Leap to Where?

Elements of a Canadian climate policy that could be both feasible and enough

FPA Currents Lecture
Carleton University
Ottawa, Ontario
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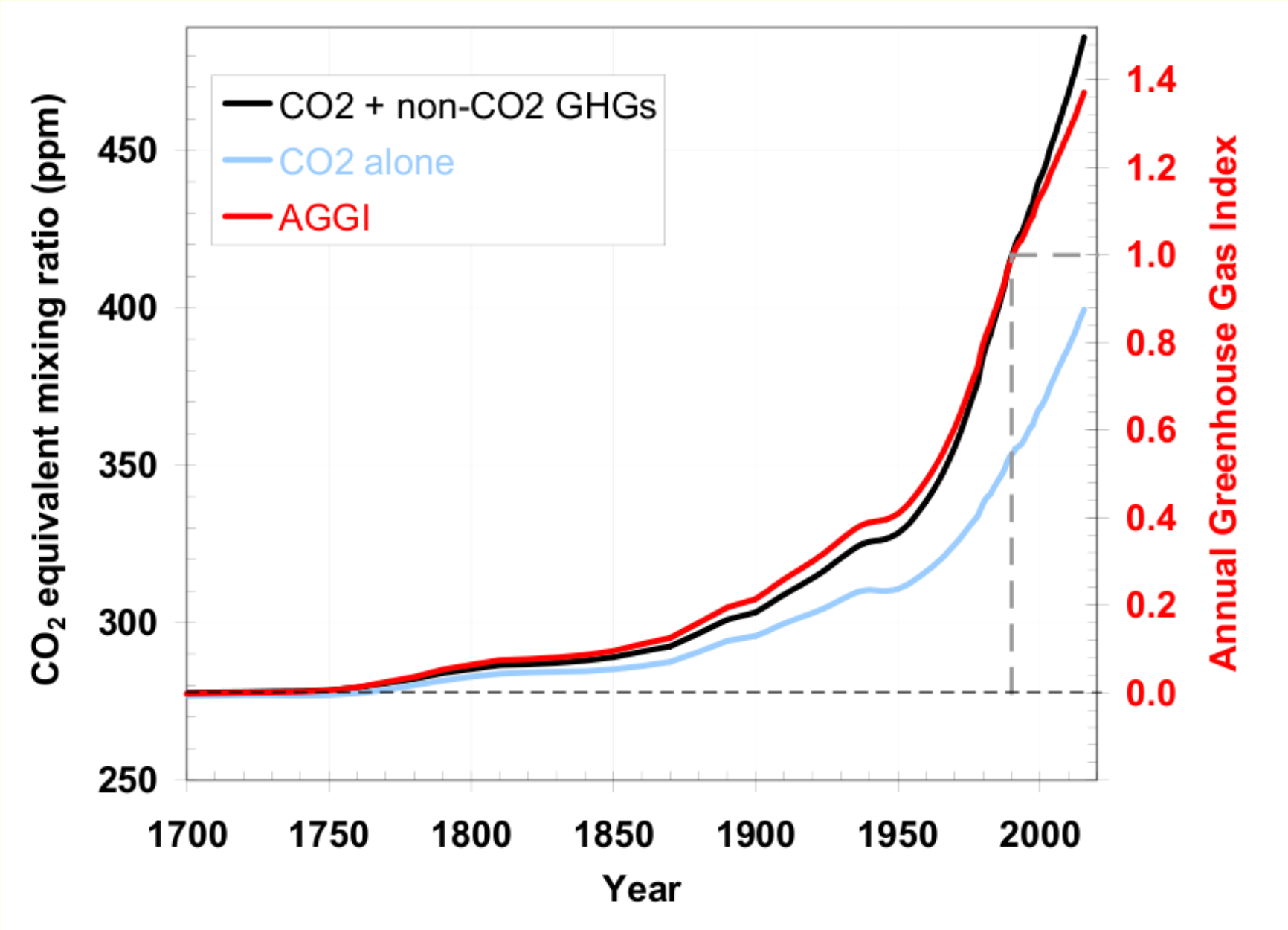
the reality of

