ENERGY & CLIMATE at a Glance

CANADIAN EDITION - 2024

Figures, Footnotes & Hyperlinks

Facts on 22 Prominent Climate Topics

A Great Wager of National Treasure?

THE HEARTLAND INSTITUTE

Authored by
H. Sterling Burnett
Ron Davison

CANADIANS FOR SENSIBLE CLIMATE POLICY

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https://sensiblechange.ca/pdfs/GB-graphicsreferences.pdf
to access a copy of all the graphics and
linked references in this book.

This book is styled after The Heartland Institute's "Climate at a Glance for Teachers and Students 2022 Edition," which is available, including videos, free of charge at https://climateataglance.com/, where it can also be downloaded for free, or accessed via an App (https://climateataglance.com/app/) that can be downloaded.

A reasonable and cost-effective way to manage climate or a Great Wager of National Treasure?

DEDICATION

To all the Canadians who followed the scientific method in their search to understand and promote the truth about energy and climate. For the past 28 years, many courageous and selfless Canadians have endured disparagement and censorship. While branded as deniers - akin to Holocaust deniers - and snubbed by most of the mainstream media,[1] these brave and talented individuals work hard to inform the public about the scientific, economic, and policy issues involved. Some have suffered ill health and loss of reputation as a result. They continue to strive for better public policies that serve the interests of present and future generations.

May this booklet inspire Canadians to build on this legacy by speaking out to family, friends, local politicians, and business leaders in a search for better understanding and sensible response to climate change and other environmental and economic issues.

Canadians for Sensible Climate Policy

October 2024

Notes:

1. Exceptions are: The National Post, The Epoch Times, and independent media

Energy & Climate at a Glance - 2024 Edition

Facts on 22 Prominent Climate Topics

Authored by H. Sterling Burnett & Ron Davison

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Figure 2.1. 2030 ERP Projected Sectoral Contributions

Sector	Where we were in 2005 (Mt)	Where we were in 2019 (Mt)	Where we could be in 2030 (Mt)	Per Cent Reductions from 2005 levels*
Buildings	84	91	53	-37%
Electricity	118	61	14	-88%
Heavy Industry	87	77	52	-39%
Oil and Gas	160	191	110	-31%
Transportation	160	186	143	-11%
Agriculture**	72	73	71	-1%
Waste and Others	57	51	29	-49%
Land Use, Land Use Change, and Forestry (LU-LUCF)*, Natural Climate Solutions	-	-	-30	-
Total*	739	730	443	-40%

Figure 2.1: Emissions reductions expected in each economic sector between 2019 and 2030, with some sectors requiring more reductions than others.
Source: Government of Canada, "Exploring Approaches for Canada's Transition to Net Zero," p. 13.

Figure 2.2. GHG Reductions in Megatons by Sector

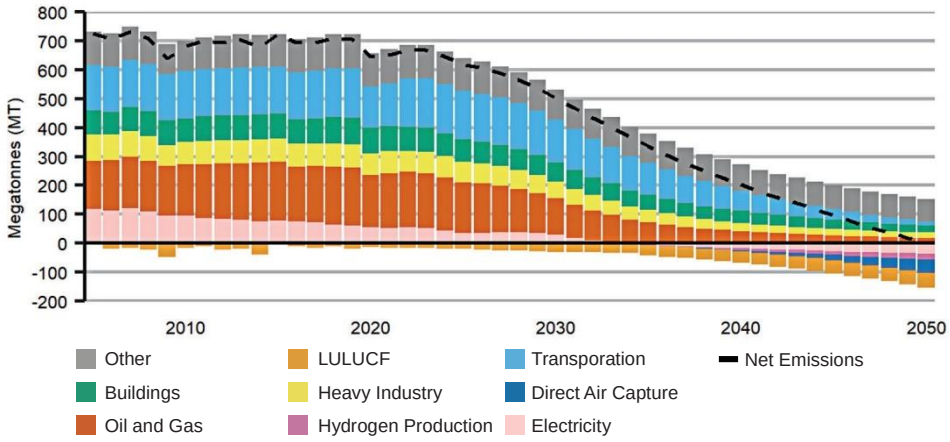


Figure 2.2: GHG reductions in Megatons by sector between 2005 and 2050.
Source: Canada's Energy Future, Scope

Figure 3.1. (a) Change in Electricity Generation from 2021 to 2050, by Fuel, Global Net-Zero Scenario

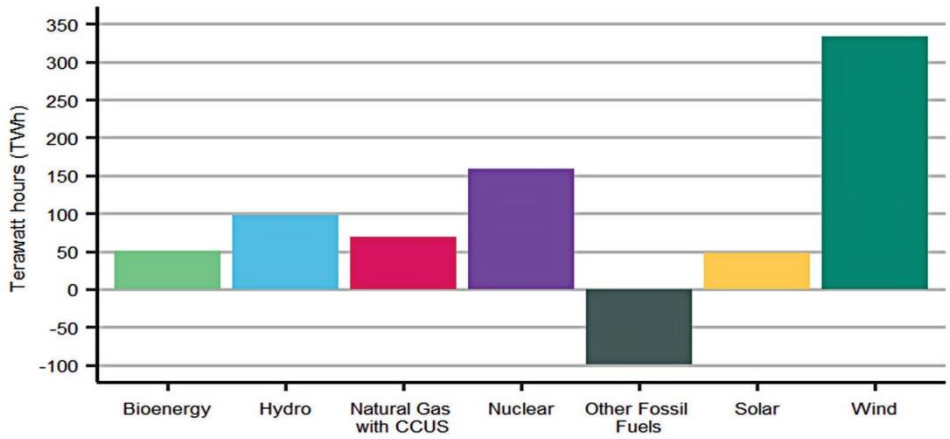


Figure 3.1. (b) GHG emissions from the electricity sector, by fuel, Global Net-zero Scenario

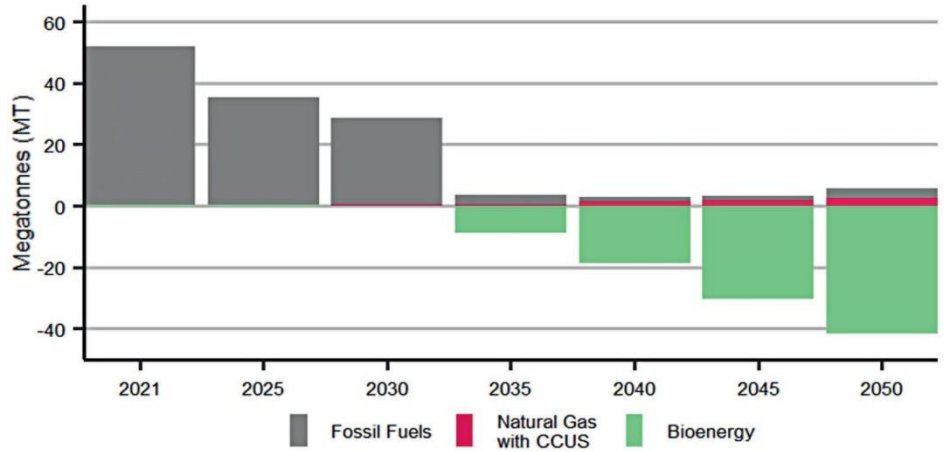


Figure 3.1: Emission Reduction Plan (ERP) – Change in electricity generation from 2021 to 2030, GHG emissions from the electricity sector by fuel.
Source: https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2023/executive-summary/

Figure 3.2. Canada's Electricity Generation by Type

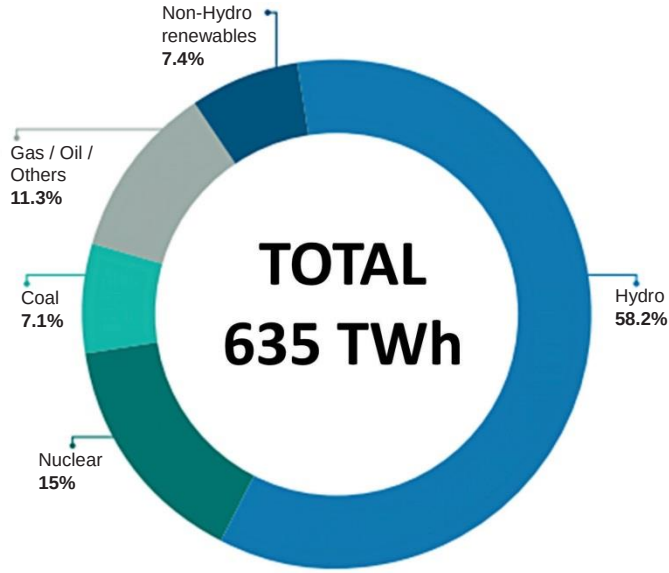


Figure 3.2: Canada's Electricity Generation by Type (82% non-emitting)

Table 3.1. AESO Grid - Renewable (Wind and Solar) Efficiencies

Time On	**Solar** Efficiency %	**Wind** Efficiency %	Consolidated Solar/Wind Efficiency %
Less Than 25%	67.2	45.8	44.6%
25% to 50%	11.4%	31.4%	45.9%
50% to 75%	10.6%	21.9%	9.5%
Greater Than 75%	10.8%	0.9%	0.0%
	100.0%	100.0%	100.0%
Yearly Average	21.5%	31.1%	28.8%

Table 3.1: Alberta Power Generation – Efficiency Summary

Figure 3.3. How Does it Make Commercial Sense?

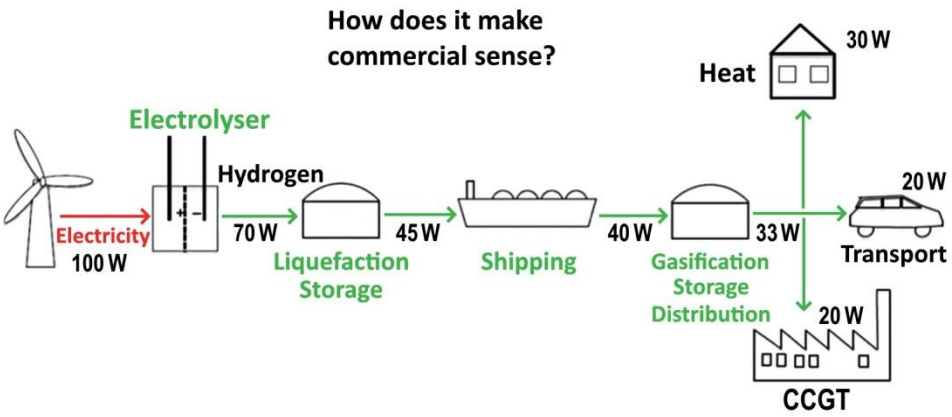


Figure 3.3: Creating hydrogen from wind and solar power. 100 W, 70 W, etc. indicates how much power remains after each stage in the process between the initial energy production and that available to the end user.
Source: Robert Lyman, Friends of Science

Figure 4.1. Annual Investment to Attain Net-Zero Emissions in Canada by 2050

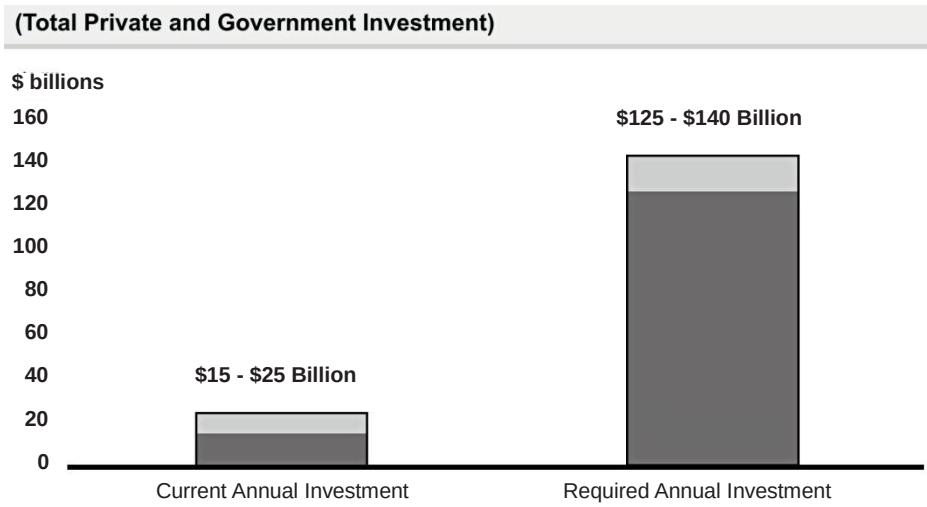


Figure 4.1: Annual Investment to Attain Net Zero Emissions in Canada by 2050 Source: 2022 Federal Budget

