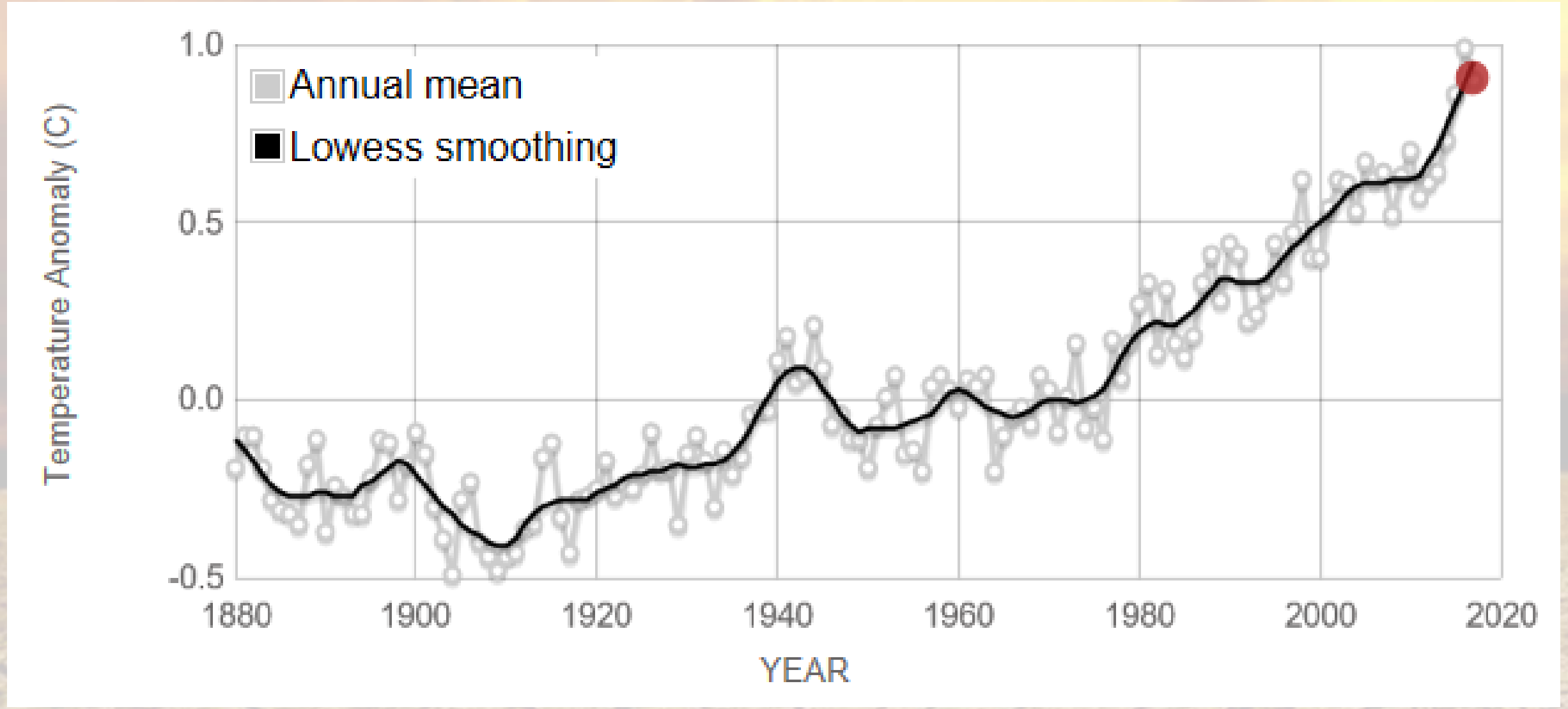
# Climate Change Mitigation: The Costs of Action vs Inaction

**David D. Maenz**
**Author – The Price of Carbon**
www.thepriceofcarbon.com

**Citizens' Climate Lobby Canada**
**2018 National Conference and Lobby Days**

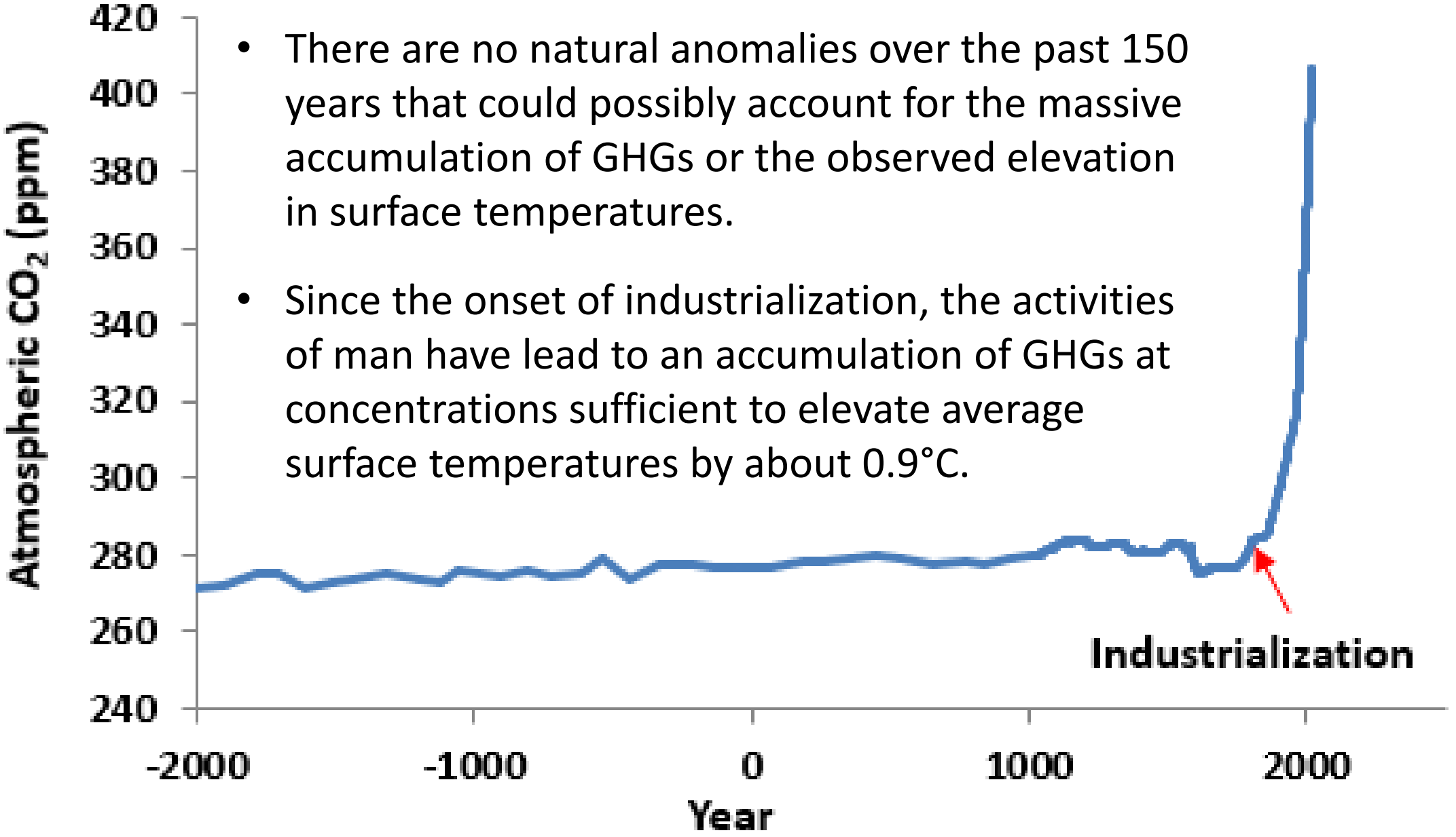
# Anthropogenic Climate Change: A Brief Summary

# NASA: Annual Global Temperature Anomaly



# Changes in Atmospheric $CO_2$ Over the Past 4000 Years

- There are no natural anomalies over the past 150 years that could possibly account for the massive accumulation of GHGs or the observed elevation in surface temperatures.
- Since the onset of industrialization, the activities of man have lead to an accumulation of GHGs at concentrations sufficient to elevate average surface temperatures by about 0.9°C.

