a socio-economic system with endless growth as its core principle, and which produces distributions of wealth and well-being that are shockingly unequal. This is not to say that some kinds of growth are not desirable or necessary—for example, with the build-out of green housing, energy, and transportation infrastructure. Some amount of "decoupling" of economic growth and environmental damage is indeed possible. We can create more value with less environmental damage per unit. The energy intensity, and the carbon intensity, of economic activity can decline, and in some periods it has. For example, ***the global energy intensity of the economy declined by 36% between 1990 and 2018.*** Unfortunately, the total amount of greenhouse gas (GHG) emissions rose from 22 billion to 32 billion metric tons of carbon dioxide equivalent in the same period. The same trend is true of resource or materials intensity. While it is in some periods getting less material intensive, the absolute amount of extraction continues to climb. From the 1970s, our ***extraction of raw material to feed production has tripled.***

Tackling climate along with the related ecological crisis of biodiversity decline, means reconsidering how we satisfy our needs and desires. It cannot continue to be at the expense of the diversity of life on the planet, or climatic stability. That is a road which passes by an extraordinary diminishment of our capacity to universally satisfy basic needs and desires, and that ends at a chasm for huge numbers of people and other life.

Currently, the vision that dominates our understanding of a decent life revolves around private consumption. A good life conjures up a certain basket of goods that we own and enjoy. And no doubt, we have some way to go to provide everyone with a material standard of living that enables them to survive, let alone live with dignity. But private consumption of the kind that characterizes an affluent life in the Global North, if it were expanded to even a significant portion of the planet, would be a catastrophe for the climate, and relatedly, for much of life (human and otherwise) on earth. We can either have a high level of private consumption for a few, and next-to-nothing for the many (which is the current state of things) or we can generate a different vision of the good life, other than one rooted in private consumption. What will create the possibility of a zero-carbon society is not any specific new green technology, but a social priority on public provision of amenities that are collectively enjoyed. A world that has grappled successfully with climate change is one which has reoriented from producing for the privatized, exclusive enjoyment of the few who are able to afford it (notably on the back of a lot of unpaid-for environmental destruction and impoverished workers), to producing spaces and places that in turn generate public affluence. After all, why do we engage in the mad, carbon-intensive scramble for a high-consumption lifestyle? Mostly it is in order to help us enjoy relationships and experiences, and to develop ourselves by learning, creating, experiencing new things, and interacting with others. A society of parks, libraries, arts and cultural centres, shared maker-spaces, public gardens, boulevards along which to stroll, and spaces in which to encounter other people, rather than to move past them, is a climate-friendly one. So too is one in which the green work of caring (child care, elder care, teaching, health care) is properly prioritized and universally provided.



Key Performance Indicator:

- **Net Social Wage.** How much value do residents of the province receive from all of its publicly provided goods and services, net of what they contribute through taxation? There are ways of counting this, most of ***which look at just the value of the expenditure.*** However, it is possible to imagine and develop consumption-based values for the social wage, which would more adequately capture how Manitobans value their public services.

The changes we need to make in order to confront climate change are huge, but they are within our capacities. They not only offer, but require a much more inclusive political-economy. Markets are not currently, nor will they, move us to a sustainable socio-economic system. An adequate and feasible response to climate change means public investment in energy, transportation, and housing. It means supporting good livelihoods for working people through that investment, and above all, building public affluence, rather than private wealth.

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Natural Spaces / Wilderness

The Intergovernmental Panel on Climate Change ***(IPCC) 1.5°C Report*** stated that the only proven pathway to limit catastrophic temperature rise was through the protection of nature. While governments and industry are trying to create carbon capture projects, no technology exists to draw down carbon from the atmosphere at the scale required to fight the climate crisis.

Manitoba has more intact nature and wilderness than many countries in the world. It is this body of functioning natural ecosystems that positions Manitoba to be a global leader in climate action. Protecting vast storehouses of natural carbon and the natural cycles that will continue to allow lands and waters to absorb atmospheric carbon creates climate stabilization and resilience.