Figure 5.1. EVs Are Not Zero Emissions but Elsewhere Emissions

250 tons (oil-centric) mining per EV battery
15 BOE used to fabricate each battery

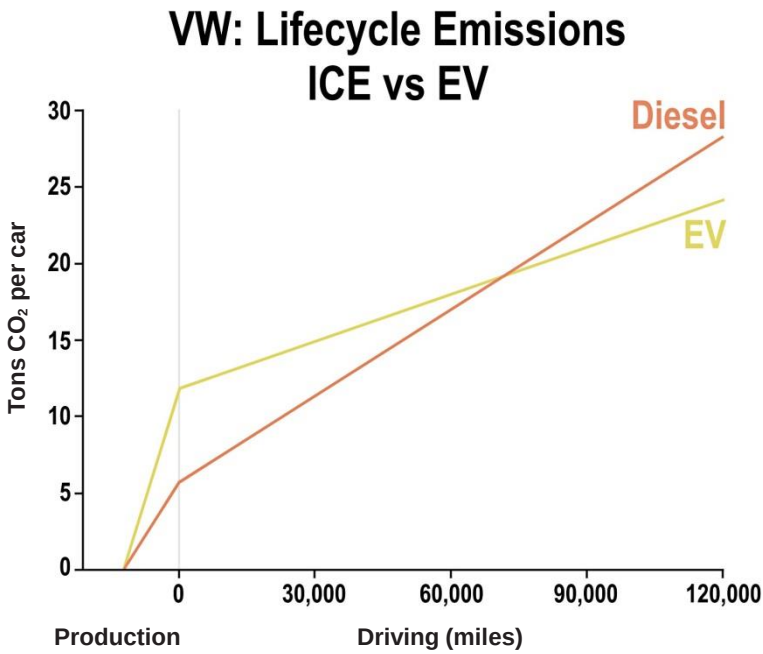


Figure 5.1: Volkswagen (VW) – Internal Combustion Engine (ICE), Electric Vehicle (EV) Lifecycle Emission Comparison. Graphic from Mark Mills - Manhattan Institute

Figure 5.2. Volume and Time Required to Develop New Mines Make EV Mandates Nearly Impossible to Achieve

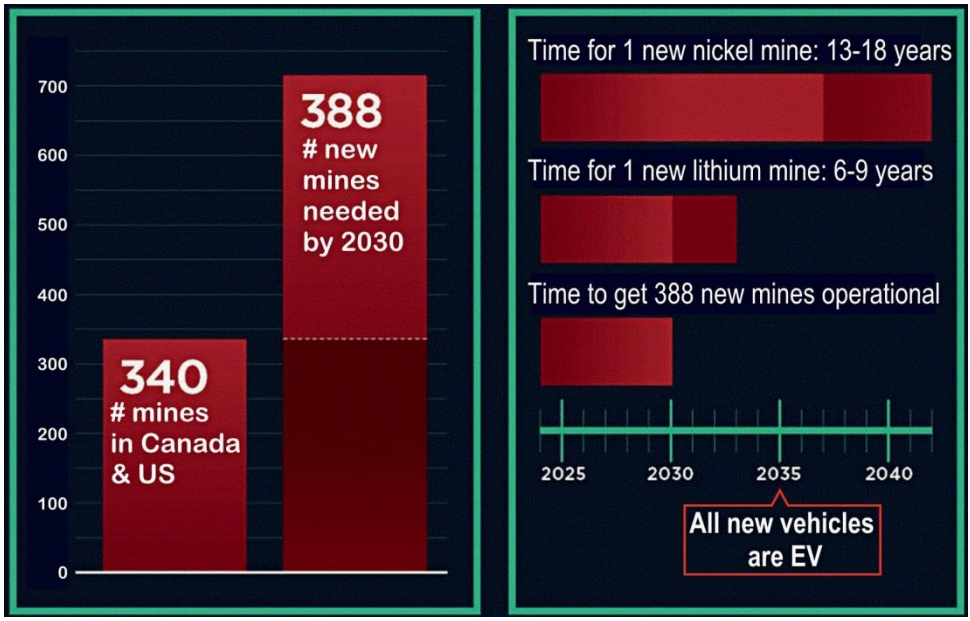


Figure 5.2: Existing Mines in Canada & US and Mine requirements with implementation times
Source: the Fraser Institute

Figure 5.3. China Is the OPEC of Green Energy Minerals

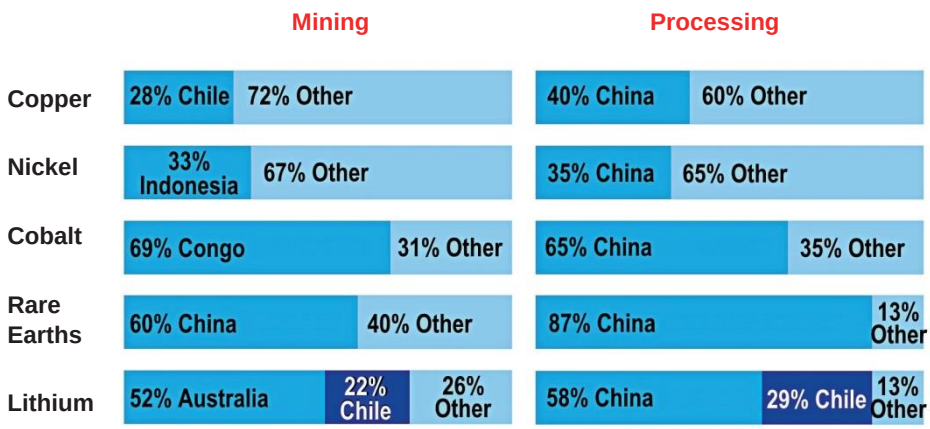


Figure 5.3: China's Dominance in the Rare Earth Mineral Fields
Source: IEA, "The Role of Critical Minerals in Clean Energy Transitions," 2021

Figure 5.4. Some Examples of the Many Environmental Problems with Renewable Energy

Figure 5.4: Some examples of the many environmental problems with renewable energy.

Figure 5.5. Land Use in Acres Per Megawatt Energy Produced

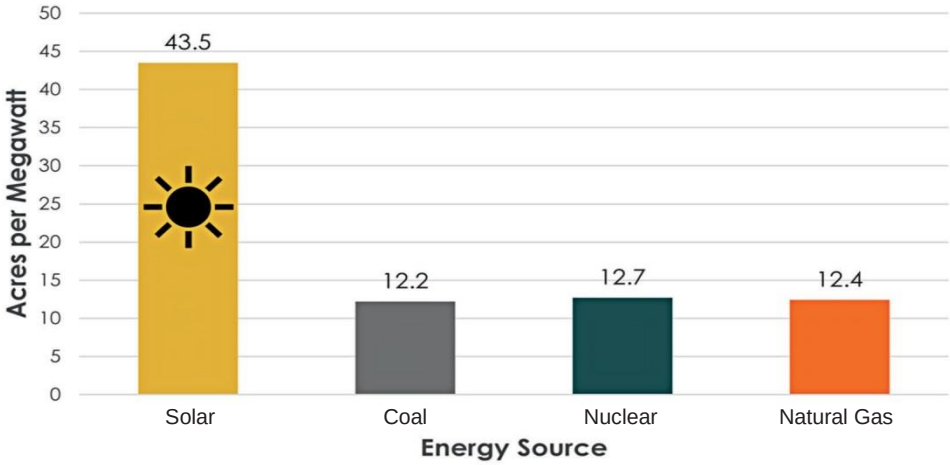


Figure 5.5: Land use in acres per megawatt energy produced for solar, coal, nuclear, and natural gas generated electricity. Data from: Landon Stevens et al., The Footprint of Energy: Land Use of U.S. Electricity Production, Strata, June 2017, https://docs.wind-watch.org/US-footprints-Strata-2017.pdf

Figure 5.6. Suggested Setbacks, Buffers, Visual Impact Zones proposed for Alberta.

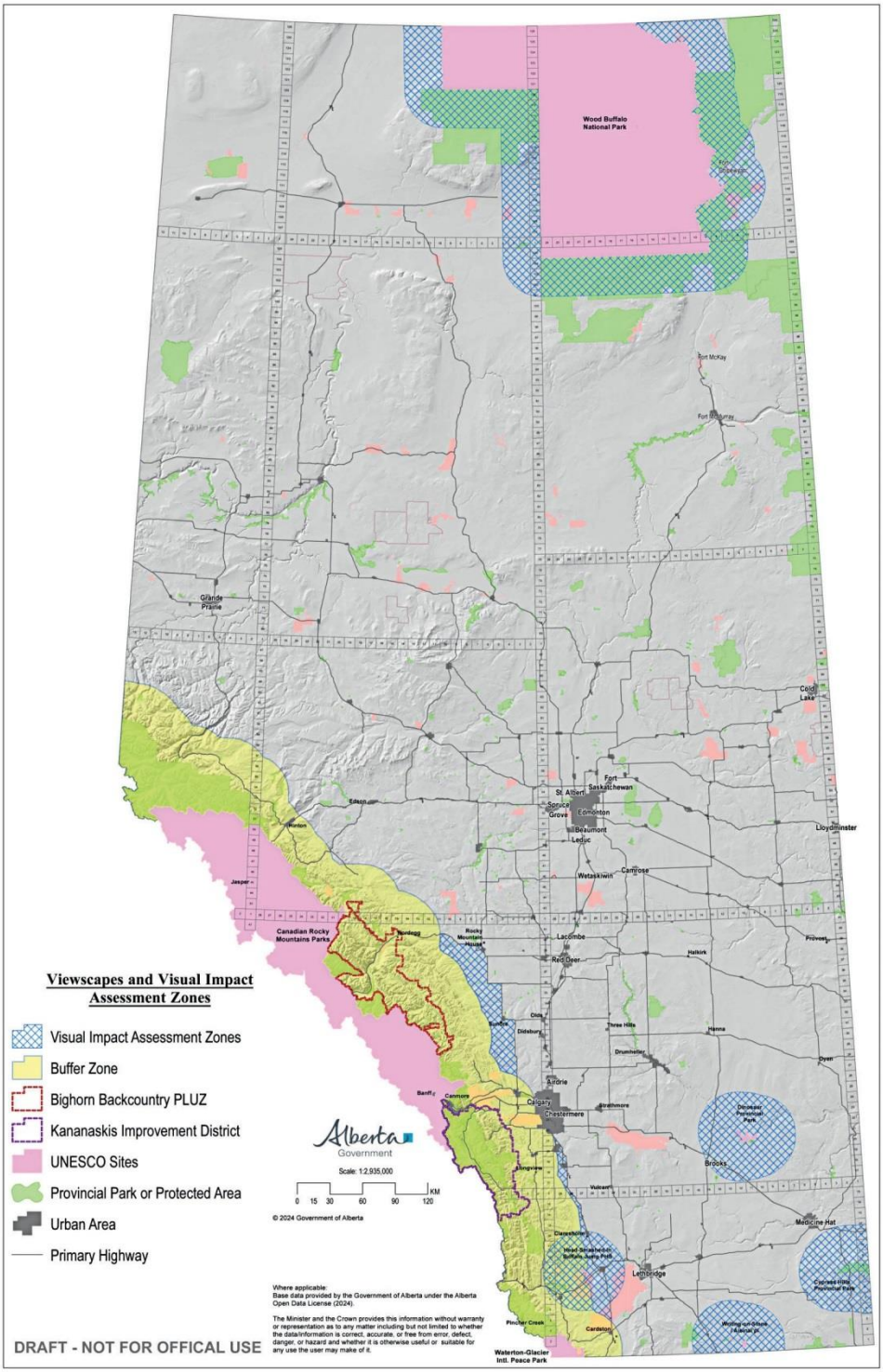


Figure 5.6: Suggested Setbacks, Buffers, Visual Impact Zones proposed for Alberta.

