

A Brief History of Climate Change

Key Scientific Discoveries and Canadian Political Actions



Note: Parts per million of carbon dioxide (ppm CO2) were retrieved from the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency, and Our World in Data. As a reminder, in this instance, ppm of CO2 represents the ratio of GHGs to non-GHGs in the atmosphere; for example, a CO2 level of 400 ppm denotes that 400 of one million gas molecules are CO2, while the remaining 999,600 molecules are other gases.

Date	Activity	Details
1824 282 ppm	Joseph Fourier describes what is now known as the greenhouse gas effect.	Fourier's work was instrumental in understanding the greenhouse gas (GHG) effect and therefore climate change ¹ . This work was a critical building block for future climate-related research.
1856 286 ppm	Eunice Foote describes the ability of water and carbon dioxide to trap heat.	Foote's work identified the crucial role of GHGs in maintaining Earth's temperature by showing how carbon dioxide and water vapour can absorb and trap heat ² . This work supports our understanding of the GHG effect, global warming, and meteorology.
1896 295 ppm	Svante Arrhenius links increases in carbon dioxide levels to increases in Earth's temperature.	Arrhenius's work is credited with being the first model demonstrating the effect of industrial activity on global warming ³ , hinting at the consequences of increased atmospheric carbon dioxide. By the early 1900's Arrhenius became concerned with the rapid increases in human-made carbon emissions, stating that "the slight percentage of carbonic acid in the atmosphere may, by the advances of industry, be changed to a noticeable degree in the course of a few centuries". He later suggested that increases in atmospheric carbon dioxide because of industry might be beneficial by making the climate "more equable", stimulating plant growth and therefore providing more food for a growing population ⁴ ; this has now overwhelmingly been shown to be incorrect.
1958 316 ppm	Charles Keeling begins to document yearly atmospheric carbon dioxide levels.	Keeling's monitoring work continues (https://www.esrl.noaa.gov/gmd/ccgg/trends/gl_trend.html) to this day and is responsible for showing a steady increase in atmospheric carbon dioxide levels.
1979 336 ppm	First World Climate Conference in Geneva.	The Geneva Conference was one of the first major international meetings on climate change.
1988 351 ppm	International Climate Conference is held in Toronto.	Many of the world's leading scientists gathered in Toronto in June 1988 with the goal of catalyzing international action on climate change. An initial global reduction target of 20% below 1988 levels by 2005 was put forth. The conference was seen as a key moment in driving the global climate change agenda forward.
1990 354 ppm	IPCC publishes first report. Canada publishes "Canada's Green Plan"	Created in 1988, the Intergovernmental Panel on Climate Change (IPCC) provides the world with an objective, comprehensive, scientific perspective on climate change. IPCC reports are considered the most comprehensive scientific reports about climate change in the world ⁵ and are released every five to six years. Typically, publications cover three topics: the physical science of climate change, the vulnerability of humans and natural systems, and options for mitigating impacts and economic issues ⁶ . The first publication underlined the importance of climate change as a global issue that required global cooperation for effective action. "Canada's Green Plan" documented a strategy for global warming "through a program to stabilize emissions of CO2 and other GHGs at 1990 levels by the year 2000" ⁷ . This was one of the first documents Canada released that discussed a strategy regarding GHG emissions.
1992 356 ppm	Earth Summit results in UNFCCC commitments.	Held in Rio de Janeiro, the Earth Summit was a major United Nations (UN) conference that dealt with a myriad of sustainability issues. One of the deliverables was the signing of the international environmental treaty United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC signatories (including Canada) committed to mitigate human interference in world climate systems through stabilizing levels of atmospheric GHGs. The Kyoto Protocol was the outcome of discussions as to how to fulfill the UNFCCC.
1995 360 ppm	IPCC publishes second report.	The second IPCC publication provided material for governments to draw upon before the adoption of the Kyoto Protocol ⁸ . The publication further emphasized human contributions to climate change and predicted next century warming. During this time, the public's opinion on climate change begins to transform. As more frequent appearances of unusual events start to surface, such as the 4,200 square kilometer Northern Larsen ice shelf disintegration, the public becomes more aware of the impact of warming.
2000 369 ppm	Canada publishes "Action Plan 2000 on Climate Change".	The government of Canada releases "Action Plan 2000 on Climate Change", formalizing a GHG reduction commitment of 65 million tonnes per year from 2008 to 2012 ⁹ . This was the first of three strategic plans to achieve Canada's Kyoto target ¹⁰ .
2001 370 ppm	IPCC publishes third report.	The third IPCC publication focused attention on the impacts of climate change and the need for adaptation ¹¹ .
2002 372 ppm	Canada ratifies Kyoto Protocol.	Though the Kyoto Protocol was adopted in 1997, negotiations with Canada on commitment levels etc. continued until 2002. At this point, Canada approves and moves forward with the Kyoto Protocol, targeting 6% reduction in GHG levels compared to 1990 by 2012.