Carbon Cycle and Storage in Nature

Intact nature is a constant cycle of water, oxygen, nutrients, and carbon. From the water, to the air, to the soil, to the plants and to the animals, this highly interconnected web has provided a planet that supports human society. Intact nature can also be fragile, with disruptions altering the flow of water, nutrients and carbon.

Living things are made up of carbon. The storage of carbon occurs as plants draw in carbon during photosynthesis, and as decomposing organisms break down into carbon dioxide and methane, although a great deal of carbon remains locked in the ecosystem each year in soil and biomass. For this photosynthesis and decomposition cycle to occur we need tremendous amounts of intact nature.

Development without enough thought to the carbon balance has caused an overload in nature's ability to absorb greenhouse gasses. Nature currently absorbs ***26% of our emissions.*** Allowing nature to continue to function and draw down carbon is critical to climate action.

Degraded Nature and Carbon

Studies have shown that disrupting intact nature negatively affects an ecosystem's ***ability to sequester and store carbon.*** Letting nature be is the simplest way to ensure we retain this vital tool to combat climate chaos. Protecting intact nature has to be part of a climate plan in Manitoba.

The Push for Protected Areas

Manitoba has incredible potential to be a global leader in climate action through the protection of nature. The recognition of our climate action is contingent upon intact wilderness being given legislated protection from disturbance. The International Union for the Conservation of Nature (IUCN) is the international standard for protected areas, and action in Manitoba must adhere to IUCN qualifications.

In 1990, a worldwide initiative to protect 12% of Earth's lands and waters by 2000 was launched.

Manitoba signed on to this goal, aiming to preserve "enduring features," however progress has been slow. Currently 11.1% of Manitoba is protected from development according to IUCN standards.

Subsequently, scientists recognized that the 12% protected area goal was insufficient to preserve plants, animals and our life support system. A global Sustainable Development goal spearheaded by the United Nations aimed to protect 17% of lands and waters by 2020. The federal government committed to the 17% protected area goal, however the provincial government has not.

The scientific support for protecting nature and wilderness in 1990 was much less prevalent. Instead, "enduring features" were to be protected. Since then an avalanche of scientific studies have driven home the great peril that nature is in while showing that plants and animals need protected habitat to survive. Human activity has altered 75% of the earth's surface. Scientists are calling for protected areas to halt the alarming decline of biodiversity.

In January 2020 the United Nations Convention on Biological Diversity released their draft plan calling for 30% of the planet to be protected by 2030.

Coupled with the essential need to preserve plants and animals on earth, the protection of intact nature is now doubly important and will be a major component of Manitoba's climate action.

Indigenous Inclusion and Consent

Protection of intact wilderness is contingent upon free, prior, and informed consent of the Indigenous communities whose territory is involved, as is required under the United Nations Declaration on the RIghts of Indigenous Peoples. Further, self-determination of Indigenous communities must be the starting point for movements to protect lands and waters. Finally, societal benefit must flow to Indigenous communities whose territories are being legally protected.

Where's the Carbon Storage

When it comes to carbon storage and sequestration, not all lands are created equal. Intact nature and wilderness has evolved differently based upon vegetation, soil composition, temperature, and water. As a result, different ecosystems store and cycle carbon differently. Further, these characteristics also determine ***how different types of landscapes, and their carbon stocks, will react to climate changes.*** Efforts to combat the climate crisis will accomplish the most by protecting resilient carbon-rich lands and waters.

The Climate Powerhouse in Manitoba

In the flat forest expanses of Manitoba we find the province's ultimate climate action tool – peatlands. Peatlands ***cover three per cent*** of the world's surface yet contain 30 percent of the world's carbon, making them superstars of carbon storage. The peatlands are so extensive here they ***cover one-third of the province,*** more vast than nearly any other jurisdiction on the planet.

