

Puzzled about CLIMATE CHANGE?

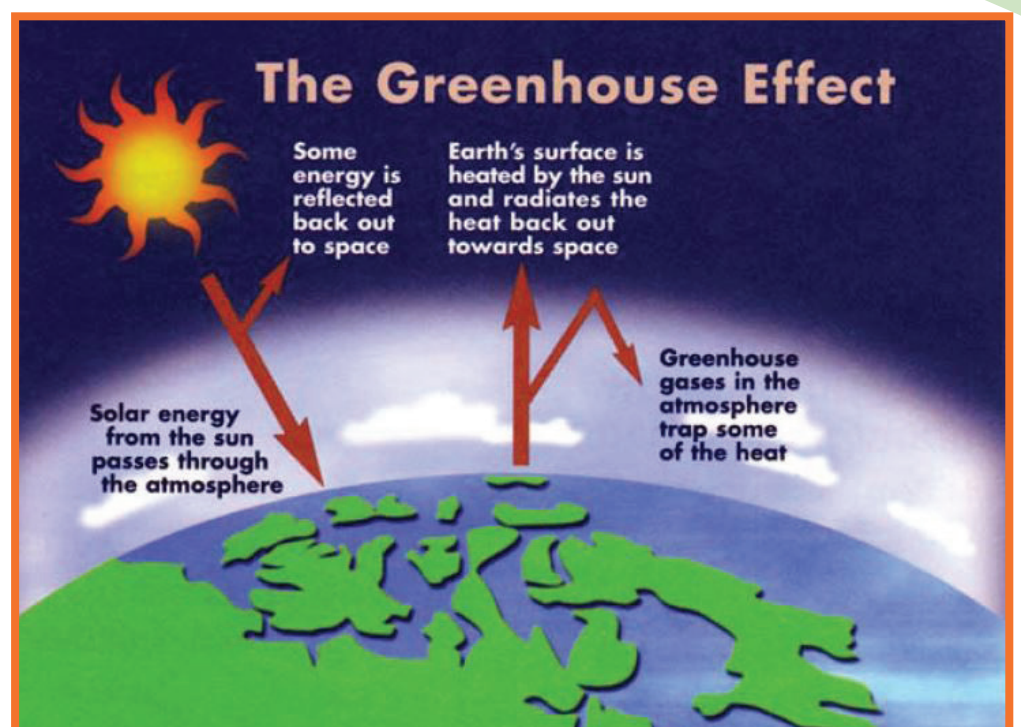
The Basics

Is the climate changing?



Yes.

The Earth's average surface temperature has risen 1.1 degrees Celsius since the late 19th century¹. This current warming trend is significant because most of the warming is the result of human activities and the warming is proceeding at a rate that is unprecedented.



Source: Elements of Ecology, 6th Edition, Chapter 29, Smith and Smith, 2005.

What is the difference between climate change and global warming?



Nothing! Global warming is one aspect of climate change.

Global warming refers specifically to a sustained increase in the global average surface temperature. Climate change refers to long-term shifts or alterations in climate. A region's climate results from an extremely complex interaction of elements, including temperature, precipitation, winds, and other factors. These changes vary from region to region.

What is the greenhouse effect (GHE)?



The GHE is a natural process that helps to regulate the temperature of our planet.

The sun's energy passes through the atmosphere and heats the Earth. Some of the heat, rather than escaping back to space, is trapped in the atmosphere by clouds and greenhouse gases (GHGs). Without the GHE, the global average surface temperature would be -18°C². When the amount of GHGs increases, more heat is trapped, leading to a rise in temperature. This is what is called the enhanced greenhouse effect.

What are the GHGs and where are they coming from?



Water Vapour

The most common greenhouse gas



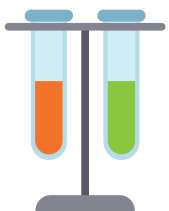
Carbon Dioxide

Released through burning fossil fuels



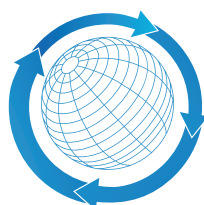
Methane

From wetlands, animal digestive processes, landfills and sewage treatments



Halocarbons

Human-made chemicals



Ozone

Exists naturally in the upper atmosphere



Nitrous Oxide

From synthetic fertilizers and the ocean

Learn more about climate change's impact at:
www.climatechangeconnection.org/impacts/



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The Cause

Are humans the cause?



Yes. And the Scientists are sure.