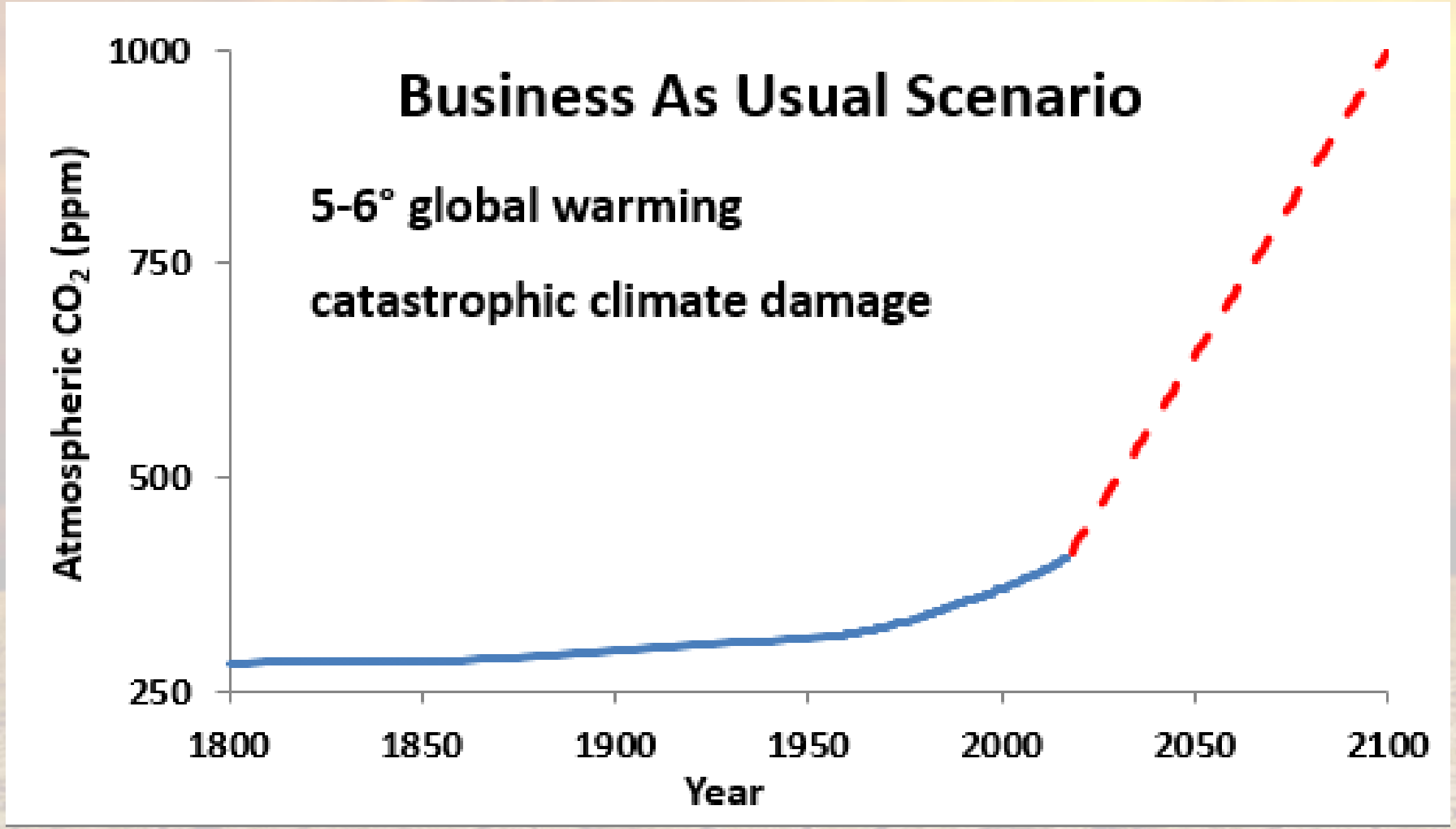


# Climate Change Damage

- Sea level rise, ocean acidification.
- Inland: shifting weather patterns plus more frequent, intense, extreme weather events (wildfires, droughts, floods, heat waves etc).
- Crop failures, famine, climate migration, human conflict, economic stagnation, loss of life and livelihood.
- The extent and cost of damage varies with the magnitude of surface warming.
- Small islands, Sub-Saharan Africa and parts of Asia are the most climate vulnerable regions on earth.

# Climate Change Damage

- GHG emissions become well mixed and evenly dispersed in the atmosphere.
- A metric tonne of $CO_2$ emitted in 2018 from a coal burning power plant in Saskatchewan will persist in the atmosphere and by mid-century will contribute to extreme hardship and suffering in Nigeria while having much less of an impact in western Canada.


Business As Usual Scenario
5-6° global warming
catastrophic climate damage
Atmospheric $CO_2$ (ppm)
1000
750
500
250
1800
1850
1900
1950
2000
2050
2100
Year

# Mitigation of Climate Change: The Paris Agreement, Global Climate Change Policies, and the Costs of Inaction vs Action

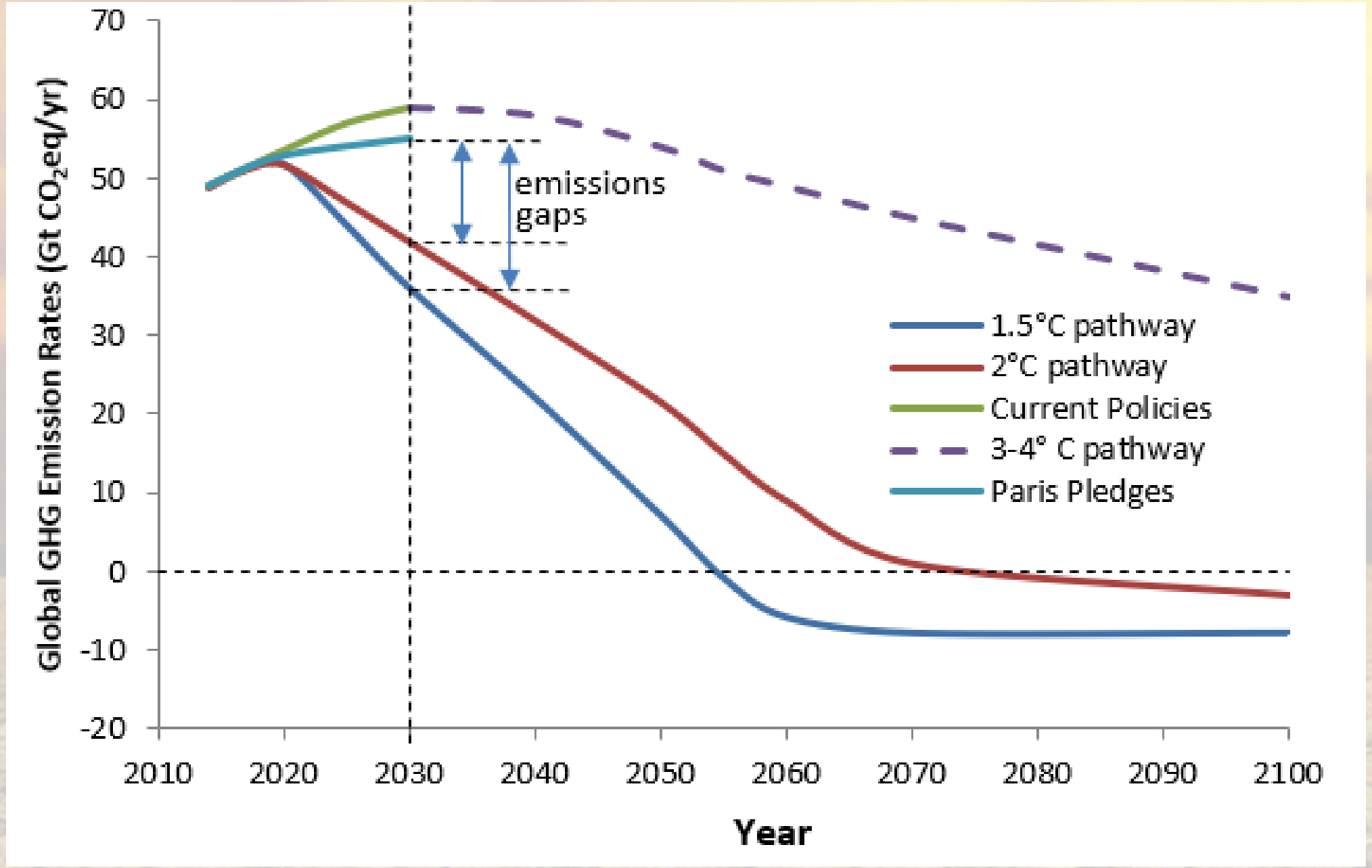
# Paris Climate Agreement

*"Future surface temperatures held to well below 2°C and ideally 1.5°C above pre-industrial temperatures."*

*"Each country or group of countries sets their own targets for emissions reductions."*

- Most countries submitted pledges to reduce or control year 2030 emissions relative to a baseline level.