Peatlands are wetlands containing at least 40 cm of decaying vegetation, most often from sphagnum moss, preserved in the low oxygen and acidic waters they're submerged in. They are natural filters providing and storing clean, clear, fresh water. Peatlands act as water sponges in the landscape, holding tightly to water to sustain flows during drought conditions, or acting as a sink of water and slowing down flood responses during wet conditions. Peatlands also act as an important sponge for excess nutrients, preventing nitrogen and phosphorus from reaching downstream lakes, which would otherwise contribute to eutrophication.

Manitoba's peatlands may not be much to look at: spindly trees, if any, dot these vast wetlands. However, they provide important habitat for moose and unique plant species like the carnivorous pitcher plant. But the most significant benefit of peatlands is they store vast amounts of carbon – almost half of the peat is made up of carbon.

The Wilderness Committee is calling for the government to commit to a new protected area goal of legal protection for two-thirds of the province's peatlands by the year 2030. This must be done in accordance with the wishes of local Indigenous communities.

Ecozones in Manitoba

Across the planet, the variations in physiography, nutrients, and vegetation allow similar areas to be identified as ***ecozones.*** Ecozones are a good classification for examining the carbon processing capacity for nature in Manitoba. Further delineation into ecoregions will create even more nuanced policy for protecting nature's climate change fighting capacity. The Manitoba government's Protected Area Initiative work to preserve more of the province's lands and waters, which was quietly eliminated last year under the current administration, was categorized by ecoregions.

Southern Arctic

Making up a mere 0.4% of the province along northern Hudson Bay, the Maguse River Upland is predominantly permafrost region above treeline. 50% of the carbon on the planet is stored in permafrost, so changes can be major for greenhouse gas emissions. Melting permafrost and the formation of subsequent ponds are shown to dramatically increase methane release as well.

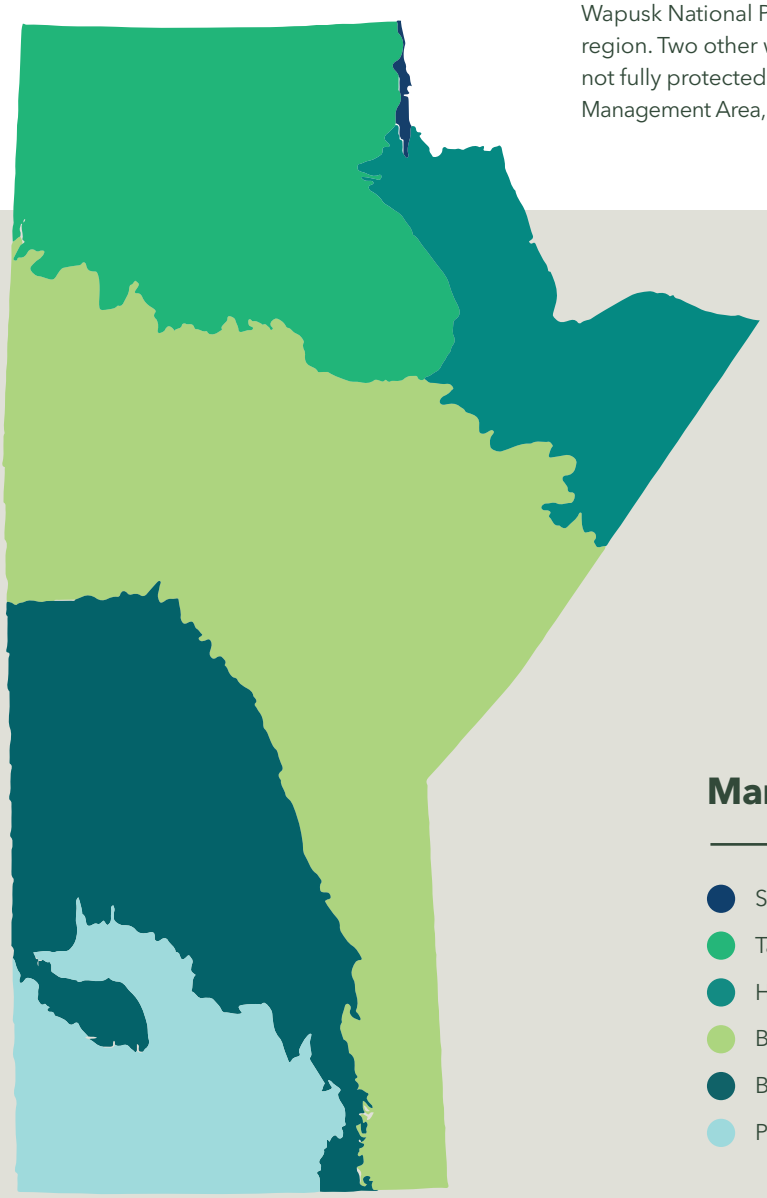
Efforts are underway with Indigenous communities and conservationists to protect the Seal River Estuary in this Ecozone.