Scientists have accumulated a vast amount of evidence that the Earth's climate is being affected by human activity. Despite claims made by some groups and confusion created by skeptics and media, the scientific community overwhelmingly agrees that the evidence is clear, reliable, and persuasive: the climate is being warmed and changed by increases in GHG concentrations made by humans.

How do scientists know human activities have raised GHG concentrations?



It just cannot be anything else and the science has proven it.

A number of factors clearly point to the role of human activities as the primary source of increases in GHG concentrations in the atmosphere. The rapid rise in GHG concentrations during the past century is consistent with trends in human emissions. The relative abundance of CO₂ molecules in the atmosphere containing the radioactive carbon 14 atom is declining³. This is consistent with increased concentrations from the burning of coal, oil, and natural gas, all of which contain 'old' carbon without carbon 14. Changes in the proportion of carbon 13 and carbon 12 in oceans are also consistent with human emissions⁴.

Isn't this natural?



Nope.

The Earth's climate warms and cools naturally. Scientist have carefully studied these natural factors and found that none of them can explain the amount and rate of warming occurring on our planet. The natural factors that affect these changes in climate occur over thousands, if not tens of thousands, of years. The current change in climate has largely taken place in the last century, particularly in the last few decades.

What causes the climate to change?

Natural processes and human influences can cause the climate to change.

Natural processes include:

- changes in the intensity of **sunlight** reaching our planet
- gradual changes in the Earth's positioning with respect to the sun (**Milankovitch cycles** – changes to the Earth's orbit, tilt, and wobble)
- variations in the concentration of **volcanic dust** in the atmosphere

Human influences include:

- changes in GHG concentrations
- stratospheric ozone depletion
- air pollution
- alterations in land use



The Intergovernmental Panel on Climate Change (IPCC) states (2014) that "Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems."

The Science

How can we talk about climate change when we can't be sure of tomorrow's weather?



Weather and climate are different.

Climate can be thought of as average weather, including weather's variability over long time periods. Natural changes in climate happen over the course of decades, centuries, and many millennia. Global Circulation Models (GCM) are able to account for the many factors that influence climate over long periods, such as changes in the sun's energy and the level of greenhouse gases (GHG) in the atmosphere. These models tell us what the average weather is most likely to be but are not able to identify specific weather events.

I have heard that scientific understanding of climate change remains limited by uncertainty.



Scientists are in overwhelming agreement that humans are causing climate change.

Uncertainty is expected in all scientific experiments and models. Having uncertainty does not make scientific results meaningless. It is the magnitude of uncertainty that is important.

Are the recent extreme weather events caused by climate change?

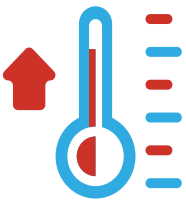


Some of it is.

Scientist have predicted more frequent and intense heat waves, heavier rain events, an increase in flooding, and intensified droughts. All of which have become a reality. Given our knowledge of global warming, we can expect more extreme weather events and side-effects, but the attribution of any particular extreme weather event to climate change remains beyond the current limits of scientific capability.

The Numbers

What is the big deal with warmer temperatures?



One degree can make a huge difference.

Currently, scientists tell us that we're on track to see global temperatures rise up to 4°C by the end of the century. While this may not seem large, it is. The difference between present-day global average surface temperature and that of the last glaciation (18,000 years ago) is only about 5°C; this amount of warming was enough to melt continental ice sheets and cause huge changes to ecosystems.