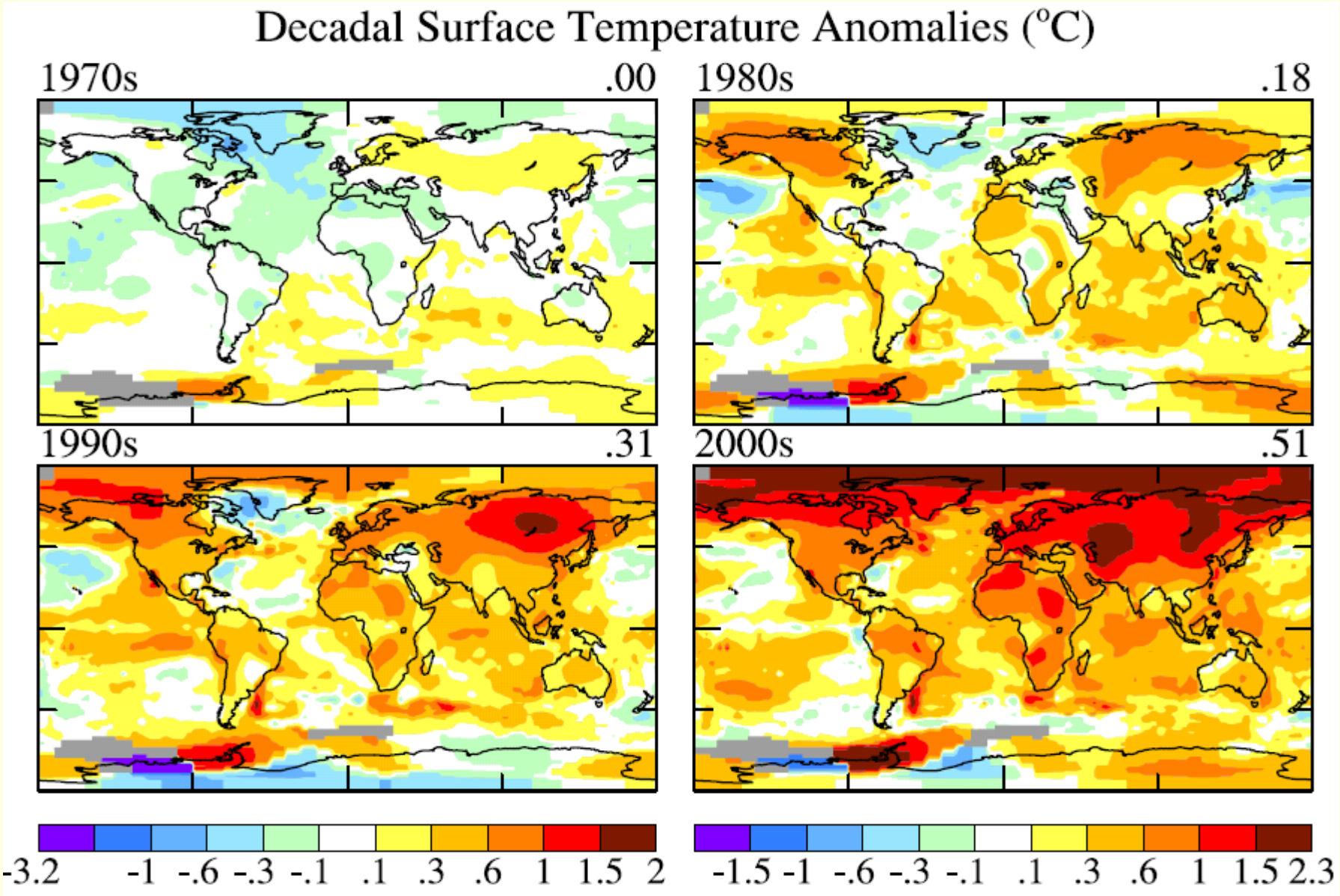
CLIMATE CHANGE

Emissions and warming trends

Past, present, and future

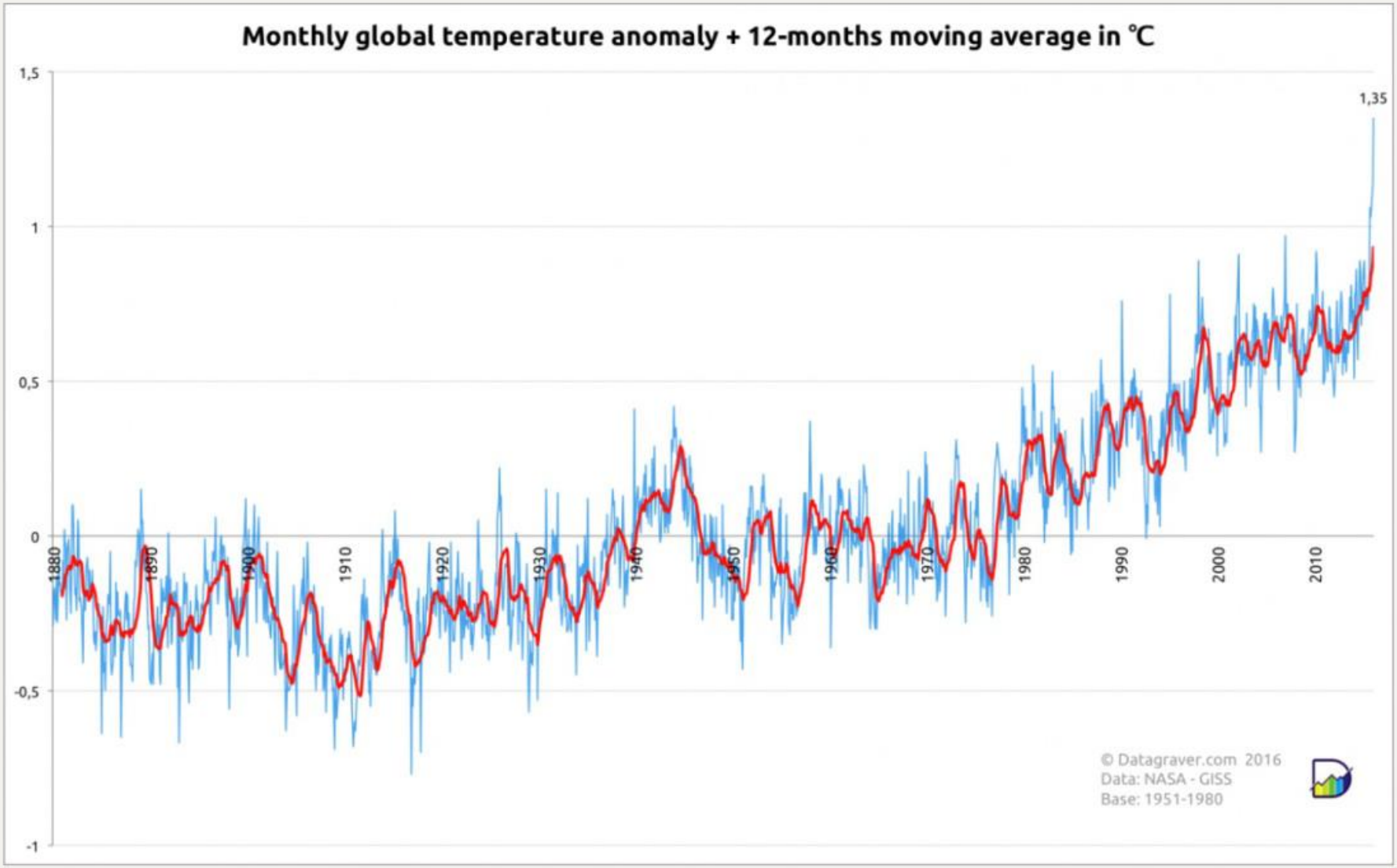