Figure 1.1. Canadian CO_2 Emissions

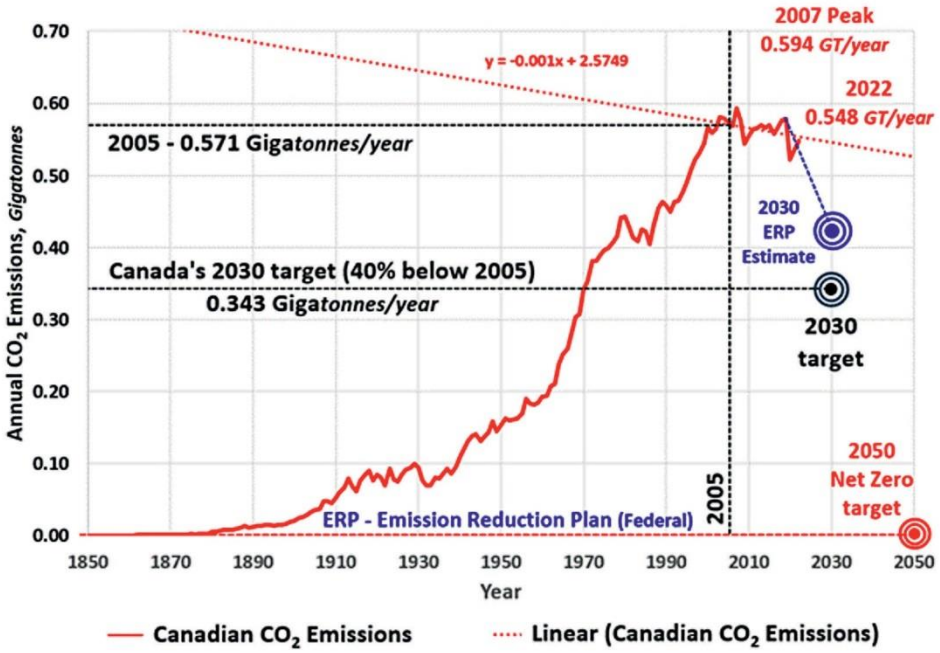


Figure 1.1: Canada is far from meeting its 2030 Net Zero goals.
Source: Ron Davison, Friends of Science Society, based on data from Our World in Data https://ourworldindata.org/

Figure 2.1. GHG Emissions by Nation 2022

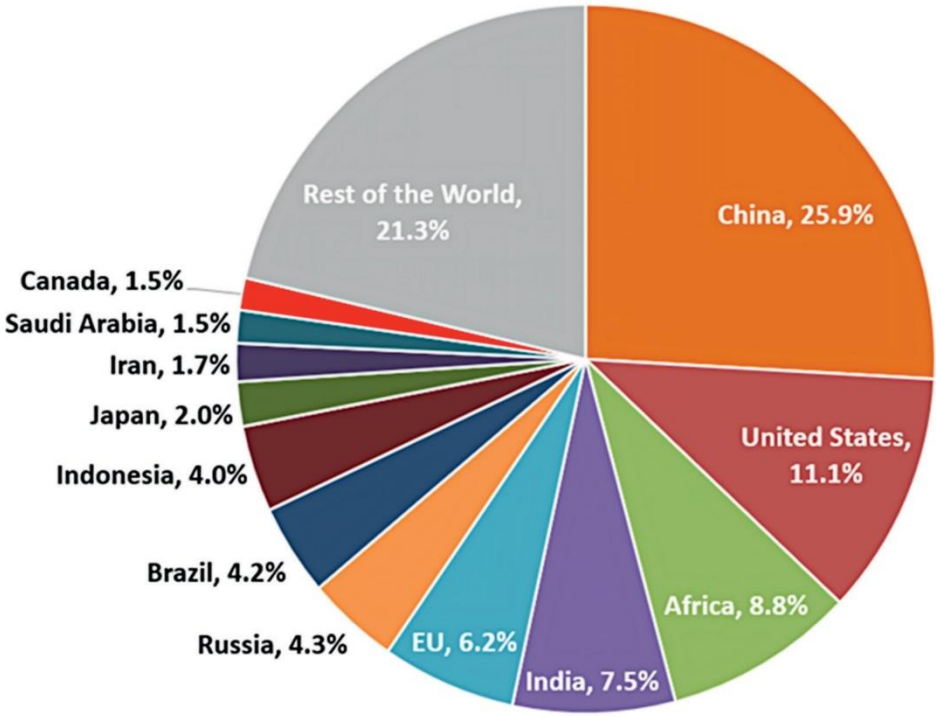


Figure 2.1: Canada produces only 1.5% of the world's greenhouse gas emissions.
Source: Ron Davison, Friends of Science Society, based on data from Our World in Data, https://ourworldindata.org/

Figure 2.2. Global Emissions (With and Without Canada)

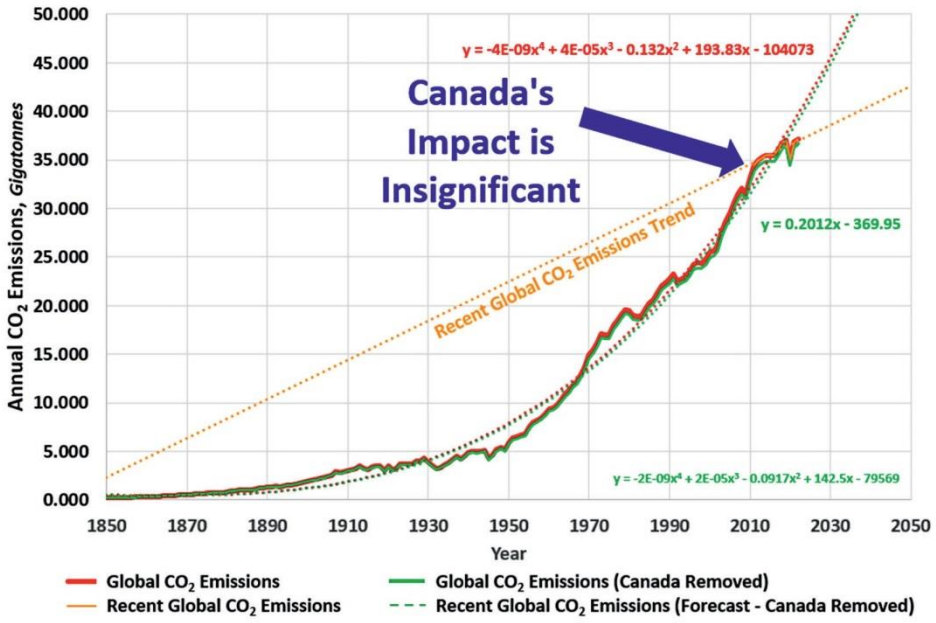


Figure 2.2: Global emissions including Canada (red line) and without Canada (green line). Canada's "contribution" to emissions reduction is effectively zero.
Source: Ron Davison, Friends of Science Society, based on data from Our World in Data
https://ourworldindata.org/

Figure 2.3. CO_2 Emissions - Africa, China, India

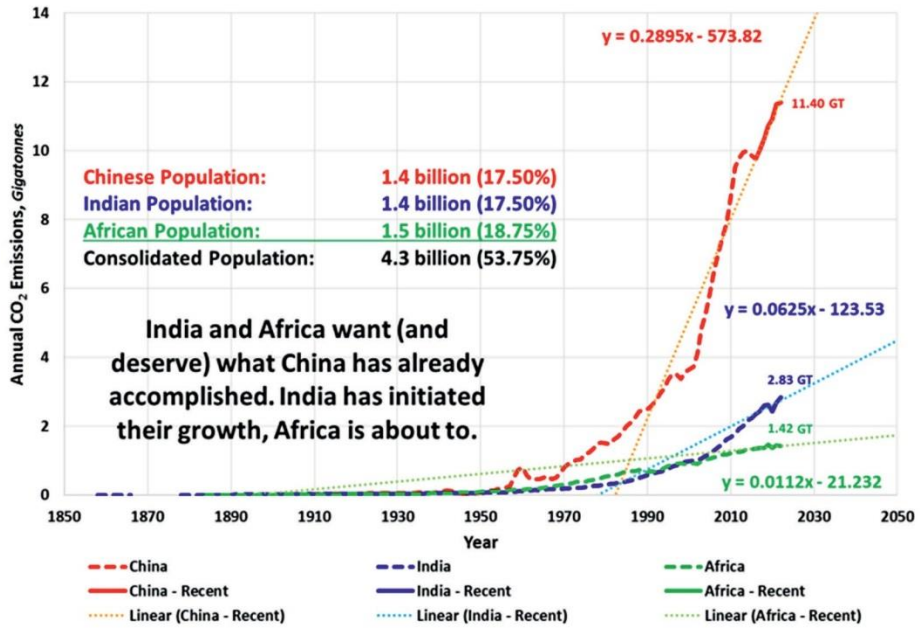


Figure 2.3: Carbon emission growth of developing regions like China, India, and Africa. Recent = 2016-2022
Source: Ron Davison, Friends of Science Society, based on data from Our World in Data
https://ourworldindata.org/

Figure 3.1. Temperature Reduction with Paris Agreement

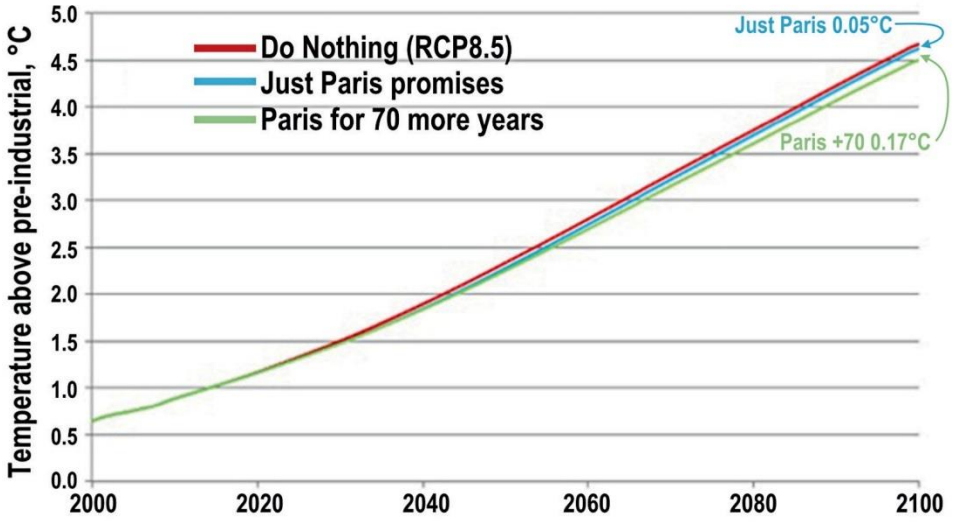


Figure 3.1: Temperature reduction with Paris (blue line, estimated by Lomborg at 0.05°C if all nations kept their climate promises up to 2030), without Paris (red Line), and if nations follow Paris for 70 more years up to 2100 (green line). There is virtually no difference in temperature reduction from following the Paris Agreement. Source: Bjorn Lomborg