# Emissions Scenarios and Future Surface Warming



- **Social Cost of Carbon (SCC) – Present day valuation of the cost of future climate damage per mt of $CO_2$ emissions.**

| Social Cost of Carbon ($US per mt of $CO_2$ emissions) | | | | | |
|---|---|---|---|---|---|
| **Year** | **2015** | **2020** | **2025** | **2030** | **2050** |
| SCC | $31.2 | $37.3 | $44.0 | $51.6 | $102.5 |
| Gt $CO_2$ | 49 | 54 | 57 | 59 | 54 |
| Annual Costs (trillions $) | $1.53 | $2.01 | $2.51 | $3.04 | $5.54 |
| % of global GDP | 2.0% | 2.3% | 2.5% | 2.6% | 2.6% |

**DICE model (W.D. Nordhaus, Yale University, Dept of Economics)**

- **Based on an extrapolation of emissions outcomes from current policies**

# The Social Costs of Air Pollution

**World Bank estimates**

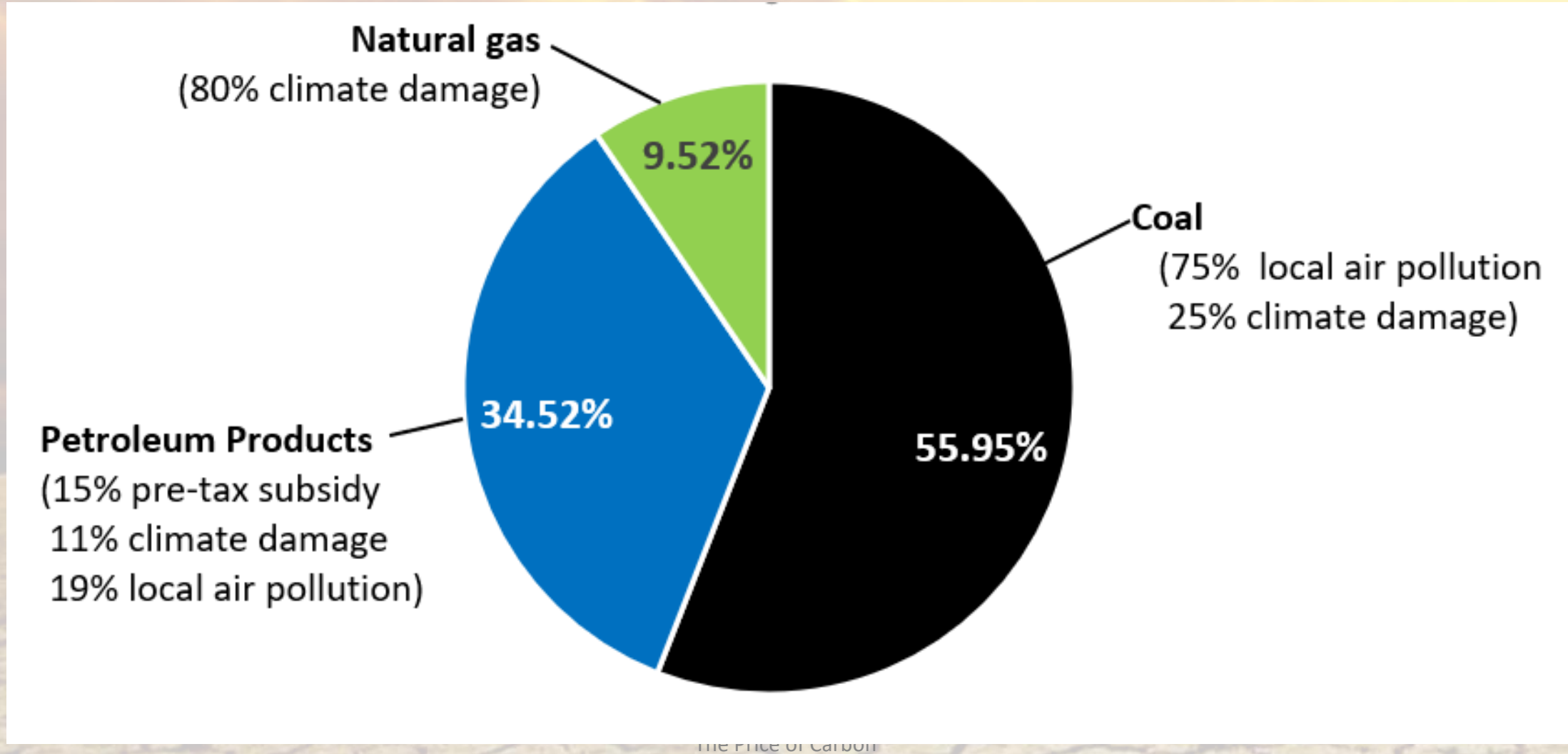
- 7 million early deaths per year caused by air pollution
  - 3.7 million deaths from outdoor air pollution
    - Over 50% of deaths from coal combustion
    - Smog in urban centers major cause of deaths
  - 3.3 million deaths from indoor air pollution
    - Combustion of coal and biomass for cooking and heating in developing countries

- **Fossil fuel subsidies consist of all costs (future climate damage, local air pollution and other costs) not included in current prices.**

| International Monetary Fund Study of Total Subsidies for Global Fossil Fuel Use in 2015 | | |
|---|---|---|
| **Subsidy** | **2015 Cost ($trillion USD)** | **% of Global GDP** |
| Local Air Pollution | $2.65 | 3.25% |
| Global Warming | $1.53 | 1.88% |
| Pre-tax subsidies and other factors | $1.12 | 1.37% |
| **Total subsidies** | **$5.3** | **6.50%** |