2007 383 ppm	IPCC publishes fourth report. Canada releases Climate Change Plan. Ontario releases "Go Green".	The IPCC publication acknowledges that serious climate change related impacts are beginning to surface; it is understood that the cost of reducing emissions is far less than the financial cost of expected damage. The publication also laid the groundwork for a post-Kyoto agreement, focusing on limiting global warming to 2°C. Canada's Climate Change Plan is released as required by the Kyoto Protocol Implementation Act ¹² and outlines the plan for successfully reaching commitments. "Go Green: Ontario's Action Plan on Climate Change" set out short, medium, and long-term GHG reduction targets: 6% reduction by 2014, 15% by 2020, and 80% by 2050 versus 1990 levels ¹³ .
2009 386 ppm	Ontario implements Green Energy and Green Economy Act.	Renamed as the Ontario Green Energy Act (GEA), the GEA was intended to expand renewable energy generation, create jobs, and work towards increased energy conservation. The GEA was quite controversial due to high initial tariff prices. In 2018, the GEA was cancelled, citing "...the disastrous feed-in-tariff program and skyrocketing electricity rates for Ontario families, and taking away powers from municipalities to stop expensive and unneeded energy projects in their communities." ¹⁴
2010 389 ppm	Canada pledges emissions reduction with Copenhagen Accord.	Countries representing 80% of global emissions signed the Accord, though it was met with some criticisms particularly that it was not legally binding, there were no real targets set, and formal adoption was not necessary. In 2014, Environment Canada released a report stating it would not meet the Copenhagen commitment.
2011 390 ppm	Canada withdraws from Kyoto.	Citing the economic situation and estimates of \$14 billion in costs to fulfill the protocol, the Federal government withdraws from Kyoto ¹⁵ . Canada was the first signatory to withdraw out of Kyoto. This was, by some, perceived to be an abdication of Canada's international responsibilities.
2013 395 ppm	Research shows 97% of publishing climate scientists support humans as the cause of climate change.	Covering a 20-year period of published research, this work puts into perspective the overwhelming support that climate change is caused by humans ¹⁶ .
2014 397 ppm	IPCC publishes fifth report. Closure of Ontario's last coal plant.	The most comprehensive report to date. The fifth report focuses more so on the socioeconomic impacts of climate change and challenges for sustainable development. ¹⁷ Ontario's first coal plant closure happened in 2005, with continuation in 2011 and completion in 2014 ¹⁸ . This work resulted in an 82% reduction of electricity-related GHG emissions: this is equal to approximately 21.4 million tonnes of avoided versus 1990. As of 2016, emissions from electricity comprised 2.7% of Ontario's emissions, versus 14.4% in 1990 ¹⁹ . This is considered the province's most successful GHG reduction strategy, and ensured Ontario achieved its 2014 goal of reducing emissions by 6% since 1990 ²⁰ .
2016 403 ppm	Global carbon dioxide levels hit an annual average of 400 ppm.	From a global warming perspective, 400 ppm of carbon dioxide does not signify a major warming event or indicate a certain impact will occur. However, it is a glaring reminder of how the world is not on track to limit emissions. The last time 400 ppm was reached was approximately 3 million years ago ²¹ . It is highly unlikely levels will dip below 400 ppm in our lifetime.
	Canada ratifies Paris agreement and releases Pan-Canadian Framework. Ontario releases Climate Change Action Plan.	The Paris Agreement's central aim is to strengthen the global response to climate change by keeping global temperature increases to no more than 2°C above pre-industrial levels ²² . Ontario's Climate Change Action Plan laid out a five-year plan outlining strategies and action areas to mitigate GHGs, including the Cap and Trade system, to meet reduction goals. This document is now archived ²³ .
2017 405 ppm	Ontario's Cap and Trade program begins.	In an effort to reduce Ontario's emissions the provincial government introduced Cap and Trade, subjecting those organizations that pollute over 25,000 tonnes of carbon dioxide equivalents, as well as electricity importers, and fuel suppliers that sell more than 200 L of fuel per day ²⁴ , to participate in the program. This program was created to put a price on carbon and generate funds for GHG reduction projects to help meet provincial targets. Furthermore, gasoline, diesel, and natural gas, were subjected to increases on homeowners, businesses etc. Cap and Trade was estimated to reduce Ontario's emissions by eight to ten million tonnes by 2020 if properly implemented. ²⁵
2018 408 ppm	Ontario cancels the Cap and Trade program.	Cap and Trade was cancelled late October 2018, less than two years after coming into force. The Financial Accountability Officer of Ontario estimated approximately three billion dollars in lost revenue over a four-year period due to cancellation ²⁶ .
2019 410 ppm	Canada implements carbon tax.	Two main dates should be noted, January 1 and April 1, the former represents the date large emitters began paying the carbon tax, and latter the date citizens fuel increases will begin (4.4 cents per litre of gasoline and 3.91 cents per cubic metre of natural gas). In 2019, the price will be set at \$20/tonne and increase by \$10/tonne annual until \$50/tonne is reached. It's estimated the average Ontario will pay approximately \$244 in direct and indirect costs but will receive a \$300 rebate for "climate-action incentives" per year ²⁷ .