Hudson Plains

The Hudson Plains constitute the largest wetland complex in Canada, and the third largest on earth. It is also the largest contiguous peat complex on the planet. The Hudson Plains make up ***12.7% of the province*** and ***67.7% of the Hudson Plains is peatlands.*** The preservation of the peatlands here are of global significance.

Warming in this region of continuous (>90% coverage) and discontinuous permafrost, already occurring due to climate change, will continue to exacerbate the release of carbon stored here in the form of carbon dioxide and methane. This area is predicted to be extremely sensitive to warming.

Wapusk National Park is a large federally protected area in this region. Two other wildlife management areas are designated but not fully protected by the province: Kaskatamagan Sipi Wildlife Management Area, and Kaskatamagan Wildlife Management Area.



Manitoba's Exoregions

- Southern Arctic
- Taiga Shield
- Hudson Plain
- Boreal Shield
- Boreal Plain
- Prairie

Taiga Shield

The Taiga Shield makes up one of the largest ecozones in ***Manitoba at 19.7% of the province.*** Sparsely forested and remote, this area is largely intact. ***About 7.2% of this ecozone is peatland.*** Much of the ecozone is permafrost, meaning it will be affected by the current warming.

Numaykoos Lake, Sand Lake, Caribou River, and Nueltin Lake Provincial Parks are all large protected areas established in this ecozone in the past.

Boreal Shield

The Boreal Shield is by far the largest ecozone in the province, covering ***37.8% of Manitoba.*** Interspersed with boreal jackpine uplands are extensive black spruce bogs (a type of peatland). Peatlands account for ***12.3% of this ecozone.*** While much of the ecozone is intact, logging and mining roads are extending their impact into the forest. Manitoba's portion of the Boreal Shield ecozone is part of the largest intact forest left on the planet.

The majority of Manitoba's peat mining occurs in this ecozone. There is some logging occurring in Manitoba's western Boreal Shield. The provincial government is also trying to restart logging in the southern Boreal Shield area. Mineral exploration is prevalent throughout the Boreal Shield.

Forest fires are a major disturbance in this ecozone, with most of the region burning every 100 years. Frequency of forest fires is tending to be lower in the Manitoba boreal, which may allow longer-term carbon storage in forests, although may lead to larger carbon release when a fire does inevitably occur, part of the natural cycle of forest rejuvenation.

Pimachiowin Aki is the greatest protected area success story in the province and is located on the east side of Lake Winnipeg in the boreal shield. Five First Nations nominated half of their traditional territory for legislated protection and UNESCO World Heritage Site designation. Popular Whiteshell Provincial Park is in this ecozone, but most of Whiteshell is not protected from industrial activity. There are numerous large areas nominated for protection throughout this region, but the provincial government has shelved work on protection. Landscape fragmentation can have serious impacts on the capacity of natural ecosystems to store and retain carbon.

Boreal Plains

The Boreal Plains account for the transition from Prairie to Boreal Shield country, and makes up ***18.8% of the province.*** 13.2% of this ecozone is made up of peatlands. The transition from intact forest into private land sometimes being utilized for agriculture, coupled with large-scale industrial logging operations, means this region is fragmented.