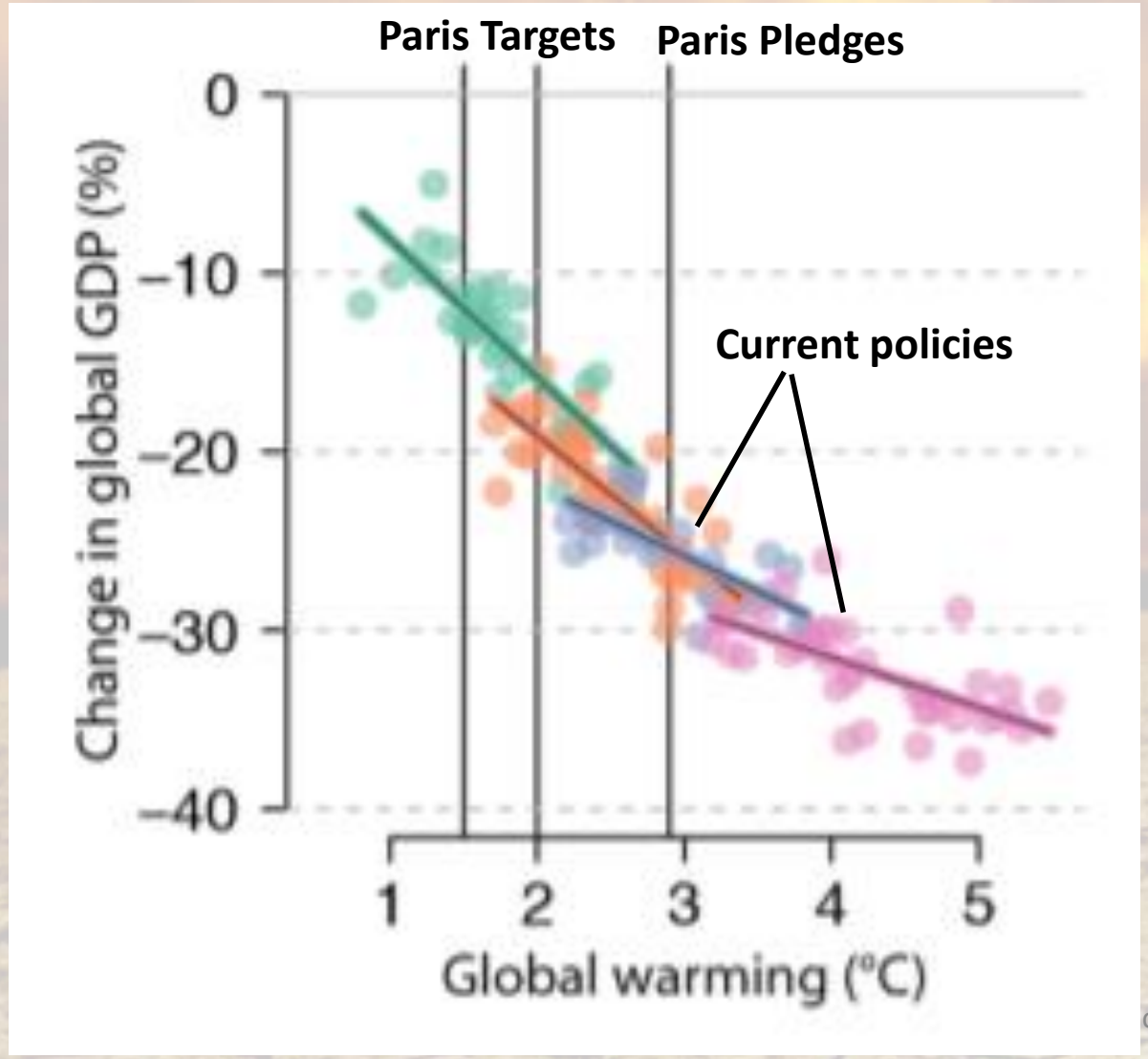
# Breakdown of Global Subsidies to Fossil Fuels

**(in 2015 total = 6.5% of GDP )**



# Cost/Benefit Analysis on Investment in Climate Change Mitigation

(2018 Stanford University Study)




- **Estimated $10 trillion savings in going from 2°C to 1.5°C in future surface warming (12% of year 2015 global GDP)**
- **Under current policies 3-4 C in surface warming will cost future generations 25-35% of global GDP.**
- **Estimated global costs of achieving Paris Agreement targets = 1-2% of year 2050 global GDP.**
- **Massive return on investment with implementation of effective climate action plans.**

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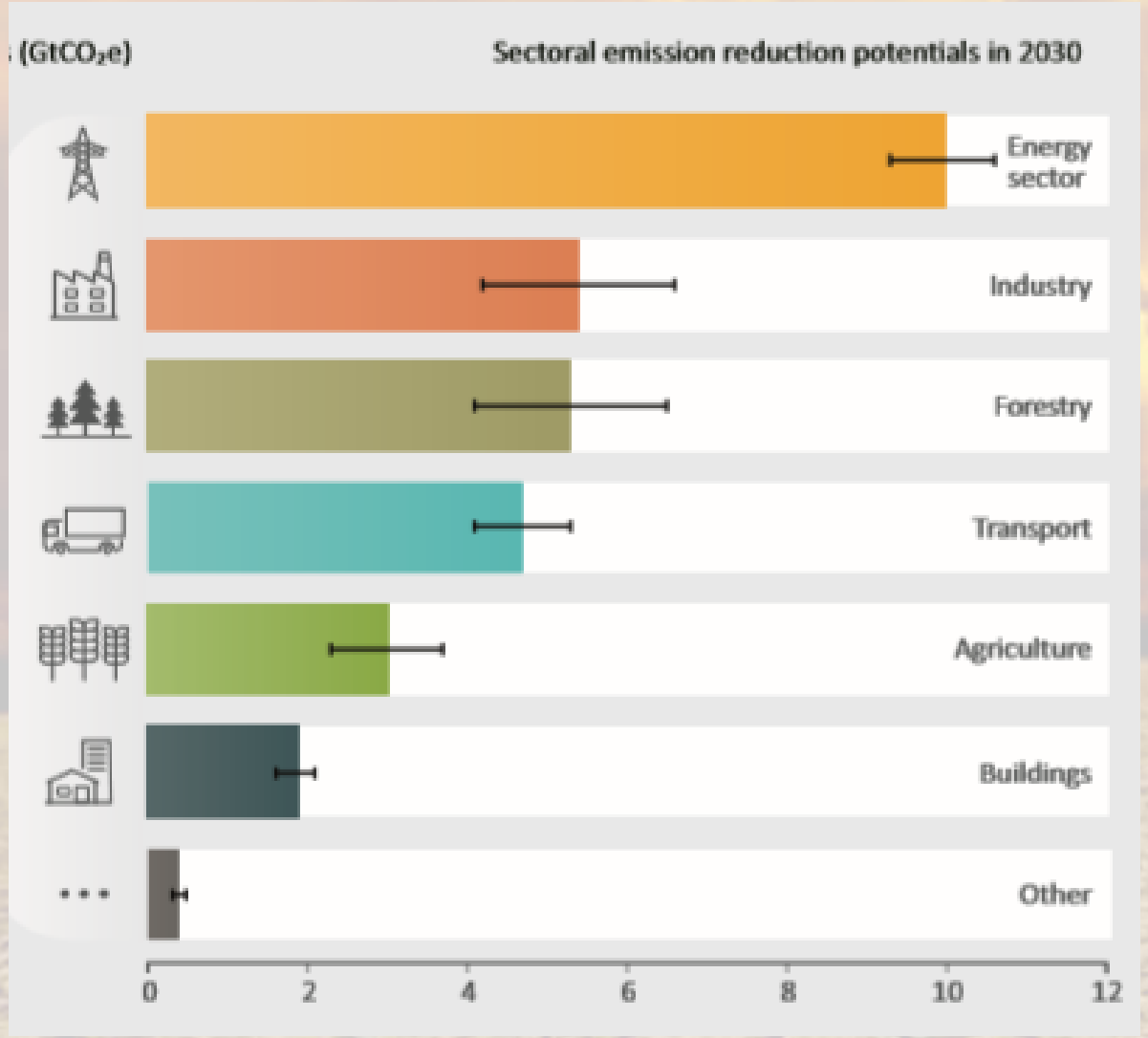
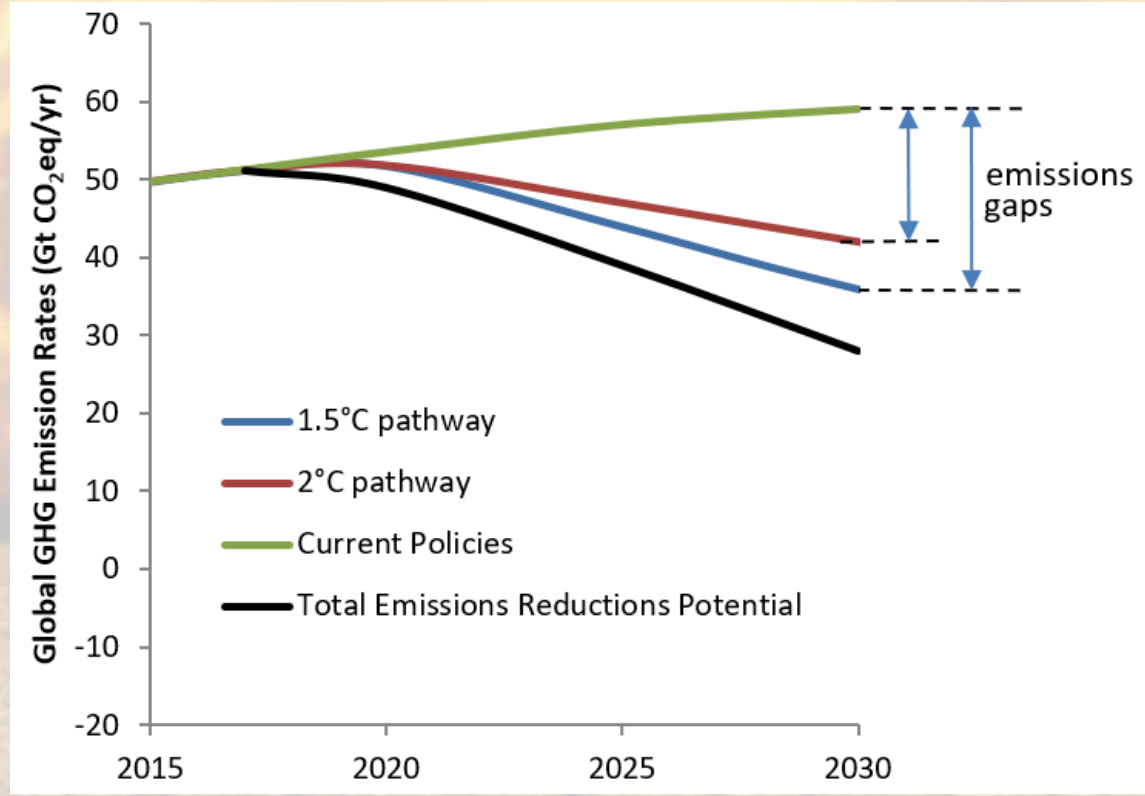
# UNEP Estimates for Year 2030 Emissions Reduction Potential by Sector