Notes

¹ Fourier, J. (1824). Remarques Générales Sur Les Températures Du Globe Terrestre Et Des Espaces Planétaires. Annales de Chimie et de Physique. 27: 136–67.

² Foote, E. (1856). Circumstances Affecting the Heat of the Sun's Rays. The American Journal of Science and Arts. Accessed from https://static1.squarespace.com/static/5a2614102278e77e59a04f26/t/15aalc3cf419202b500c3b388/1520550865302/foote_circumstances-affecting-heat-suns-rays_1856.pdf

³ Arrhenius, S. (1896). On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground. Philosophical Magazine and Journal of Science. 41: 237–276. Accessed from http://www.rsc.org/images/Arrhenius1896_tcm18-173546.pdf

⁴ NASA Earth Observatory. (2000). Svante Arrhenius. EOS Project Science Office. Accessed from https://earthobservatory.nasa.gov/features/Arrhenius/arrhenius_3.php

⁵ Intergovernmental Panel of Climate Change. (2018). History of the IPCC. Accessed from <https://www.ipcc.ch/about/history/>

⁶ Union of Concerned Scientists. (2018). The IPCC: Who Are They and Why Do Their Climate Reports Matter? Accessed from <https://www.ucsusa.org/global-warming/science-and-impacts/science/ipcc-backgrounder.html#bf-toc-0>

⁷ Flanagan, E. (2015). Pembina Reacts to Paris Agreement Tabled at COP21. Pembina Institute. Accessed from <https://www.pembina.org/media-release/pembina-reacts-to-paris-agreement-tabled-at-cop21>

⁸ Intergovernmental Panel of Climate Change. (2018). History of the IPCC. Accessed from <https://www.ipcc.ch/about/history/>