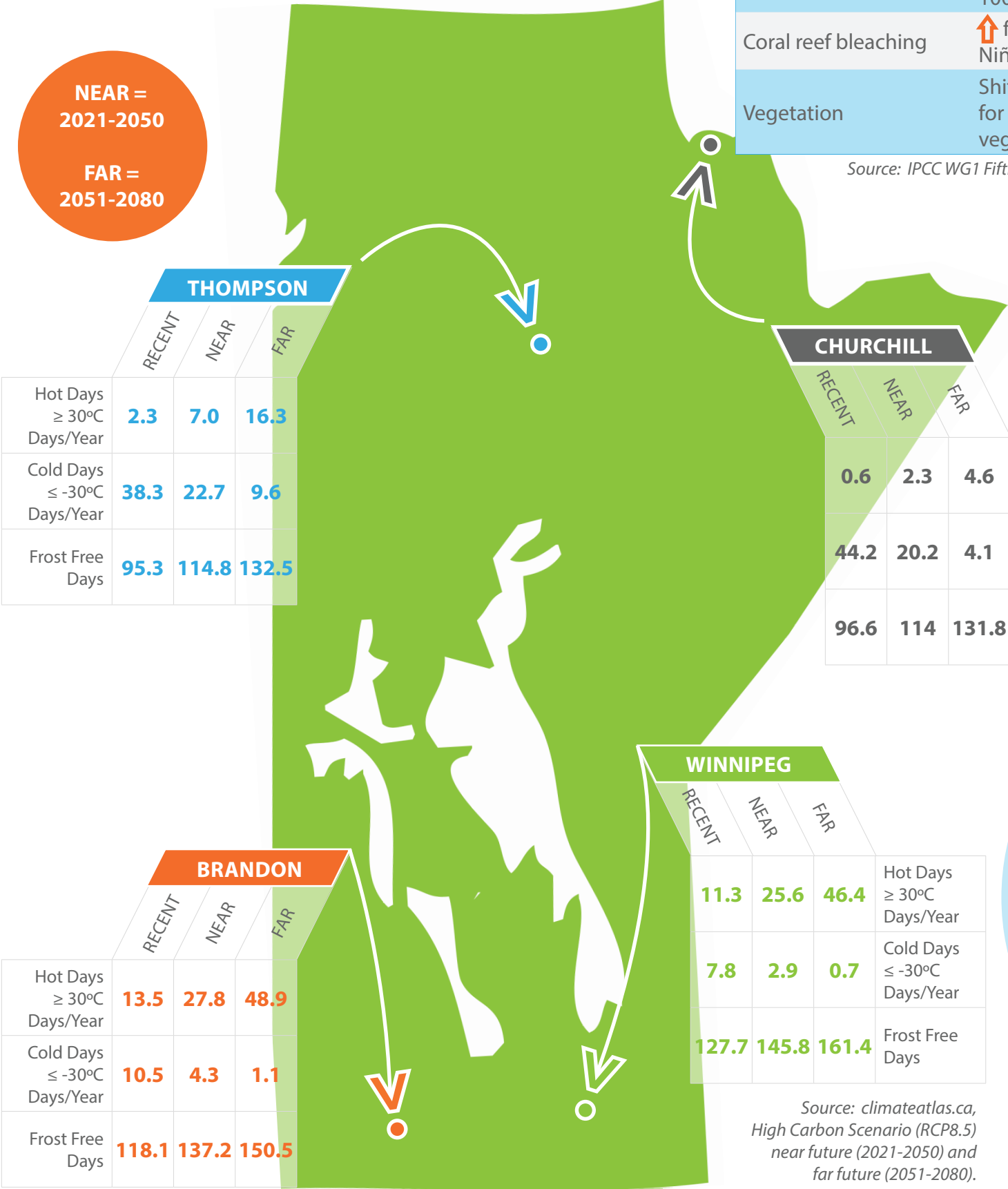
Do we need to stop breathing out CO₂?



No! The CO₂ we breathe out is part of a natural cycle.

Our planet has a natural cycle that moves huge amounts of carbon (200 billion tonnes) into and out of the atmosphere every year⁵. When the cycle is balanced, atmospheric CO₂ levels remain relatively stable. Careful measurements over the past fifty years have confirmed that CO₂ in the atmosphere is increasing (pre-industrial value of about **280 ppm to 408 ppm**³ in 2018, far exceeding the natural range over the last 650,000 years (180 to 300ppm)⁶.

How is Manitoba's climate going to change in the coming decades?



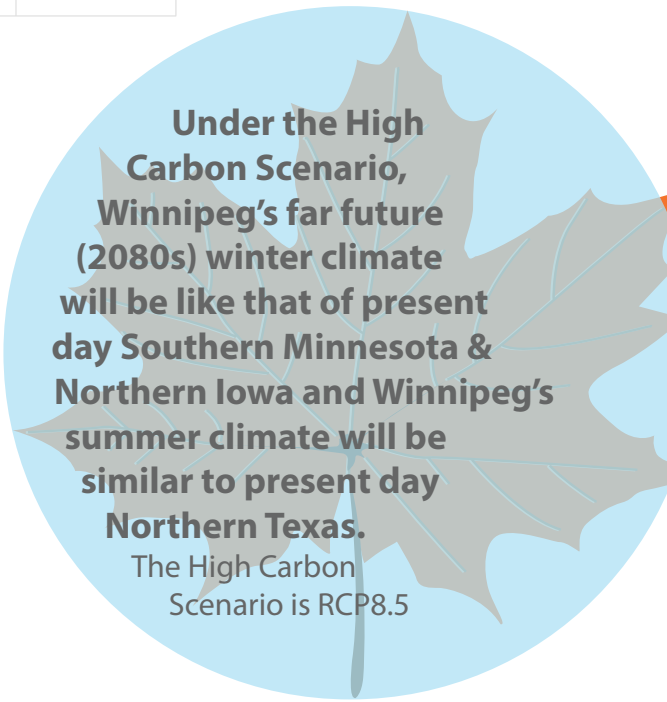
The Trends

The following is a list of climate-related changes observed in the Northern Hemisphere.