## (Year 2030 Carbon Price of $100 US/mt)



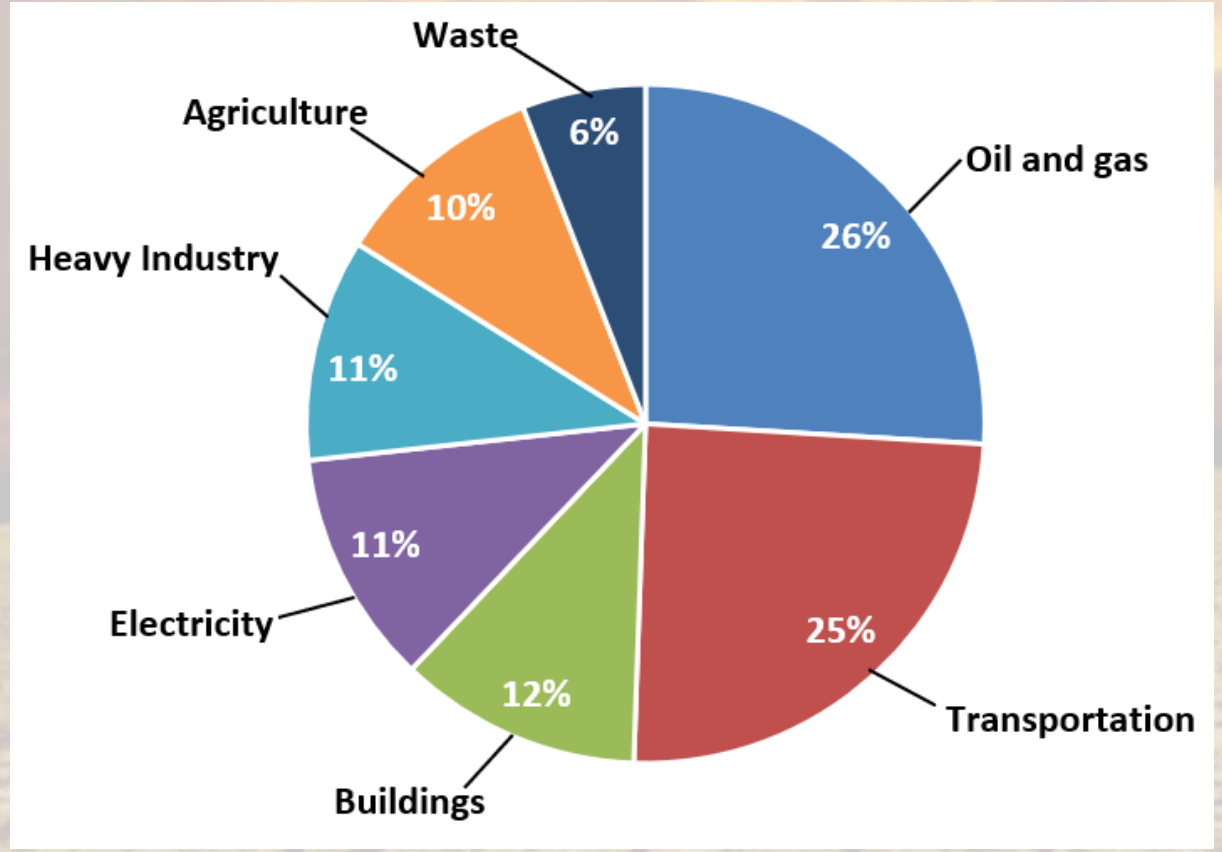



# Canada:
# Greenhouse Gas Emissions and Climate Action Plans- Our contribution to the Global Effort

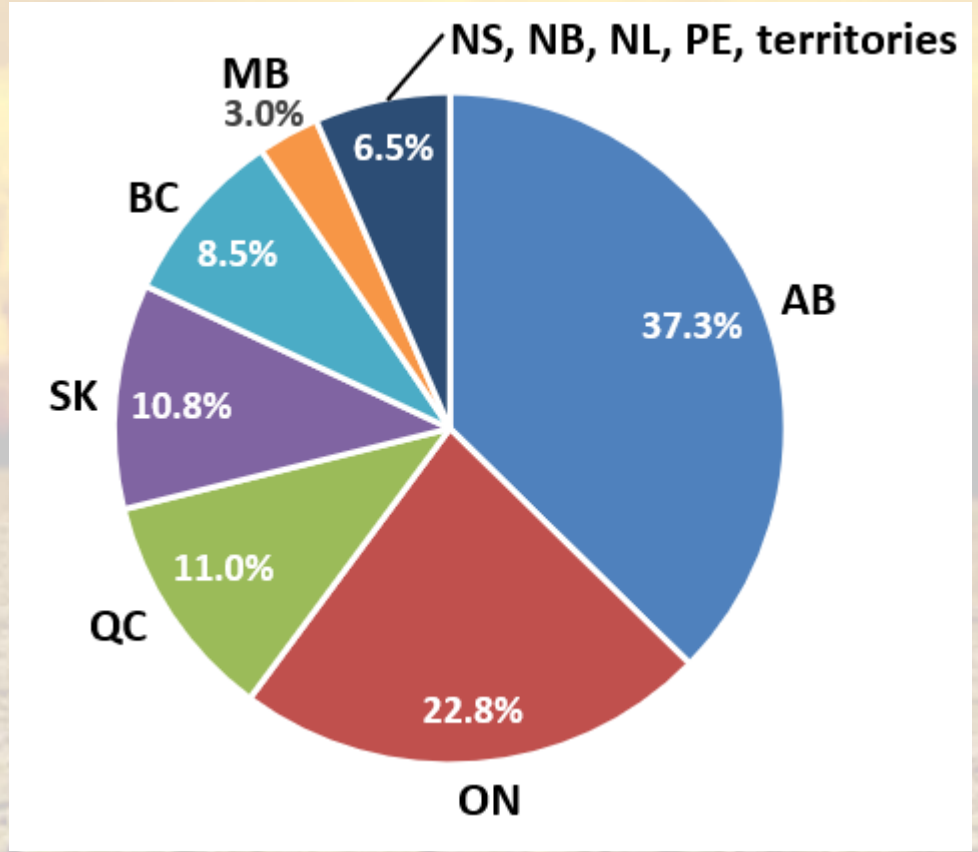
# Breakdown of 2016 GHG Emissions from Canada