⁹ Government of Canada. (2000). Government of Canada Action Plan 2000 on Climate Change. Accessed from <http://publications.gc.ca/collections/Collection/M22-135-2000E.pdf>

¹⁰ Maciunas, S. and de Lassus Saint-Genies, G. (2018). The Evolution of Canada's International and Domestic Climate Policy: From Divergence to Consistency? Centre for International Governance Innovation. Accessed from <https://www.cigionline.org/sites/default/files/documents/Reflections%20Series%20Paper%20no.21%20Maciunas.pdf>

¹¹ Intergovernmental Panel of Climate Change. (2018). History of the IPCC. Accessed from <https://www.ipcc.ch/about/history/>

¹² Environment Canada. (2007). A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act. Accessed from http://www.ec.gc.ca/doc/ed-es/p_123/CC_Plan_2007_e.pdf

¹³ Government of Ontario. (2007). Go Green: Ontario's Action Plan On Climate Change. Accessed from <http://www.climateontario.ca/doc/workshop/2011LakeSimcoe/On%20arios%20Go%20Green%20Action%20Plan%20on%20Climate%20Change.pdf>

¹⁴ Government of Ontario. (2018). Ontario's Government for the People Introduces Legislation to Repeal the Green Energy Act. Newsroom. Accessed from <https://news.ontario.ca/mndm/en/2018/09/ontarios-government-for-the-people-introduces-legislation-to-repeal-the-green-energy-act.html>

¹⁵ CBC News. (2011). Canada pulls out of Kyoto Protocol. Accessed from <https://www.cbc.ca/news/politics/canada-pulls-out-of-kyoto-protocol-1.999072>

¹⁶ Cook, J et al. (2013). Quantifying the consensus on anthropogenic global warming in the scientific literature. Environmental Research Letters. Accessed from <https://iopscience.iop.org/article/10.1088/1748-9326/8/2/024024>

¹⁷ Union of Concerned Scientists. (2018). The IPCC: Who Are They and Why Do Their Climate Reports Matter? Accessed from <https://www.ucsusa.org/global-warming/science-and-impacts/science/ipcc-backgrounder.html#bf-toc-0>

¹⁸ Government of Ontario. (2018). The End of Coal. Accessed from <https://www.ontario.ca/page/end-coal>

¹⁹ Environment and Climate Change Canada. (2018). National Inventory Report 1990–2016: Greenhouse Gas Sources and Sinks, Part 2. Government of Canada. Accessed from <https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2018>

²⁰ Government of Ontario. (2016). Ontario's five year climate change action plan 2016–2021. Accessed from http://www.applications.ene.gov.on.ca/ccap/products/CCAP_ENGLISH.pdf

²¹ World Meteorological Organization. (2017). WMO Greenhouse Gas Bulletin: The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2016. Accessed from https://ane4bf-datapl3-6u-west-1.amazonaws.com/w-mocms/s3fs-public/ckeditor/files/GHG_Bulletin_13_EN_final_1_1.pdf?LGNjmhPwKkE2Qw4mEQjdm6bWxGWAJHa

²² United Nations Climate Change. (2018). The Paris Agreement. Accessed from <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

²³ The Government of Ontario. (2016). Climate Change Action Plan. Accessed from <https://www.ontario.ca/page/climate-change-action-plan>

²⁴ Government of Ontario. (2018). Cap and trade. Accessed from <https://www.ontario.ca/page/cap-and-trade>

²⁵ Government of Ontario. (2018). Cap and trade in Ontario. Accessed from <https://www.ontario.ca/page/cap-and-trade-ontario>

²⁶ Financial Accountability Office of Ontario. (2018). Cap and Trade: A Financial Review of the Decision to Cancel the Cap and Trade Program. Accessed from <https://www.fao-on.org/en/Blog/Publications/cap-and-trade-ending>

²⁷ The Globe and Mail Canada. (2018). Canada's carbon tax: A guide to who's affected, who pays what and who opposes it. Accessed from <https://www.theglobeandmail.com/canada/article-canadas-carbon-tax-a-guide/>