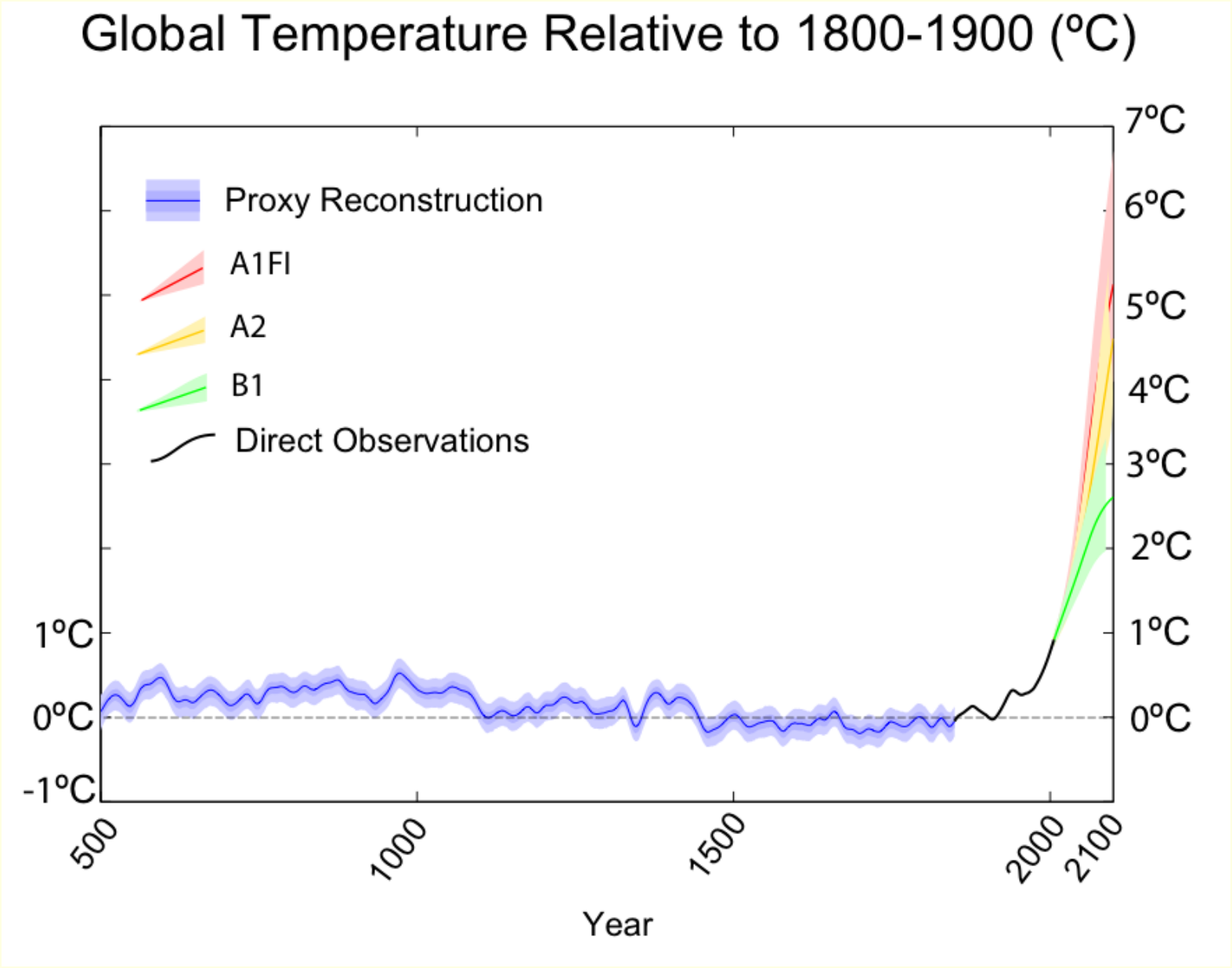
Source: NOAA, http://www.esrl.noaa.gov/gmd/aggi/



Decadal mean surface temperature anomalies relative to base period 1951-1980.

Source: update of Hansen et al., GISS analysis of surface temperature change. *J. Geophys. Res.***104**, 30997-31022, 1999.