INDICATORS	OBSERVED CHANGES
Global Average Surface and Ocean Temperatures	↑ 16 of the 17 years hottest years recorded (instrument) have occurred since 2001
Global mean sea level	↑ at an average annual rate of 1.7mm per year
Lakes and rivers	↑ runoff and earlier spring peaks; warming of lakes and rivers; ↑ # of glacial lakes
Arctic sea-ice extent and thickness	↓ by 3.5-4.1% per decade and 9.4-13.6% per decade in the summer
Non-polar glaciers	Widespread retreat
Snow cover	↓ decrease 1.6% per decade for march and April and 11.7% per decade for June
Permafrost	↓ Reduced thickness and areal extent.
Animals	Earlier bird migration and egg-laying; poleward and upward shift in ranges for animal species
Growing season	Lengthened by 1-4 days per decade in last 40 years, especially at higher latitudes
El Niño events	↑ frequency and intensity in the last 20-30 years compared to previous 100 years.
Coral reef bleaching	↑ frequency, especially during El Niño events
Vegetation	Shifted north and up in elevation for plants; earlier 'greening' of vegetation

Source: IPCC WG1 Fifth Assessment Report, Climate Change 2013: The Physical Science Basis

High Carbon Scenario assumes we continue to emit large amounts of CO₂



Source: climateatlas.ca, High Carbon Scenario (RCP8.5) near future (2021-2050) and far future (2051-2080).

The Future

Is it too late to stop climate change?



Sort of, but we can slow it down.

Scientists agree that the current warming trend cannot be stopped or reversed, but that it can be slowed down to allow biological systems and human society more time to adapt.

Some scientists predict that a 2°C rise in the surface temperature is the point at which some of the most undesirable and dangerous processes brought on by climate change could become unavoidable⁷. These include:

- The melting of the West Antarctic and Greenland ice sheets, which between them could raise global sea levels by up to 7 meters⁸.
- The drying of many parts of Africa, and the inundation by salt water of the aquifers used by many coastal cities⁹.
- The risk of water shortages for between 2.3 and 3 billion people¹⁰. The melting of glaciers will jeopardize people who depend on their melt water as a source of drinking water¹¹.

Is our economy at risk because of climate change?



Yes. A healthy economy needs a healthy climate.

The good news is taking action on climate change will not threaten our economy. The Stern Review, an economic report for the British Government, concludes that it would cost less to take strong preventive action against climate change than to react to changes as they unfold.

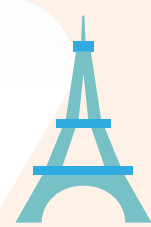
Action on climate change will create significant business opportunities, as new markets are created for low-carbon energy technologies and other low-carbon goods and services.

Won't we be better off with a warmer climate?

No! There are more costs than benefits to a warmer climate.

Costs:	Benefits:
<ul style="list-style-type: none">• Enhanced drought conditions• Sea level rise and ocean surges• Increased intensity of rainfall and flooding• More severe weather events• Lower freshwater levels• Adverse effects on human health• Loss of species and forested area• Melting of permafrost, glaciers, and sea ice• Loss of traditional economies• Spread of diseases and pests• Increased need for air-conditioning	<ul style="list-style-type: none">• Longer growing seasons and increased productivity• Reduced space-heating costs• Opportunities to expand into new areas of environmental technology and services

What is the Paris Agreement?



An agreement between countries to limit future emissions.

In 2015, representatives from each country gathered to develop a framework for reducing global emissions. The agreement sets out a global action plan to put the world on track to avoid future climate change impacts by limiting global warming below 2°C. This agreement is to be reviewed every few years. 170 Parties have ratified of the 197 Parties to the convention.

What can we do?



Take action!

This is a global issue that requires all of us to do our part. At home, on the road, and at work, there are simple things all Manitobans can do to reduce their GHG emissions. Whether it is composting household organic waste, cycling or taking the bus to work, buying local products, making our homes more energy efficient with the help from *PowerSmart, or setting up an office car pool, every step helps. With small changes to our daily activities, planning and priorities, Manitobans can become Climate Champions. For more information about reducing your GHG emissions, please visit: www.climatechangeconnection.org

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Learn more about climate change's impact at: www.climatechangeconnection.org/solutions/



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