The two large commercial logging mill operations in Manitoba are operating in the Boreal Plains ecozone. The principal logging method in Manitoba is clearcutting.

Chitek Lake Provincial Park was designated in 2014, and is the first park protected in Manitoba under the new Indigenous Traditional Use park designation. Duck Mountain Provincial Park is in this ecozone, but it is not protected and in fact the only park in the province being logged.

Protected areas progress in this region should include protection for the Saskatchewan RIver Delta—the largest freshwater delta in North America, protection for the Porcupine Hills which are being heavily clearcut, and expansion of Fisher Bay Provincial Park as requested by Fisher River Cree Nation.

Because of the ongoing and extensive land use off this area, policies and regulations to return carbon to nature should be started here.

Prairies

The Prairies make up ***10% of Manitoba,*** but include the largest population and the most disturbed land of any region. ***Less than 1% of intact tall-grass prairie*** remains, and much of the mixed-grass prairie that remains is degraded. The carbon capture and storage potential for this ecozone is immense. Due to the majority of this ecozone being held in private ownership and utilized for agriculture, these carbon sequestration efforts will be covered eventually under the agriculture chapter of this plan.

Accounting for Disturbances in the Force

Protecting intact wilderness from disturbances is the best way to avoid skewing nature's ability to draw down carbon. Disturbances in nature will continue in modern society, so in addition to a protected area timeline and goal, policies and regulations for operations in intact nature need to be enacted.

Impact to the land is referred to globally as Land Use, Land Use Change, and Forestry (LULUCF). On an international level, qualifying and quantifying emissions from LULUCF has been inconsistent and troublesome. Varying ecozones have varying carbon emission changes, seasonally and annually. Due to the complexity of this calculation, and the difficulty in reaching international agreement, LULUCF is not part of international commitments to emissions reductions.

The goal of the Climate Action Team in Manitoba is not to make nice for international agreements but rather saving human society by stopping climate chaos. Tackling the difficulty of regulating LULUCF in Manitoba is something we can and must do.

Policy and Regulations for Destruction of Nature's Carbon Storage

In order for development opportunities to occur, proper policy and regulations need to be established in Manitoba to account for the loss of ecosystem services. The policies and regulations should be informed by the ecozone where development is occurring.

When intact nature is destroyed, the true cost of lost climate stabilization and carbon cycle disruption must be included. However, the commodification of nature—simply putting a dollar value on intrinsic and irreplaceable ecosystem functions—will not get us out of the ecological and climate crisis we have created.

Only a limited amount of intact nature can be distrubed on the planet if we are to preserve natural carbon cycles and follow the science-based path that keeps the world below 1.5 or 2 C warming.

Below is a list of some of the larger nature disruptors and recommendations for policy and regulations.

Carbon Cycle Disruptions from Peat Mining

Peat being mined is used for horticultural products, as a soil additive. Economically, the only reason peat is mined is because we are not charging the full cost to our environment that peat mining causes.

There are 10 peat harvesting companies in Manitoba right now. While there was a brief ban on new peat leases in Manitoba, it was lifted in 2016. Our climate powerhouse peatlands are at risk from expanded harvesting operations. New peat leases have been staked, although new mines have yet to be established.

A 2015 analysis of peat mining in Manitoba, commissioned by the government from the International Institute for Sustainable Development concluded that there is no way to mitigate the release of carbon from mining peatlands, and that carbon offsets are the only way to account for the impacts of mining peat.

We need regulation to account for carbon disruption from peat mining. There should also be a price applied to carbon released.

A policy banning new peat mines and peat mine expansions in the province should be introduced, as has occurred in other jurisdictions around the world.