## (Total = 704 Mmt $CO_2$ eq) (1.6% of global emissions)

### GHG Emissions By Sector




### GHG Emissions By Province



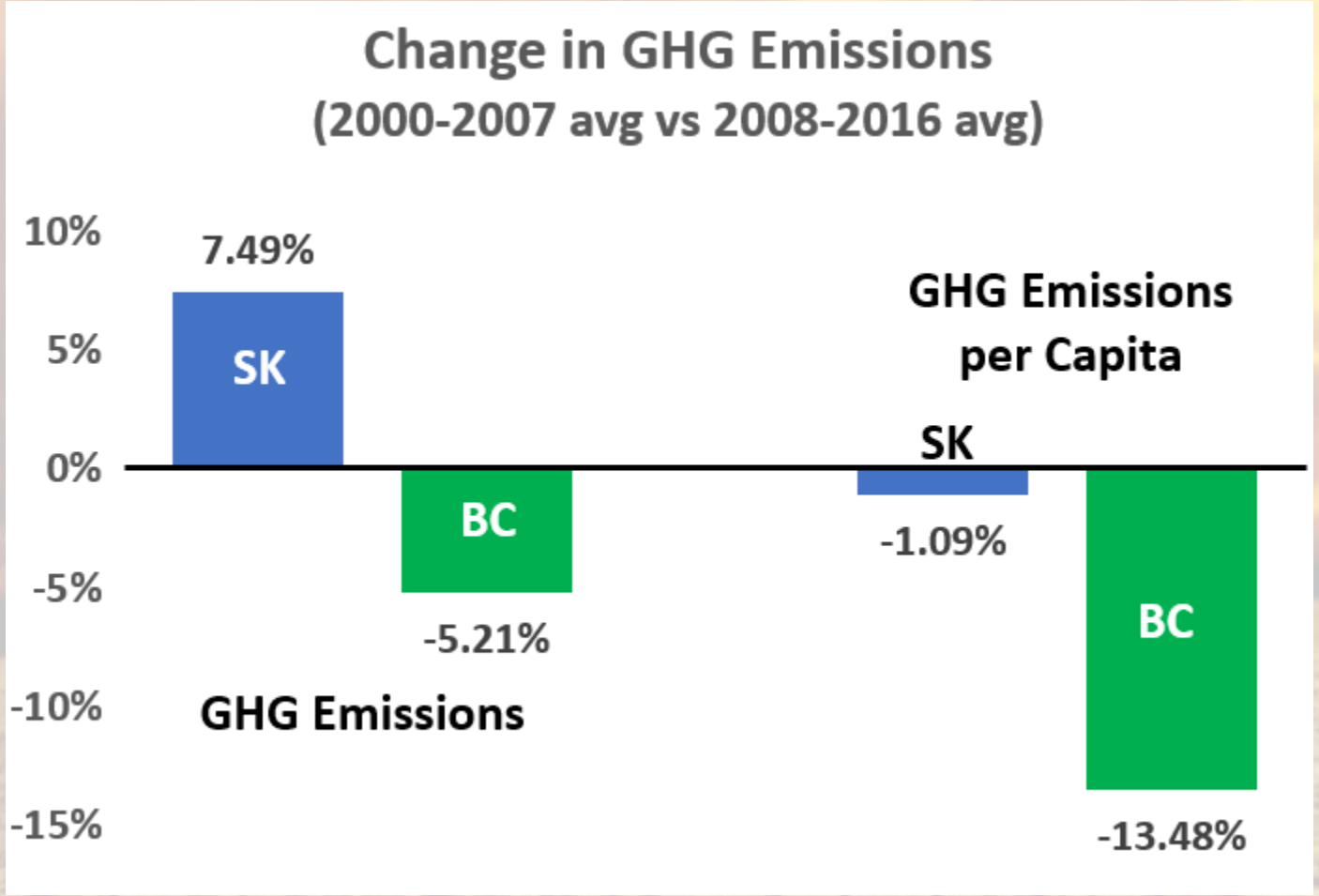
# Pan-Canadian Framework on Clean Growth and Climate Change

- Set of minimal standards for carbon pricing and policies that must be implemented within provincial climate action plans or these will be imposed by the federal government.
- Bench mark minimum carbon pricing of $10/mt (or equivalent) to be in place within each province by 2018 and to increase by $10/mt on annual basis to $50 by 2022.
- Phase out of coal-fired power plants by 2030.
- Reduce methane emissions from the oil and gas sector by 40-45% by 2025.

# The Role of the PCF in Meeting Canada's Commitment Under the Paris Agreement

- Canada's climate action plan is based on provincial cooperation and recognition of responsibility to contribute to the national effort.
- A comparison of climate policies and GHG emissions in BC and Saskatchewan over the past 18 years illustrates the need for the PCF as a stopgap measure to ensure provincial compliance.

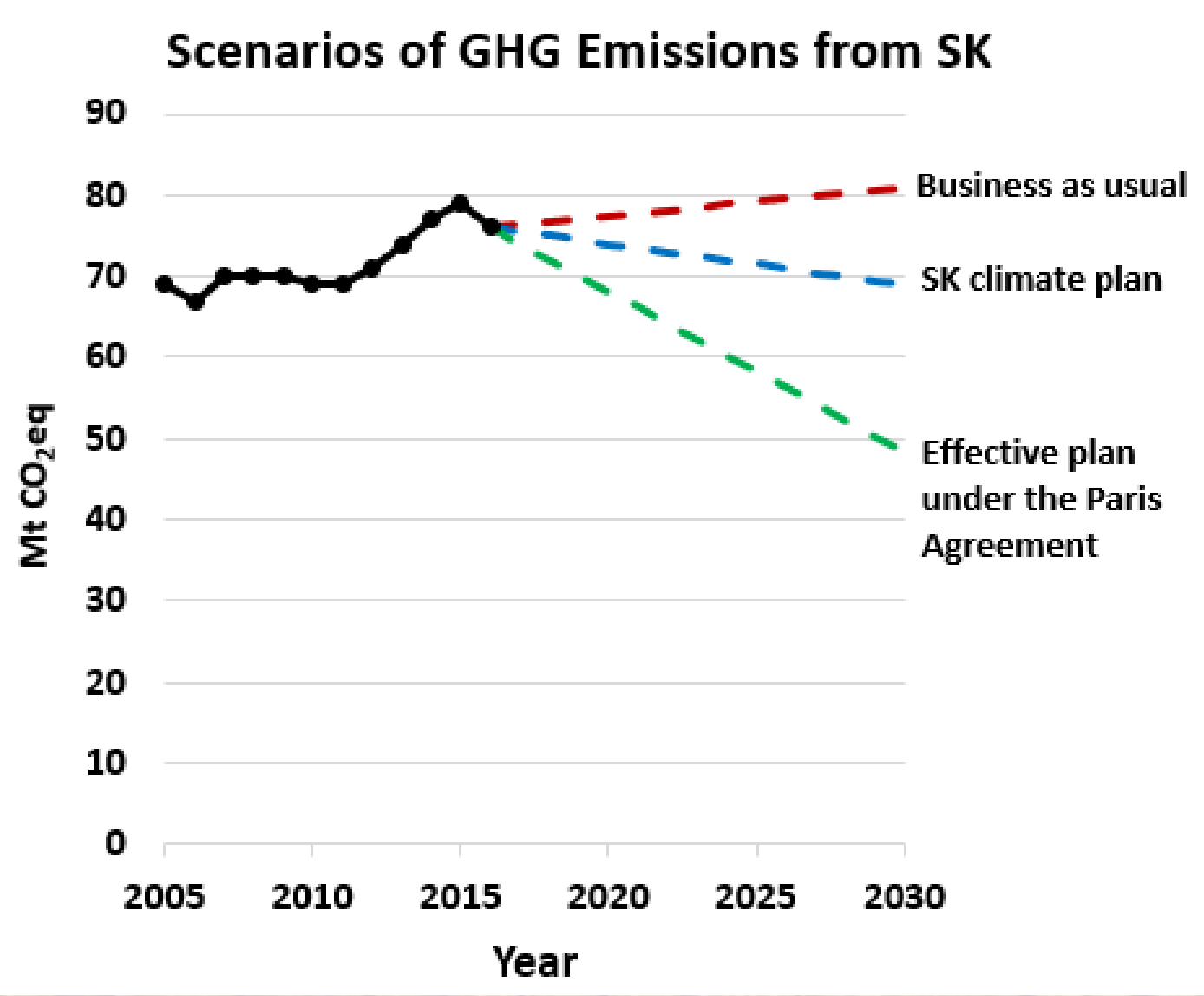
# Comparison of Emissions and Climate Action Plans of BC and SK Since 2008




