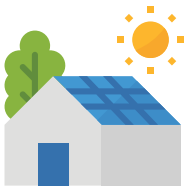
Buildings



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

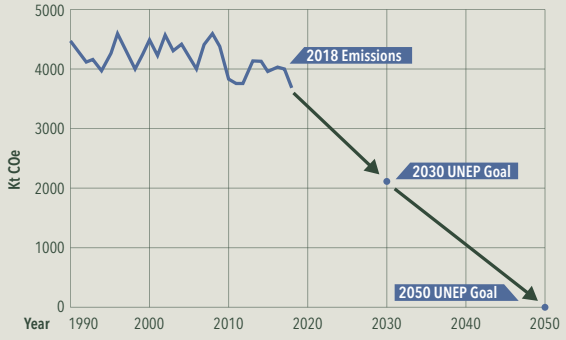


Figure 2: Manitoba Climate Pollution from Building Sub-Sectors

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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