Figure 4.1. Canadian GDP Profile - OECD

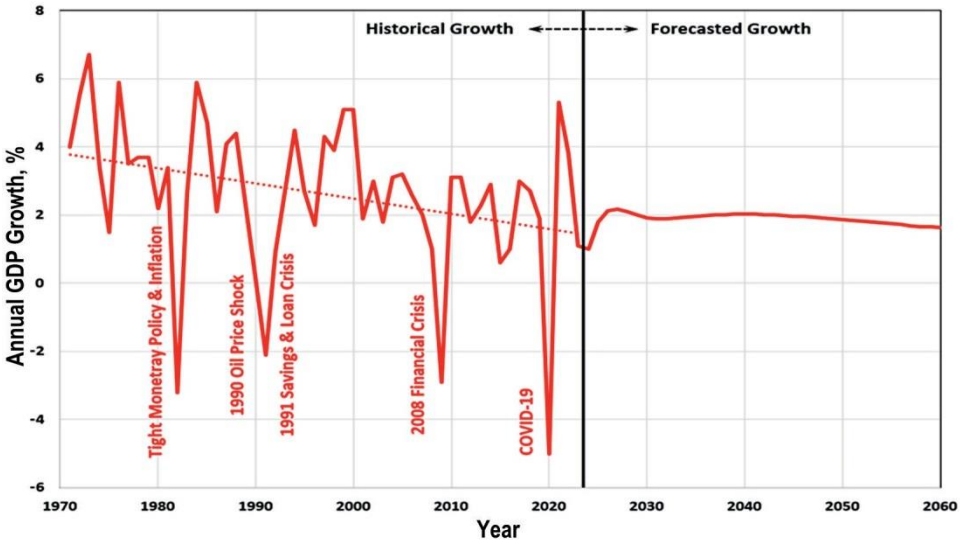


Figure 4.1: Canada's declining GDP from 1970 to today, plus forecasted declines.
Source: OECD

Figure 4.2. Average Growth Rates (%) in Real GDP Per Capita, OECD Countries, 2014-2022

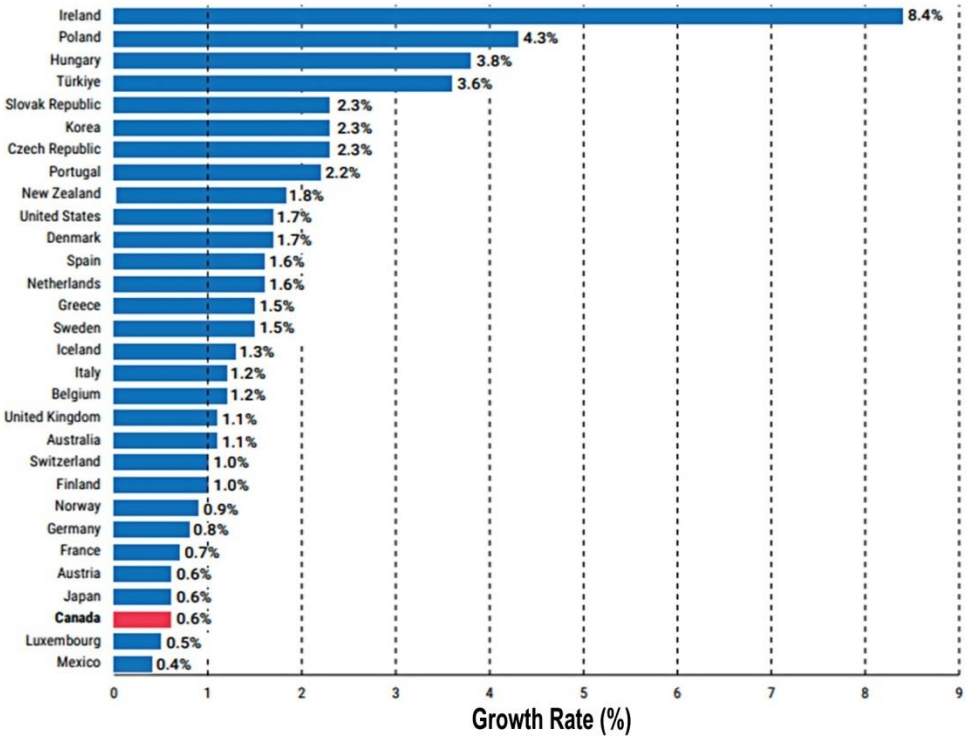


Figure 4.2: Average GDP/capita growth rates for OECD nations; Canada is near the bottom in red.
Source: OECD

Figure 4.3. Projected Growth Rates in Per-Capita GDP, OECD Countries, 2030-2060

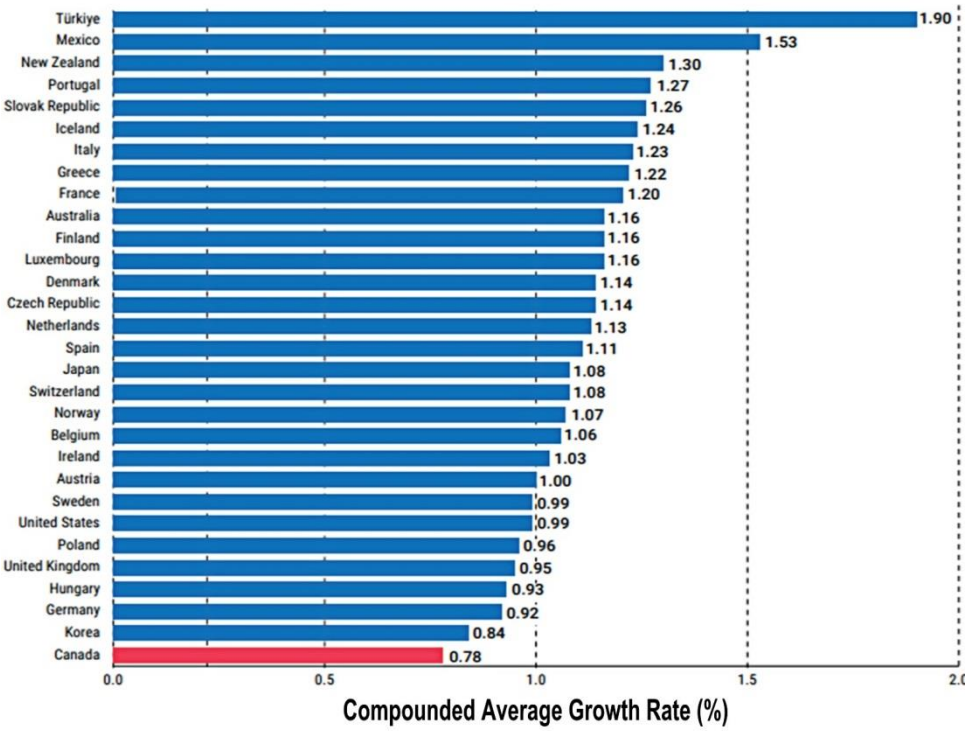


Figure 4.3: OECD projections of GDP growth rates per capita 2030-2060. Canada (in red) is at the bottom of all OECD countries with only 0.78 per cent projected growth.
Source: OECD

Table 4.1. Estimated Impact of Climate Change on Canada's Real GDP Based on Global GHG Emissions Scenarios

With the Paris Accord

Percentage difference	2021	2050	2075	2100
Current policies plus announced pledges (APS)	-0.8	-2.4	-4.1	-5.8
Current policies only (STEPS)	-0.8	-2.5	-4.4	-6.6

Without the Paris Accord

Table 4.1: Estimated impact of Climate Change on Canada's real GDP based on global GHG emissions scenarios.
Source:. https://publications.gc.ca/collections/collection_2023/dpb-pbo/YN5-259-2022-eng.pdf

Figure 4.4. Share of Major Trading Partners in Total U.S. Merchandise Imports, 1990-2018 (%)

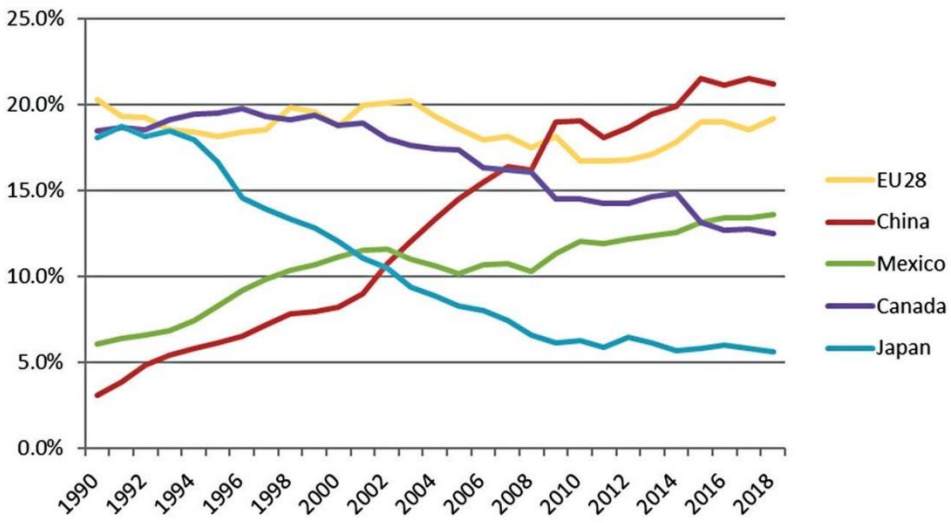


Figure 4.4: Canada's share of trade with the United States is falling, while U.S. trade with China is increasing, in part because our products are less competitive due to our carbon-tax policies.
Source: Global Affairs Canada, Office of the Chief Economist.

Figure 1.1. Breakdown of Total Atmospheric Gas Composition by Percent, All Greenhouse Gases

(Note: read left to right for diminishing values)

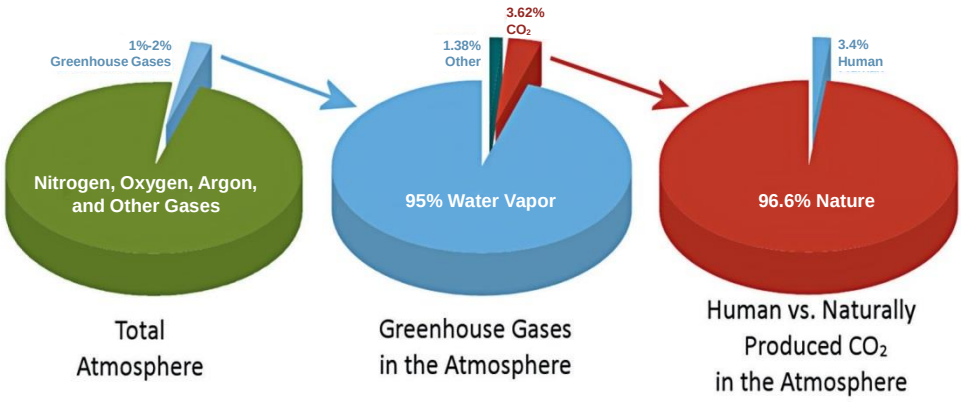
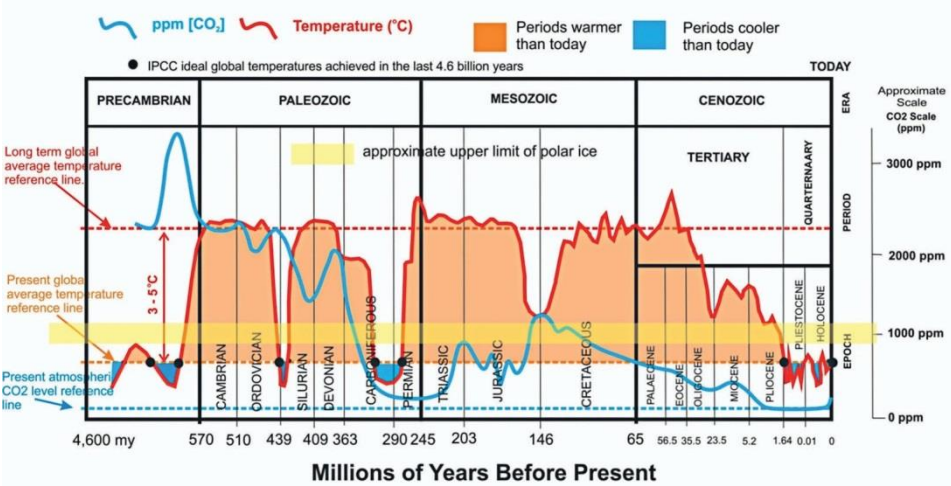


Figure 1.1: A breakdown of total atmospheric composition, all greenhouse gases, and human versus naturally produced carbon dioxide in Earth's atmosphere. Graphic by A. Watts, adopted from National Center for Policy Analysis, A Global Warming Primer.