- **BC Carbon Tax introduced in 2008**
  - Covers 70% of emissions
  - Current rate = $35 per mt $CO_2$
  - Tax to increase by $5 annually
  - Provincial climate action plan is compliant with the PCF.
- **SK - no carbon pricing or meaningful climate action plan up to 2018**
- **GDP growth (2000-2007 to 2008-2016)**
  - SK = 20.8%
  - BC = 20.5%
- **GHG emissions per capita in 2016**
  - SK = 66.9 mt $CO_2$eq/person
  - BC = 12.6 mt $CO_2$eq/person

# Prairie Reliance: Saskatchewan's Climate Action Plan

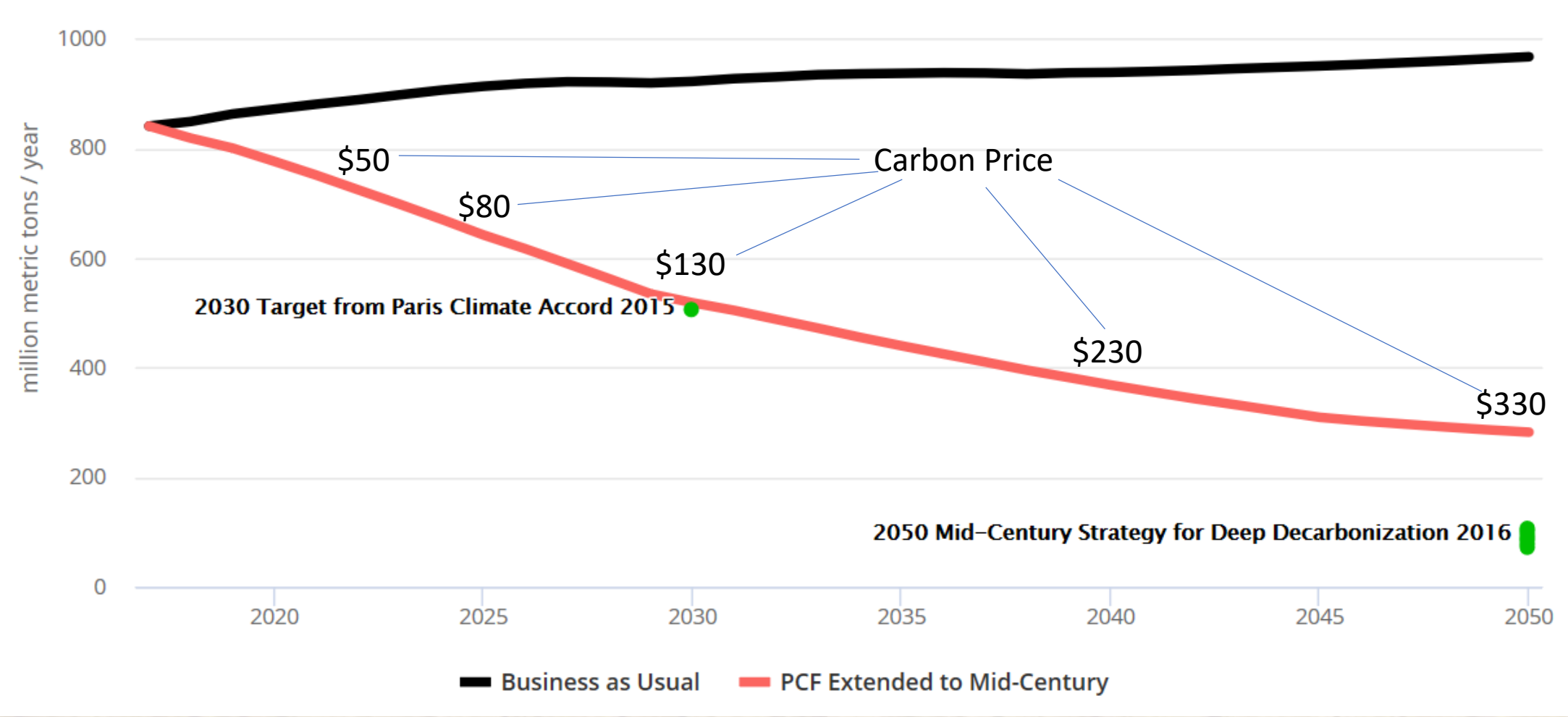
(yet to be implemented)



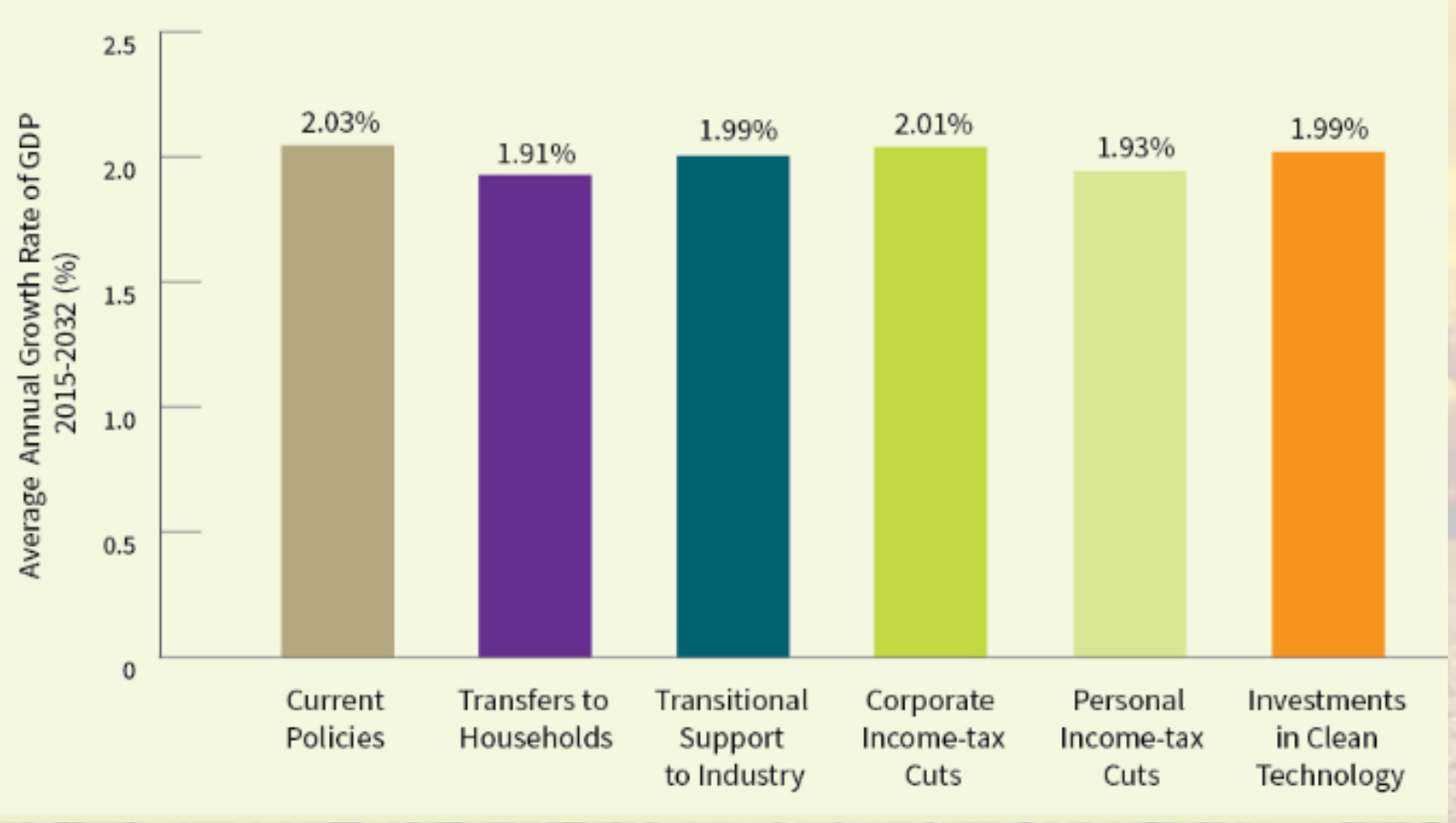

- **No economy wide carbon pricing.**
- **Does not comply with the PCF.**
- **No emissions reduction targets.**
  - Actions are focused on increased grid penetration by renewables and methane reduction from the oil and gas sector.
- **Emissions projections for 2030 under the SK plan are similar to 2005 levels.**