Carbon Cycle Disruptions from Logging

There are three ways logging impacts carbon emissions. In Manitoba as elsewhere, we are only accounting for one of them. The logging mill in Swan River—Louisiana Pacific's siding board plant—is listed as the fifth largest greenhouse gas emitter in Manitoba, and emissions from the plant are the only carbon release we are counting. Trees are clearcut by machinery in the forest, delimbed and loaded and then hauled some distance to the mill to be processed. The fossil fuel consumption of all that equipment is not counted towards the impact of Louisiana Pacific's logging in Manitoba. The third impact is land use change.

Louisiana-Pacific's mill utilizes hardwoods, mostly aspen, to make it's wood product. A 2011 study found aspen forests growing in good soil and logged on a 40-year cycle will sequester more carbon than older forests left to grow for longer periods. The qualifier that would need to be addressed for concerns is the soil quality of the tree plantation they are logging. Much of the Duck Mountain forest region is poor quality soil on gravel. Policy for this operation needs to include carbon analysis of the soil on the scheduled logging rotation.

Canadian Kraft Paper's operation, at The Pas, utilizes softwoods in their mill. A 2017 study analyzed the carbon sequestration of clearcuts in jack pine forests and black spruce forests in Canada--the trees Canadian Kraft Paper logs. In the best case scenario of good soil and ideal growing conditions, it took 67 years for a forest to recover the carbon lost due to land disturbance during clearcutting. In average soil conditions, emissions from clearcut logging contribute substantial atmospheric CO2 emissions. Canadian Kraft Paper operates in sparse northern forests where tree growth is very slow.

Continued clearcutting of the boreal forest necessitates that Manitoba begin measuring carbon emissions from land use changes due to logging, particularly when considering the cumulative impacts of industrial disturbance and climate changes. A ***study in an Alberta aspen boreal plain forest*** found "regional drying as a result of predicted climatic changes combined with increased industrial activity may result in significant decline in productivity [carbon storage] within these stands over broad regions."

The logging industry, particularly in eastern Canada, is promoting the carbon storage capability of wood as it is used for construction. Durable wood products do lock up carbon for their life cycle, although that doesn't account for the land use change carbon release described above. In Manitoba, Canadian Kraft Paper is making paper products rather than durable wood products so this argument doesn't apply.

Carbon Cycle Disruption for Biomass Burning

Biomass burning as a replacement for fossil fuel burning has been touted in Manitoba. The rationale that it is cheaper than buying fossil fuels is often presented.

The carbon emissions release of biomass can be considerably higher than that of fossil fuels. The wood debris remnants from logging will release the carbon stored slowly over time in the forest, but if collected and burned for biomass the carbon is released immediately.

All biomass operations in Manitoba need to have a full-cost accounting of carbon done that includes fossil fuel for transport of the biomass and land-use change from the woody debris.

Carbon Cycle Disruption due to Forest Clearing for Roads, Mineral Exploration, Mining, Transmission Lines

Currently there is only a passing discussion of the climate impacts of intact nature disruption when roads or transmission lines are built, and none whatsoever for mineral exploration. Land use changes have a carbon cycle cost. Regulations need to be established so the costs to our climate health are qualified and paid for.

Hydro Dam Reservoir Flooding

Manitoba Hydro has begun examining the disruptions to the carbon cycle by it's upstream reservoirs. Regulations should be put in place so the climate cost of the carbon cycle disruption is recognized and paid. Again, compensation for climate damage should benefit the Indigenous communities whose territory is being disrupted.

Adaptation and Resilience

Intact wilderness is far more complex than we imagine. Frank Edgar famously stated:

"Forests aren't only more complex than we think, they're more complex than we can think."

As such, adapting nature is not something we are capable of doing, but rather something nature will do for itself. The adaptation may or may not be better for human society. We have little control over this.

Offering resilience to intact nature and wilderness occurs when we give nature and wilderness more space. Scientific thought on protected areas and species is that expanding protected areas, often to the north as temperatures increase, may allow species to adapt to the rapidly changing climate.

A policy of expanding existing protected areas, in addition to creating more protected areas, is the climate resilience needed in Manitoba.

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