Figure 1.2. Geological Timescale: Concentration of Atmospheric CO_2 & Mean Global Temperatures



1 - Analysis of the Temperature Oscillations in Geological Eras by **Dr. C.R. Scotese** © 2002. 2 - **Ruddiman, W.F**. 2001, *Earth's Climate past and future* .W..H. Freeman & Sons, New York, NY. 3 Mark Pagani et al. *Marked Decline in Atmospheric Carbon Dioxide Concentrations During the Paleocene. Science*: Vol 309, No. 5734; pp 600-603, 22 July 2005. *Conclusion and Interpretation* by Nasif Nahle © 2005, 2007. *Corrected on 07 July 2008 (CO2: Ordovician Period).*

Additional lines, highlights, colouring and text by ***Robert Fagan****, 2018. Please be aware that the horizontal time scale varies markedly from left to right. The temperature troughs represented in blue as glacial episodes are up to 2 - 3 times deeper than portrayed. Additional information available at www.dr-robert-fagan.com*

Web link to data for this chart. http://www.biocab.org/carbon_dioxide_geological_timescale.html
is no longer available but can be found here:
https://web.archive.org/web/20191031054150/https://www.biocab.org/carbon_dioxide_geological_timescale.html

Figure 1.2: Temperature and CO_2 variations over 600 million years. Over geologic time there is little correlation between temperature and CO_2. Source: Temperature after Scotese (2002), & CO_2 after Pagani et.al, (2005), with contributions by others.
https://www.dr-robert-fagan.com/climate-charts-ice-cores-and-milankovitch-cycles/

Figure 2.1. Global Bulk Atmospheric Temperatures (TMT Surface to 50K ft) 1979-2022

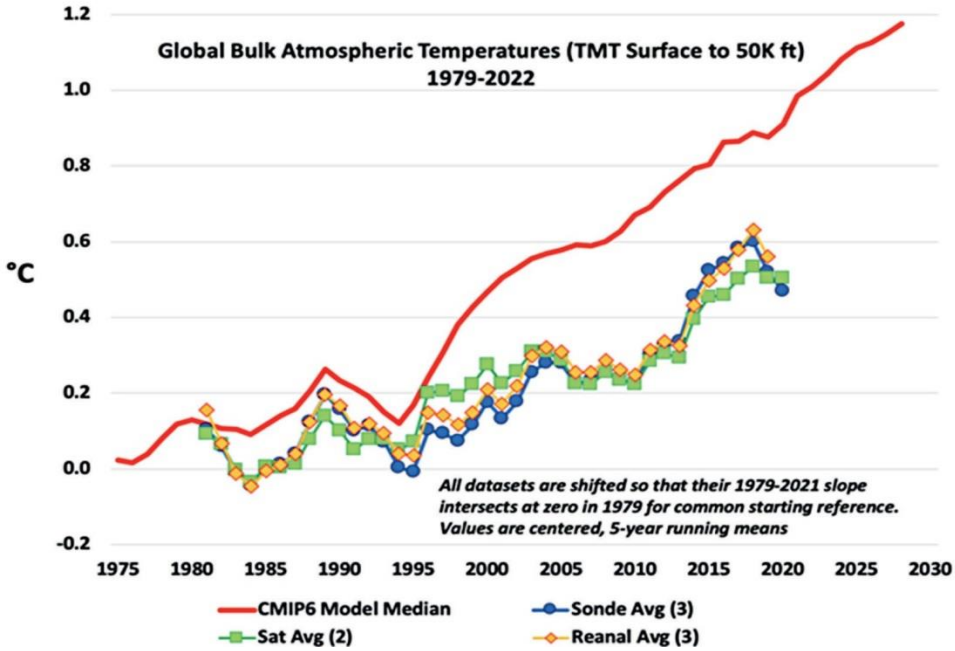


Figure 2.1: Comparison of global warming trends from 1979 to 2022 between CMIP6 climate models (median of all models in red) compared to average of satellite-derived temperature measurements (green), average of weather radiosonde balloons (blue), and reanalysis of average surface temperature measurements (orange). Note the red line (climate model temperatures) has warming rates nearly double that of actual measurements in 2022. Graph by Dr. John Christy.

Figure 3.1. Weather Station at the University of Arizona

Figure 3.1: U.S. Historical Climatology Network weather station used to collect climate data. This station is located in a parking lot at the University of Arizona in Tucson. The station was previously located in a grassy area, but researchers moved the station as the campus grew.
Photo by Anthony Watts.

Figure 3.2. CONUS, All Unperturbed

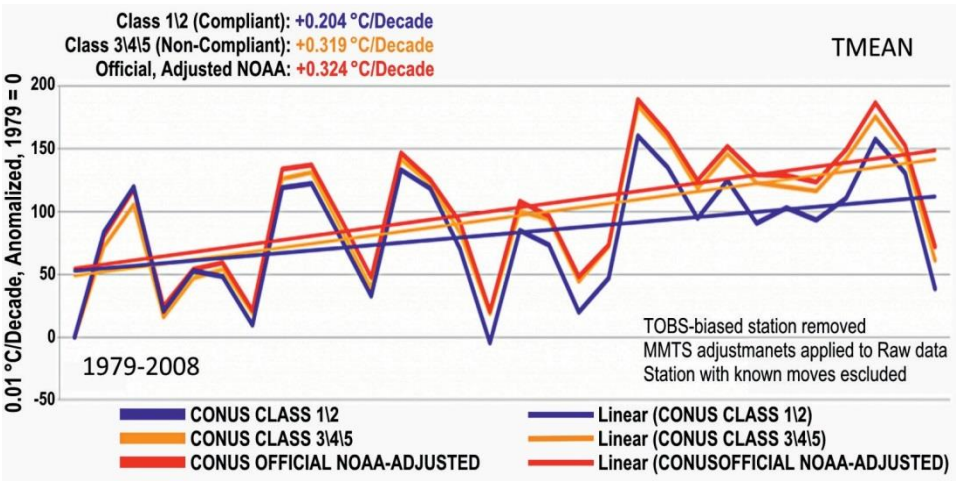


Figure 3.2: Uncorrupted stations (classes one and two, blue line) report much less warming than stations corrupted by urban heat island factors (classes three, four, and five, red line). The trend lines for the corrupted stations (red) clearly show more warming than the uncorrupted stations (blue).[67]

Figure 4.1. IPCC's AR6 Report Table

Climatic Impact-driver Type	Climatic Impact-driver Category	Already Emerged in Historical Period	Emerging by 2050 at Least for RCP8.5/SSP5-8.5		Emerging Between 2050 and 2100 for at Least RC8.5/SSP5-8.5	
Wet and Dry	Mean precipitation		6	7		
	River flood					
	Heavy precipitation and pluvial flood				8	
	Landslide					
	Aridity					
	Hydrological drought					
	Agricultural and ecological drought					
	Fire weather					

6. Increase in most northern mid-latitudes, Siberia, Arctic regions by mid-century, others later in the century.
7. Decrease in the Mediterranean area, Southern Africa, South-west Australia.
8. Northern Europe, Northern Asia and East Asia under RCP8.5 and not in low-end scenarios.

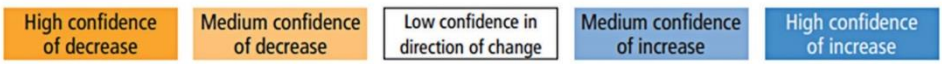


Figure 4.1: IPCC's AR6 report shows no human-influenced trend for most wet and dry "extreme weather." The white boxes indicate "low confidence in direction of change" (i.e., no discernible human influence"). Source: IPCC AR6, Working Group I, Chapter 12, Table 12.12.

Figure 4.2. Global Tropical Cyclone Frequency - 12 month Running Sums (Updated December 31, 2023) @RyanMaue

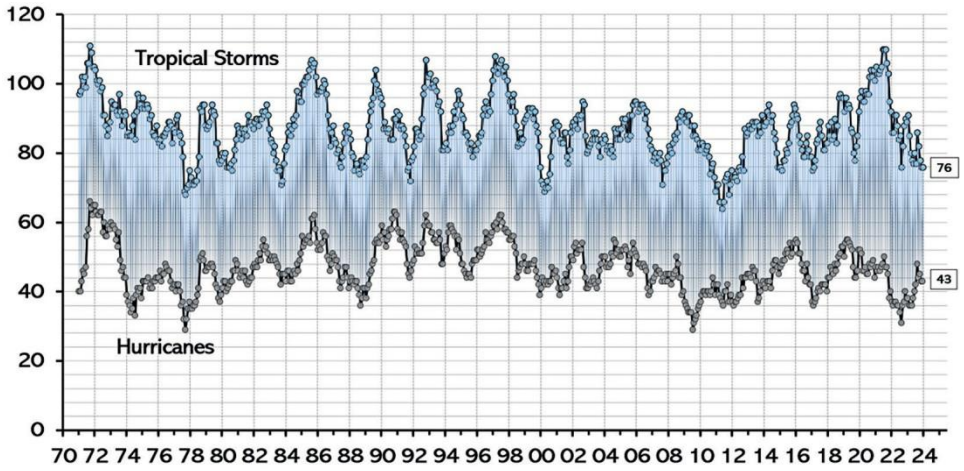


Figure 4.2: This figure shows that global hurricane and tropical cyclone activity is not increasing. Even with the slight uptick in the number of tropical storms in 2021, it is still below the peak recorded in 1971. Source: Ryan N. Maue, "Global Tropical Cyclone Activity," Climate Atlas, http://climatlas.com/tropical/frequency_12months.png.

Figure 4.3. IPCC's AR6 Report Table

Climatic Impact-driver Type	Climatic Impact-driver Category	Already Emerged in Historical Period	Emerging by 2050 at Least for RCP8.5/SSP5-8.5	Emerging Between 2050 and 2100 for at Least RC8.5/SSP5-8.5
Wind	Mean wind speed			
	Severe wind storm			
	Tropical cyclone			
	Sand and dust storm			

Figure 4.3: IPCC's AR6 report shows no human-influenced trend (white boxes) for most "wind" weather events. Source: IPCC AR6, Working Group I, Chapter 12, Table 12.12.

Figure 4.4. Canada "All-Time" Provincial & Territorial High Temperature Records

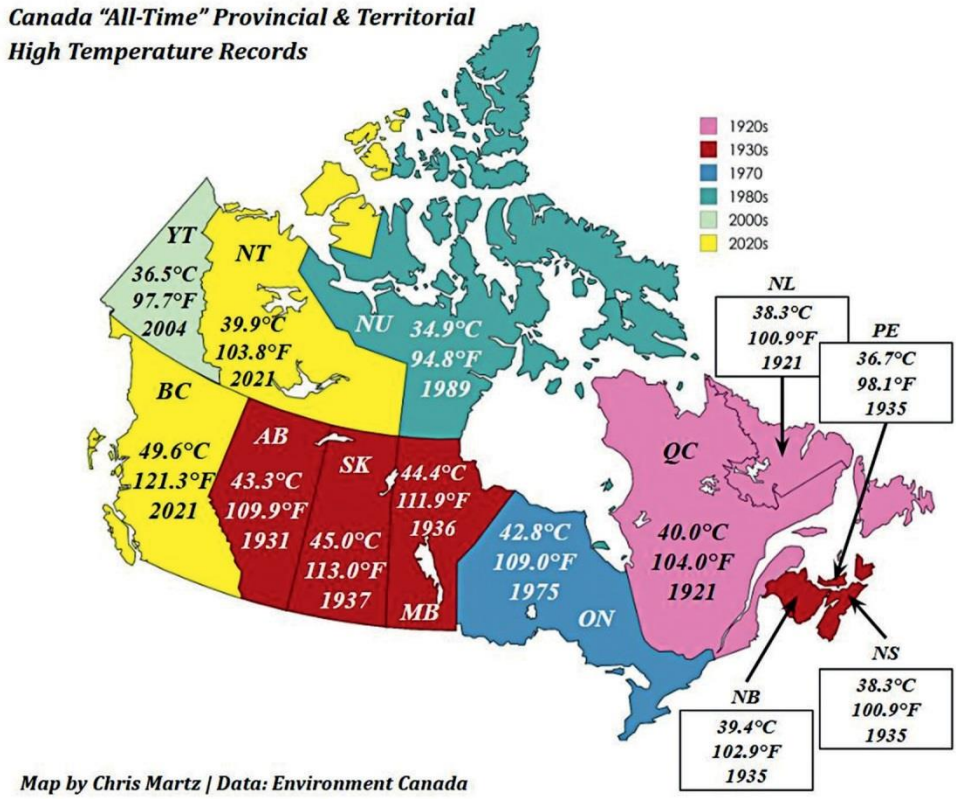


Figure 4.4: Temperature records by province Source: Chris Martz (map), Environment Canada.