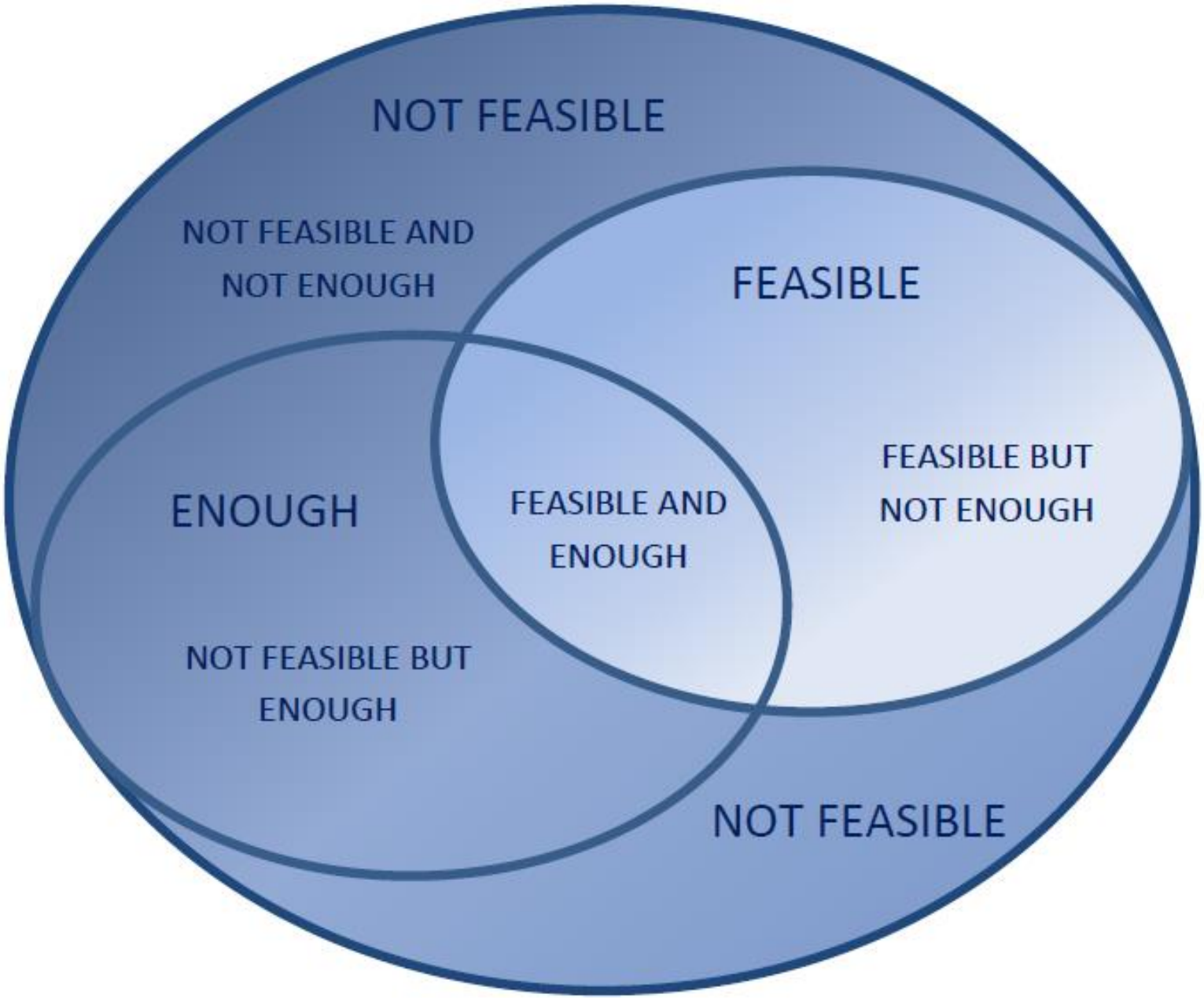

Monthly global temperature anomaly + 12-months moving average in °C
1,5
1
0,5
0
-0,5
-1
1,35
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
© Datagraver.com 2016
Data: NASA - GISS
Base: 1951-1980