# Pembina Institute Model of Emissions Under the PCF

(Assumes extension of carbon pricing and other policies to 2050)



# Canada's Ecofiscal Commission Study on the Costs of Carbon Pricing in Canada

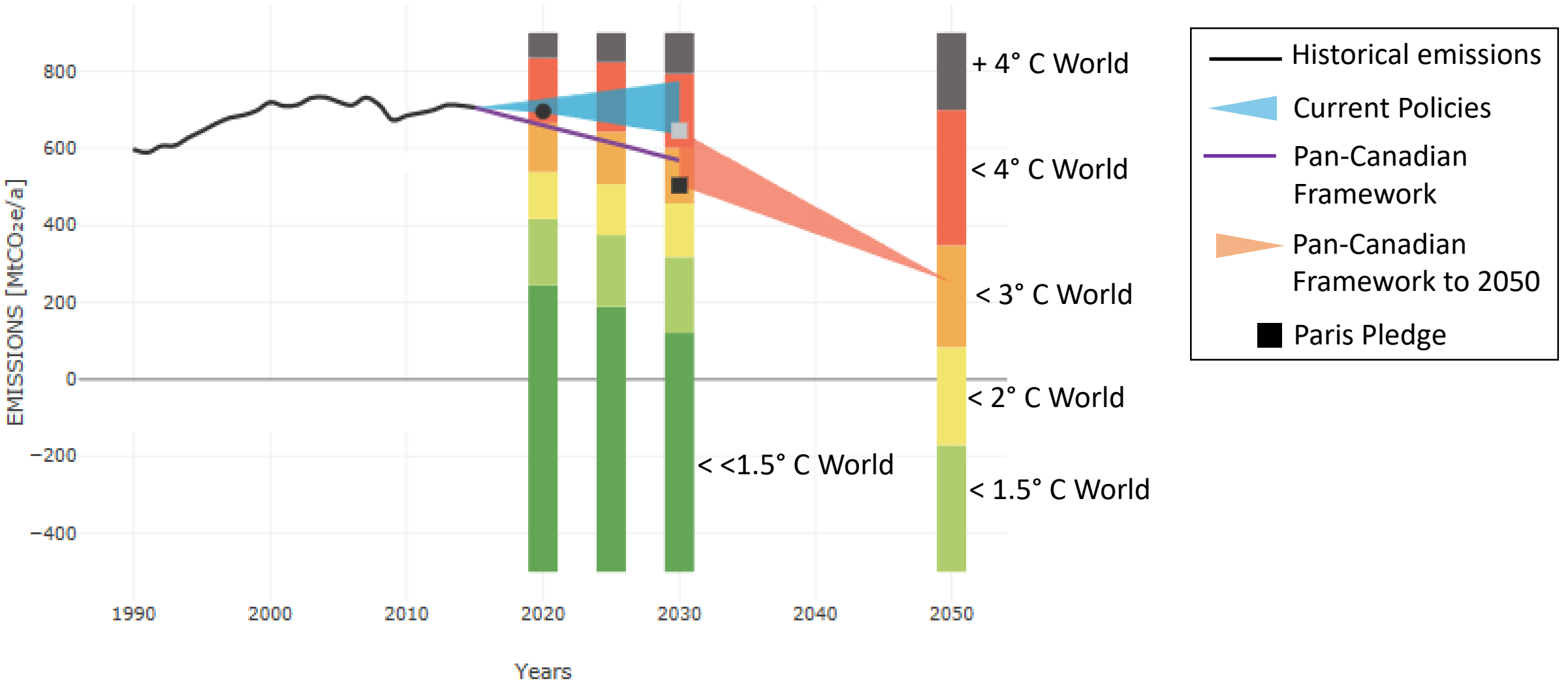



- **All scenarios assume a carbon fee starting at $30/mt advancing to $100 by 2027.**
  - Costs are projected by effects on GDP growth rates between 2015 to 2032.
- **Each scenario differs by method of recycling of carbon fee revenues back to the economy.**
- **Costs are very low regardless of method of revenue recycling.**
  - Costs are within the margin of error of the study.

# Canada's Ecofiscal Commission Study on the Costs of Carbon Pricing in Canada

- In the absence of carbon pricing, the policy framework to achieve a 30-40% cut in emissions by 2030 is a complex, costly mixture of specific regulations that do not access the efficiencies of the market place.
- The cost advantages of carbon pricing are enormous. The Ecofiscal Commission estimates that with carbon pricing, Canada GDP would be 3.8% higher in comparison to a regulatory approach to achieve similar results in controlling emissions.

# Climate Action Tracker Assessment of Canada's Contribution to the Global Effort



# Climate Action Tracker Global Ratings

| CRITICALLY INSUFFICIENT | HIGHLY INSUFFICIENT | INSUFFICIENT | 2°C COMPATIBLE | 1.5°C PARIS AGREEMENT COMPATIBLE | ROLE MODEL |
|---|---|---|---|---|---|
| *4°C+ WORLD* | *< 4°C WORLD* | *< 3°C WORLD* | *< 2°C WORLD* | *< 1.5°C WORLD* | *<< 1.5°C WORLD* |
| RUSSIAN FEDERATION | ARGENTINA | AUSTRALIA | BHUTAN | MOROCCO | |
| SAUDI ARABIA | CANADA | BRAZIL | COSTA RICA | THE GAMBIA | |
| TURKEY | CHILE | EU | ETHIOPIA | | |
| USA | CHINA | KAZAKHSTAN | INDIA | | |
| UKRAINE | INDONESIA | MEXICO | PHILIPPINES | | |
| | JAPAN | NEW ZEALAND | | | |
| | SINGAPORE | NORWAY | | | |
| | SOUTH AFRICA | PERU | | | |
| | SOUTH KOREA | SWITZERLAND | | | |
| | | UAE | | | |

# Summary and Take Home Messages

1. Anthropogenic climate change is real and a failure of our generation to cut emissions and establish pathways of progressive decarbonization of practices will have devasting, costly impacts on future generations.

    - Costs of current practices extend beyond future climate change damage and include substantial present day costs associated with air pollution from combustion of fossil fuels.

# Summary and Take Home Messages

2. Globally, a scenario based on current policies will result in 3-4°C in surface warming at a future cost of 25-35% of global GDP.

3. All countries, including Canada, must up the level of ambition to combat climate change. The return on investment based on avoidance of future damage is immense and clearly justifies the adoption of policies designed to achieve the objectives of the Paris Agreement.

# Summary and Take Home Messages

4. In Canada, implementation of the PCF (either within provincial climate action plans or by imposition of federal policies) is required if we are to meet our international obligations under the Paris Agreement.
5. Costs of well-designed climate action plans based on a foundation of carbon pricing mechanisms are minimal over the short-term. Higher costs come into effect as practices evolve toward deep decarbonization going forward to mid-century and beyond.

# Summary and Take Home Messages

6. Carbon pricing is the foundation of effective, cost-efficient climate plans. In the absence of carbon pricing, a pure regulatory approach will be less effective and will be costly to implement.

7. An opposition to carbon pricing is an opposition to the most cost-efficient and effective pathways of emissions reduction. **Through inaction, an opposition to carbon pricing is a form of climate change denial.**