Figure 4.5. Global Burned Area 1901-2018

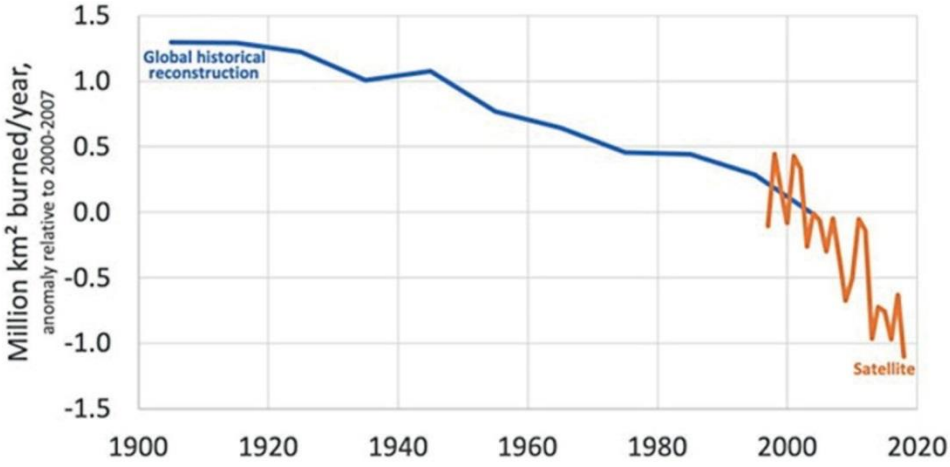


Figure 4.5:
1901-2007 data from https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2013JG002532;
1997-2016 from http://globalfiredata.org/index.html;
2017-2018 from https://gwis.jrcec.europa.eu/apps/gwis.statistics/

Figure 4.6. Number of Fires and Area Burned in Canada by Year

Source: Canadian Nation Fire database (CNFDB)

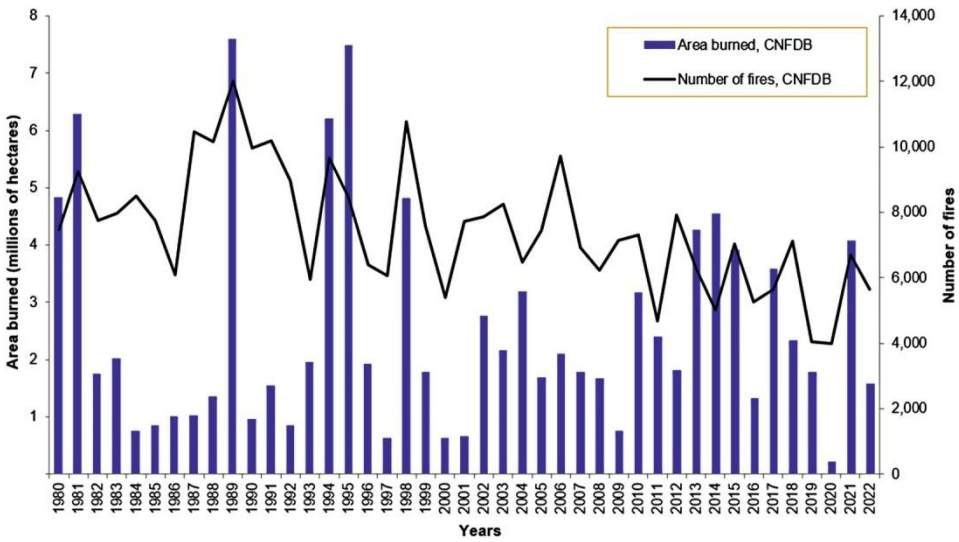


Figure 4.6: The number of forest fires has declined in Canada since 1980.
Source: Canadian National Fire database

Figure 5.1. The PH Scale

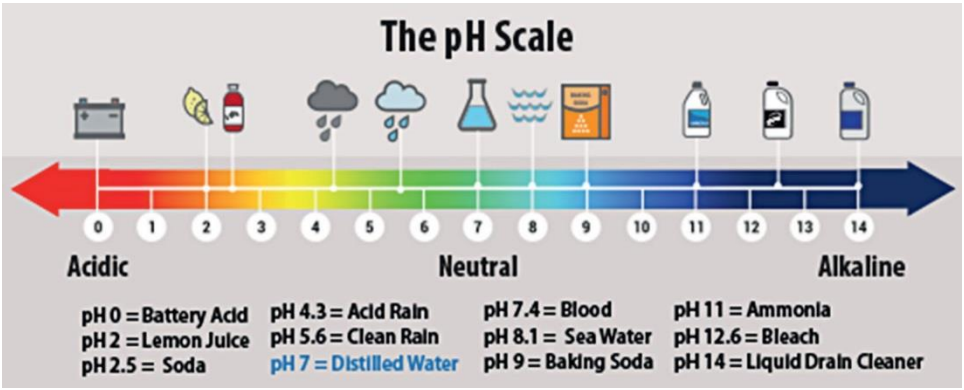


Figure 5.1: Comparison of the pH of common substances. U.S. Environmental Protection Agency, "Measuring Acid Rain," https://www.epa.gov/acidrain/what-acid-rain

Figure 5.2. Reconstructed Global Sea Level

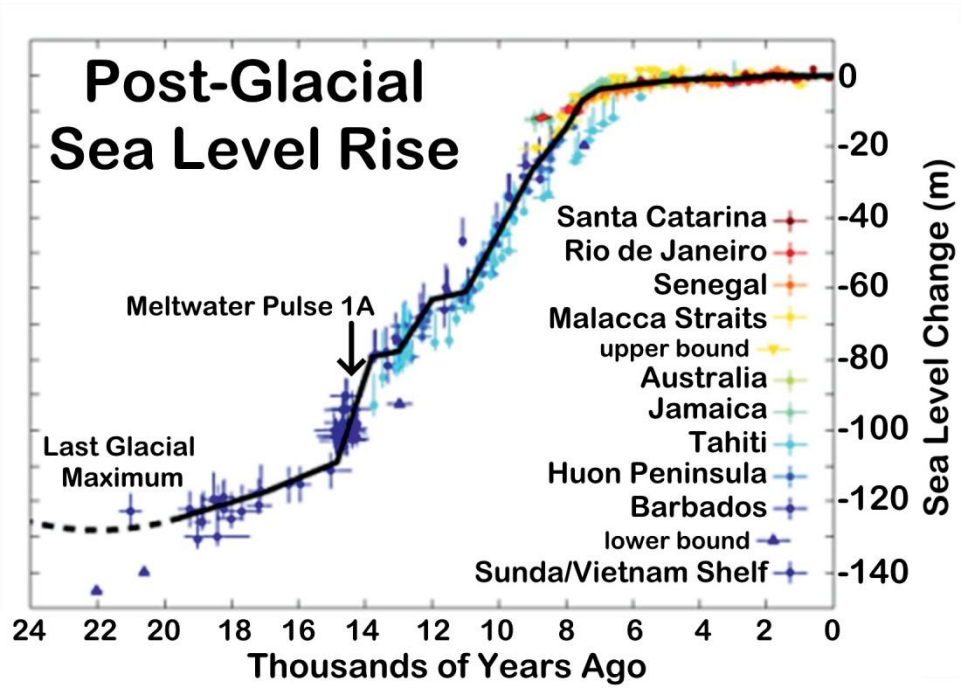


Figure 5.2: Sea level since the Last Glacial Maximum, 20,000 years ago, based on dated worldwide coral and peat deposits.[85]
Source: R.G. Fairbanks

Figure 6.1. Climate-related Deaths 1920-2021

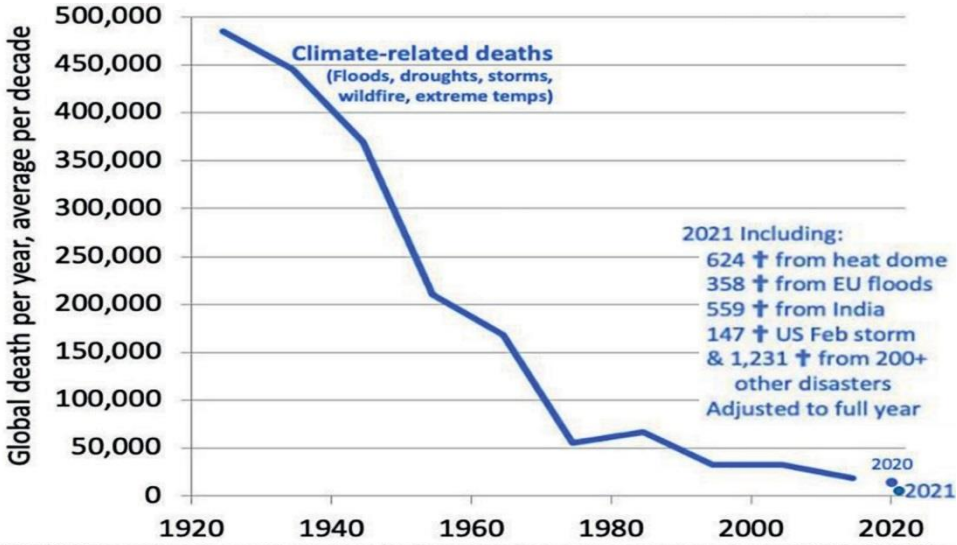


Figure 6.1. There has been a remarkable fall in human deaths related to all extreme weather events from 1920 to 2021. Source: Dr. Bjorn Lomborg, data from International Disaster Database published in ScienceDirect.[87]

Figure 6.2. Climate Crisis Update, 2000-2019: About Ten Times As Many Deaths From Cold Weather As From Hot Weather

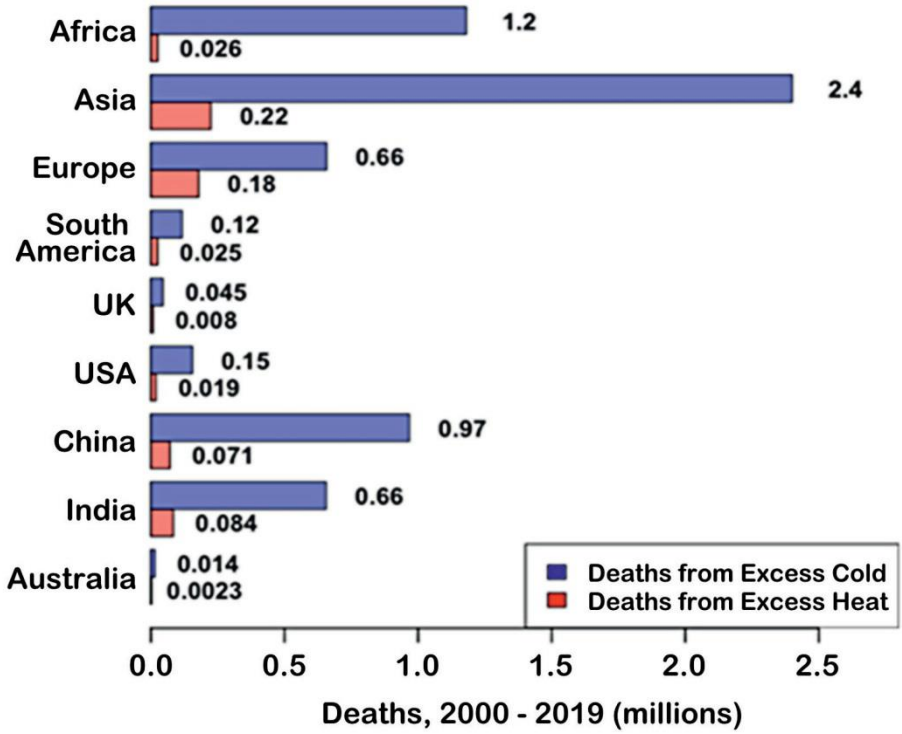


Figure 6.2: A Lancet study found deaths due to cold weather outnumbered deaths due to extreme heat by almost ten to one.
Data Source: https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00081-4/fulltext