Source: Copenhagen Diagnosis, 2009

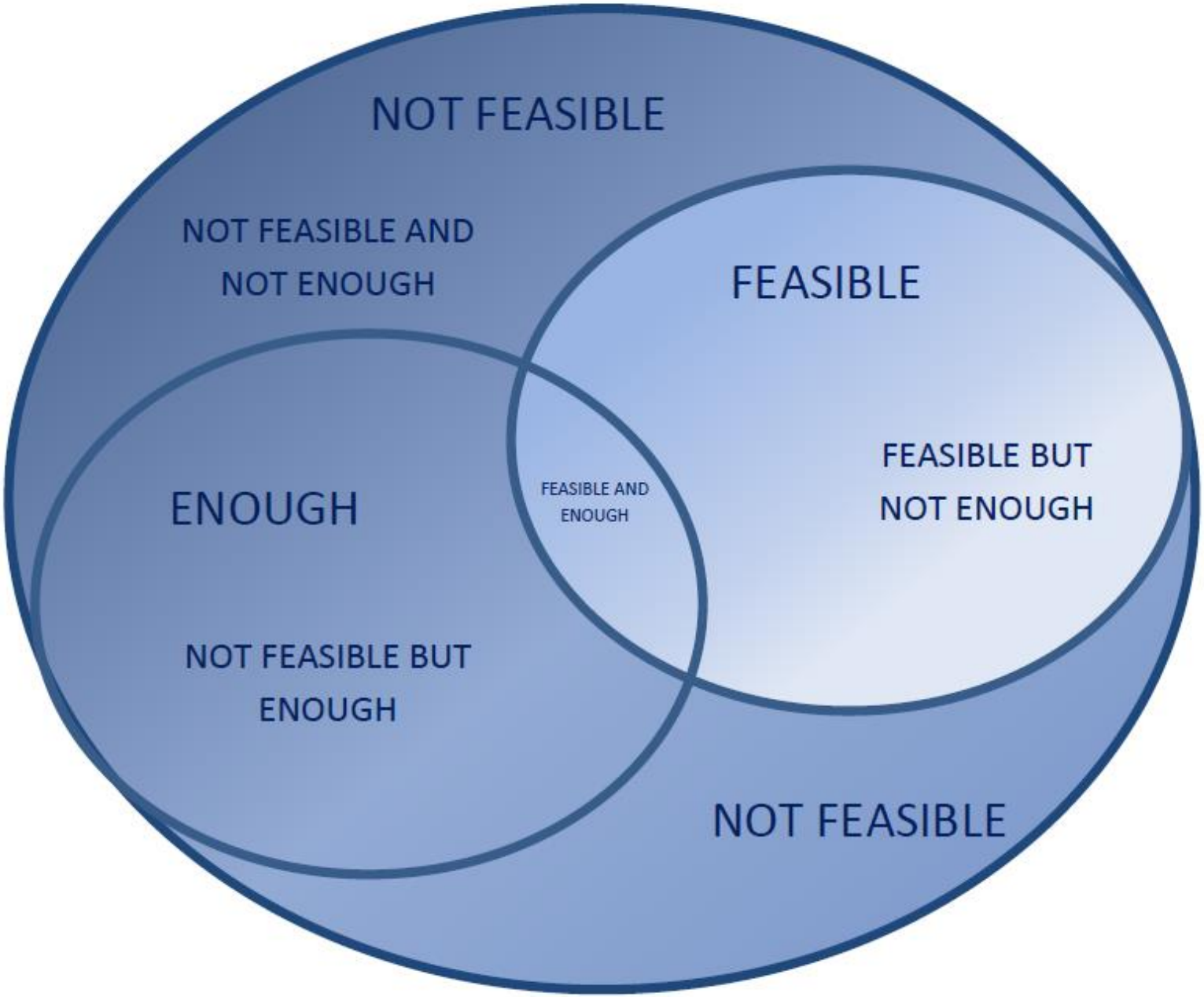
Consequences for Canada

What can be done?
The feasible-enough conundrum


NOT FEASIBLE
NOT FEASIBLE AND
NOT ENOUGH
FEASIBLE
ENOUGH
FEASIBLE AND
ENOUGH
FEASIBLE BUT
NOT ENOUGH
NOT FEASIBLE BUT
ENOUGH
NOT FEASIBLE

“The longer we wait for effective climate policy, the more severe and the more traumatic will be the emissions reductions in the future.”