Figure 1.1. The Bigger Picture: Life Without Oil - Not As Simple As You May Think

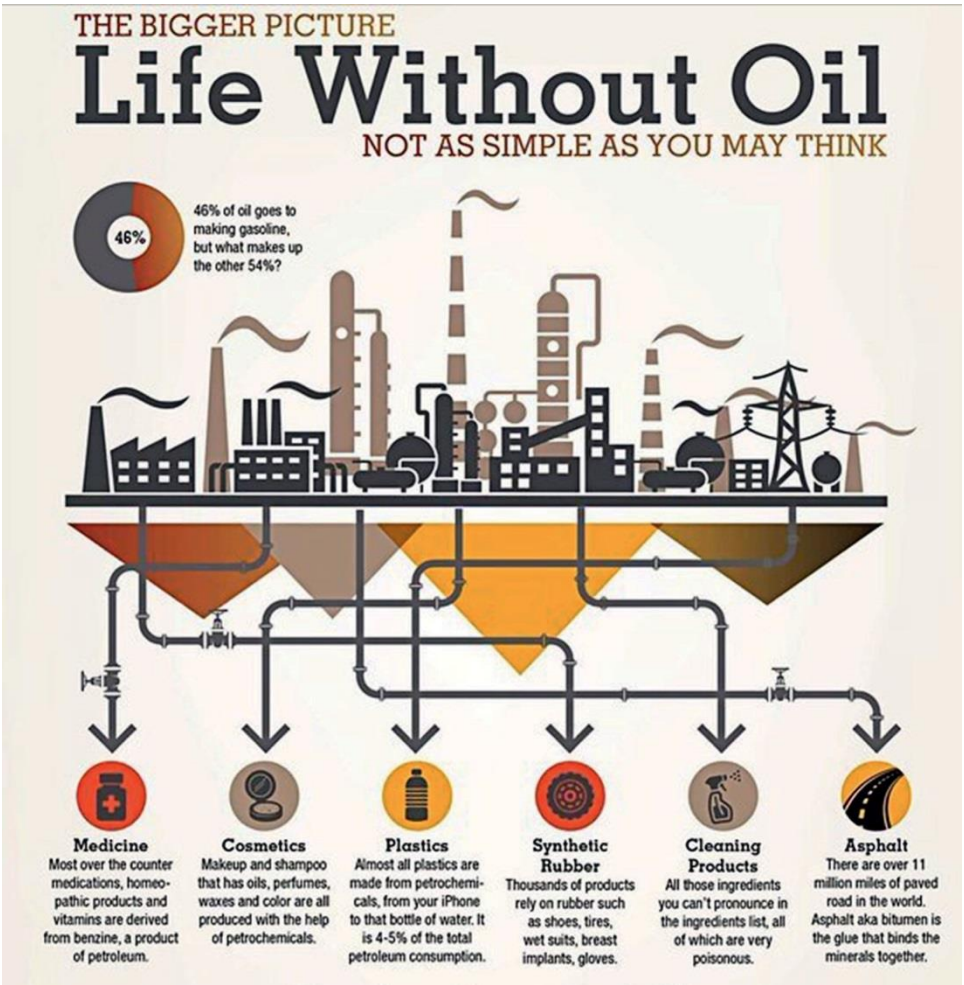


Figure 1.1: Life without out oil—just a few of the products we'd have to do without.

Figure 2.1. The Environmental Case for Synthetic Fertilizer

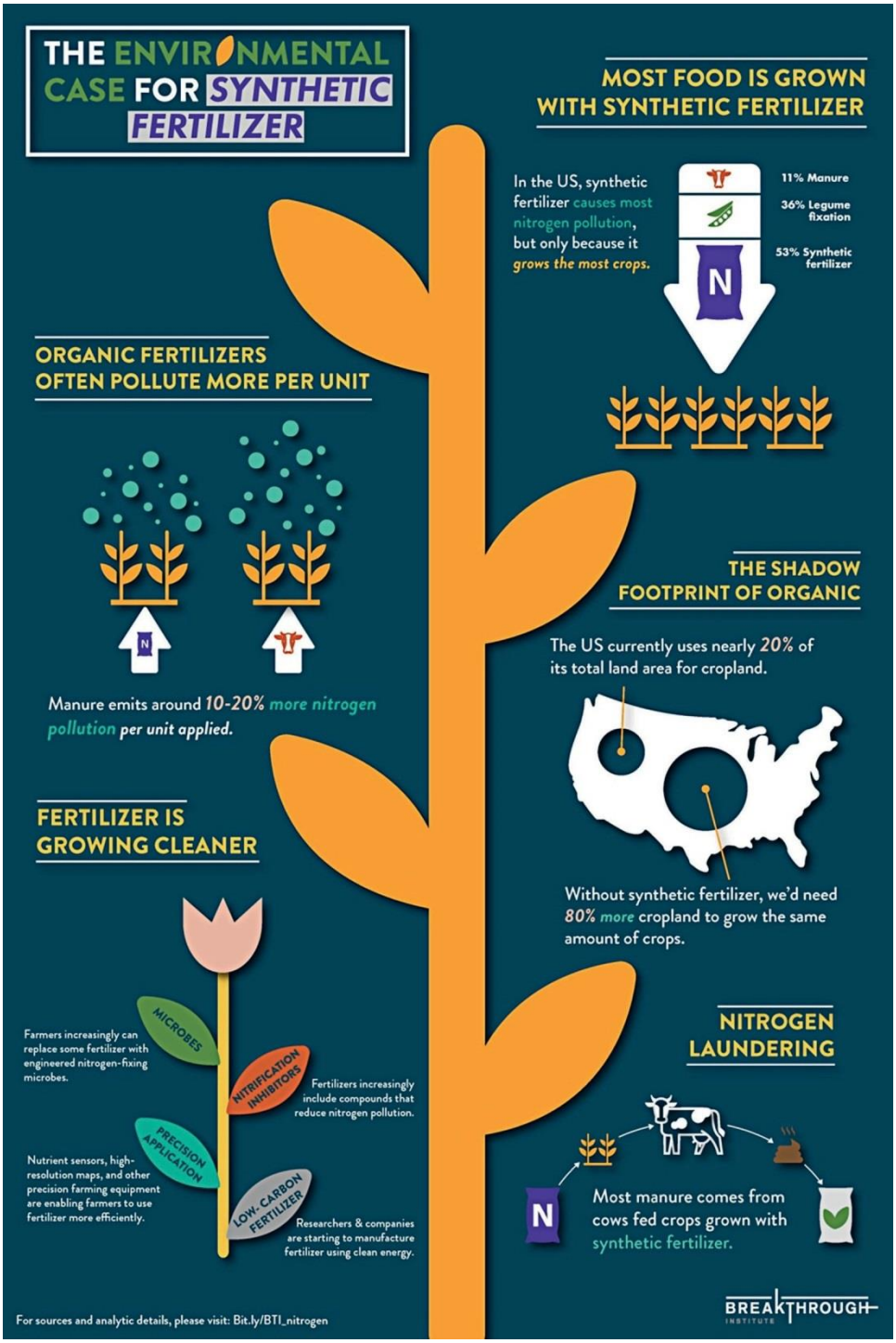


Figure 2.1: Without synthetic fertilizers, we would have to expand the amount of cropland by up to 80 per cent to feed the world. Source: Break Through Institute

Figure 3.1. GDP and Fossil Fuels Consumption

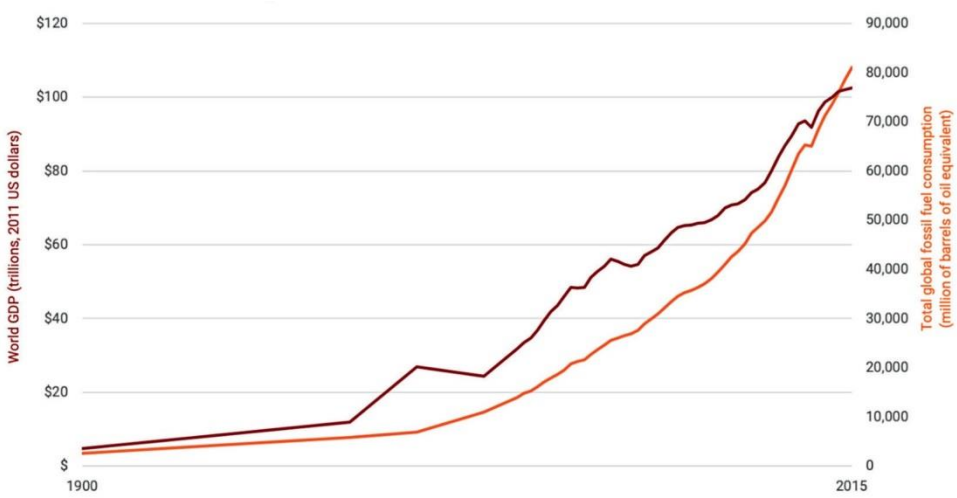


Figure 3.1: Rise of fossil fuel use and global GDP 1900-2015. Dark brown line is world GDP; light brown line is global fossil-fuel consumption. Source: Our World in Data/Brookings Institute

Figure 3.2. Life Expectancy

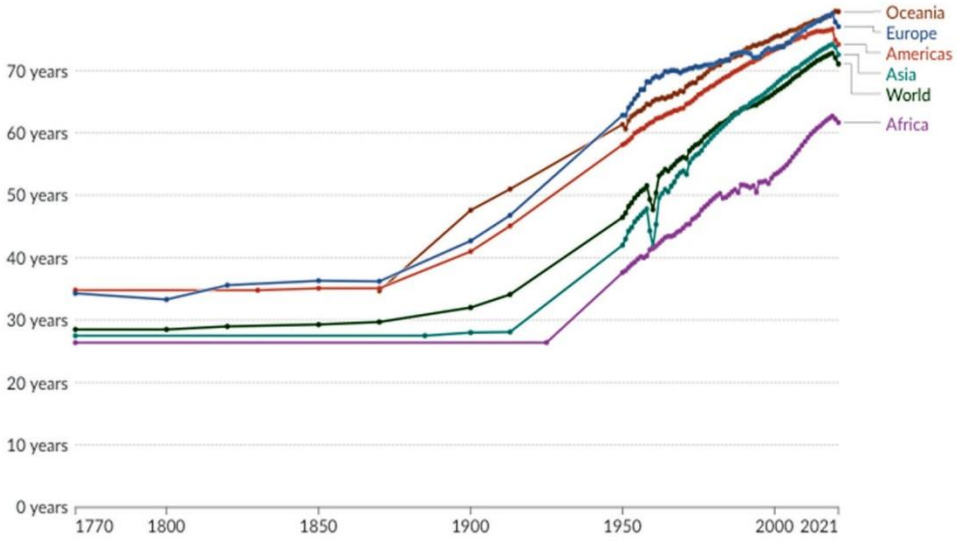


Figure 3.2: Increase in lifespan from 1770 to 2021. Source: Our World in Data

Figure 3.3. Neonatal Mortality Rate

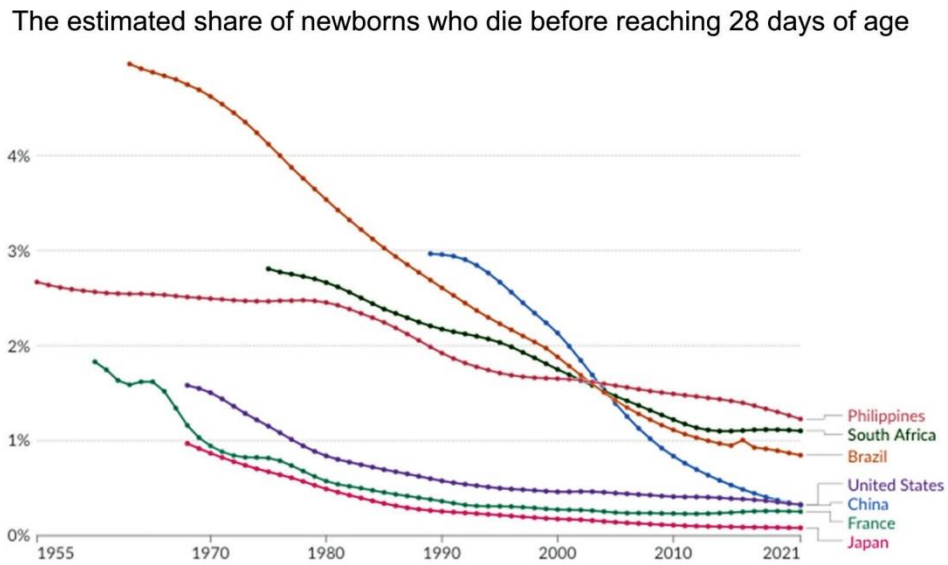


Figure 3.3: Decline in child mortality (newborns) from 1955 to 2021. Source: UN Inter-agency Group for Child Mortality Estimation (2023). From Our World in Data

Figure 4.1. Change In Leaf Area (1982-2015)

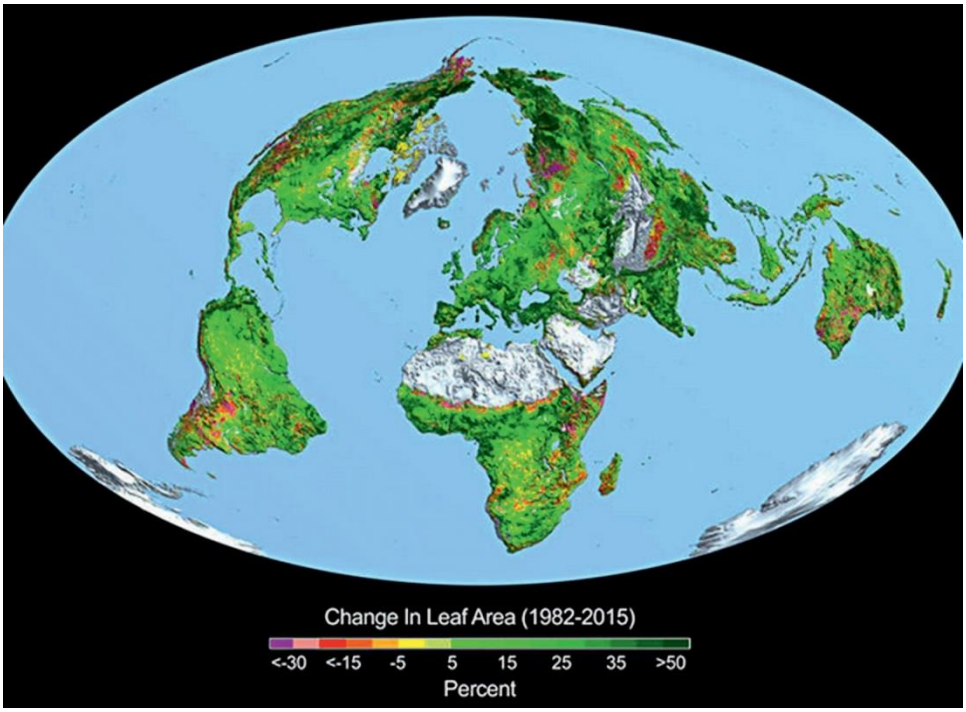


Figure 4.1: Earth shows 'significant' greening over last 35 years: NASA

Figure 5.1. Corn, Soybeans, & Wheat vs. CO_2

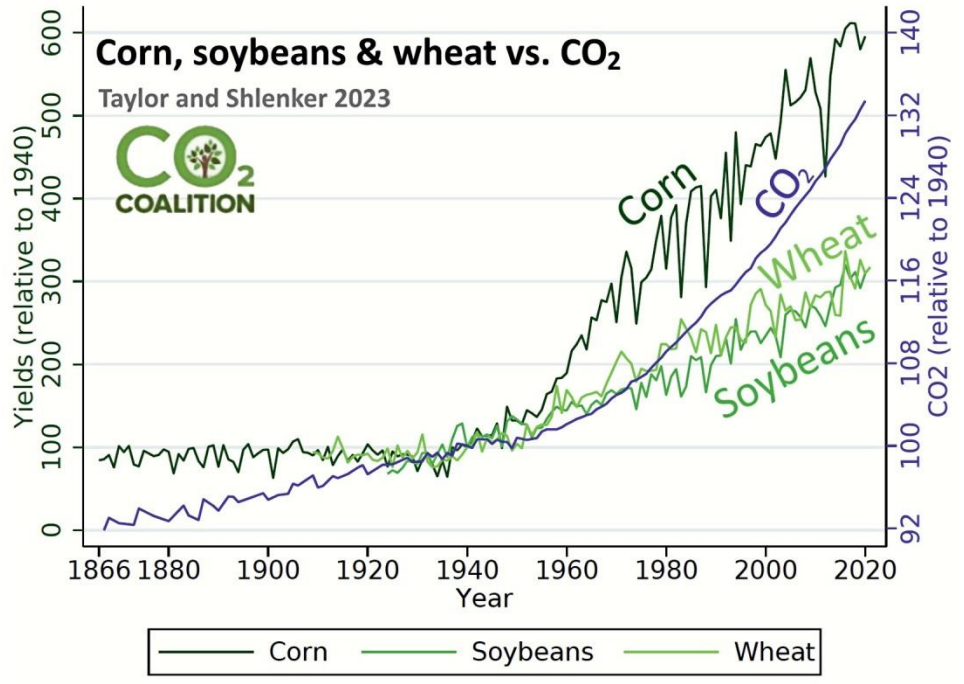


Figure 5.1: Increase in yields of corn, wheat and soybeans from 1866-2021 compared to rising CO_2 levels. Source: CO_2 Coalition

Figure 5.2. Cereal Production, Utilization, and Stocks

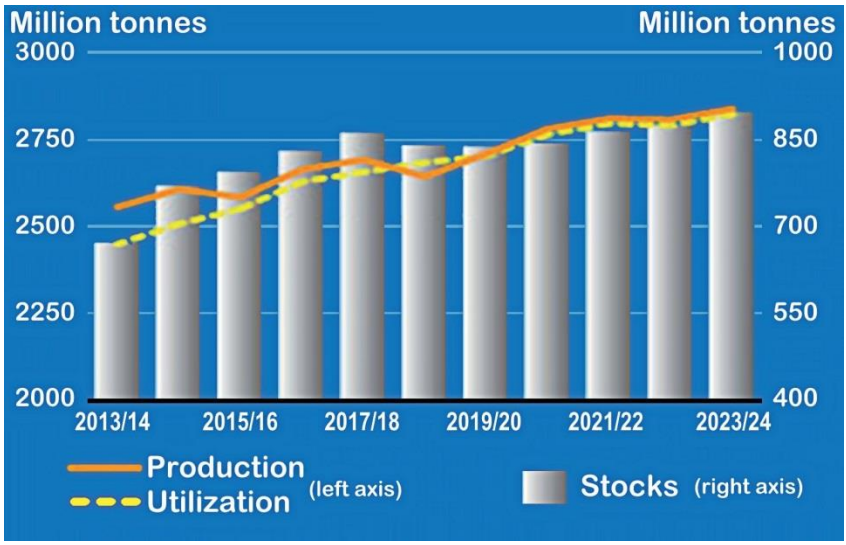


Figure 5.2: Increase in cereal production stocks from 2013-2024. Source: UN Food and Agriculture Organization, "World Food Situation," July 9, 2021.

Figure 5.3. More CO_2 Means More Plant Growth

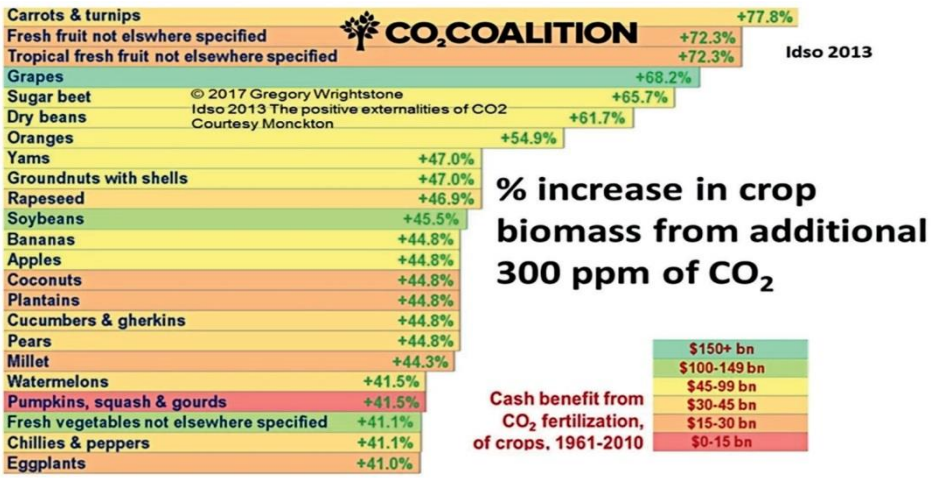


Figure 5.3: Increase in plant growth caused by 300 ppm increase in CO_2.
Source: CO_2 Coalition

Figure 6.1. Greenland GISP2 Ice Core Temperature Data - 10,000-Year Cooling Trend

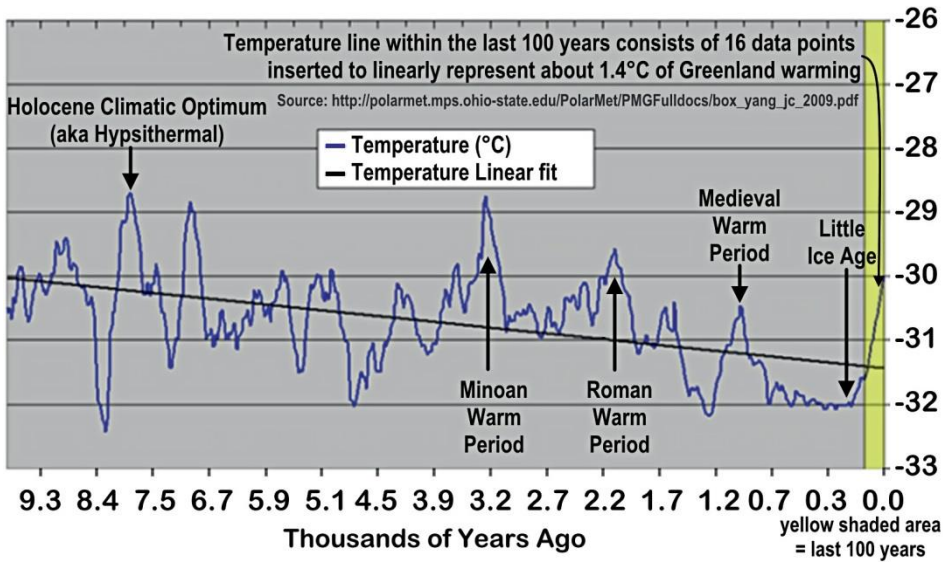


Figure 6.1: Temperature variations during the Holocene interglacial based on Greenland ice core data.
Source: National Oceanographic and Atmospheric Administration (NOAA); R.B. Alley, 2004.

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- Conrad Black, former newspaper publisher, financier, historian, and columnist.

Ron Davison is a private equity investor and current president of The Friends of Science Society, which has been informing Canadians about climate science and policy for 21 years. During his career in the oil and gas industry, Davison was lead engineer on the Zama acid gas disposal project. He maintains a personal website, which includes the peer reviewed paper he authored on the Zama project. https://climatechangeandmusic.com/

H. Sterling Burnett has worked on climate, energy, and environmental issues for 30 years. He currently serves as the director of the Arthur B. Robinson Center on Climate and Environmental Policy at The Heartland Institute and publishes Climate Change Weekly, which interested parties can subscribe to at Heartland.org.

Contributing Authors

Tom Harris, Robert Lyman,
Paul MacRae, Andrew Bonvicini, and John Zacharias

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