Ottmar Edenhofer, chief economist at the Potsdam Institute for Climate Change Research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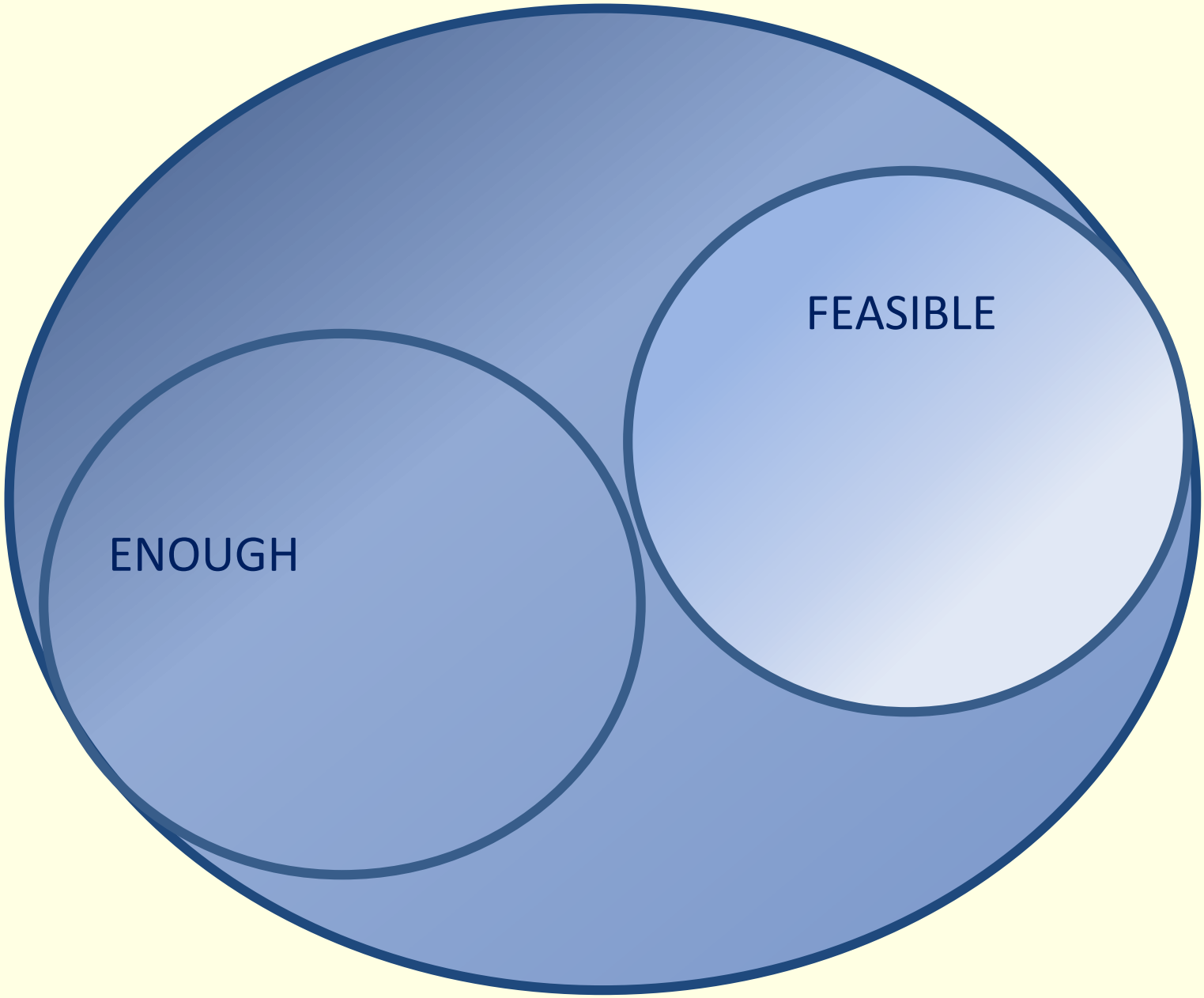
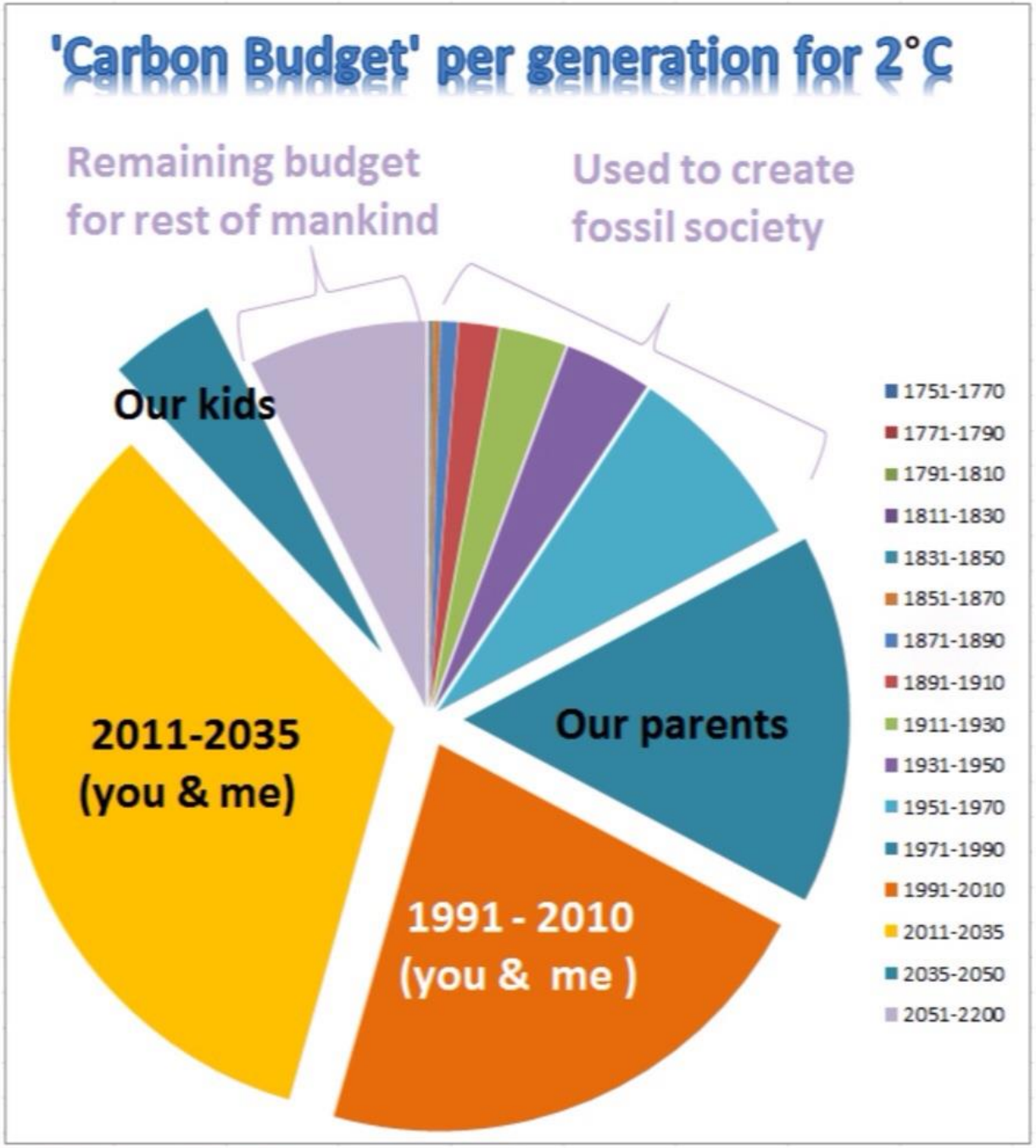

FEASIBLE
ENOUGH

What is the world doing?

2°

“The [Intended Nationally Determined Contributions] have the capability of limiting the forecast temperature rise to around 2.7C by 2100, by no means enough but a lot lower than the estimated four, five, or more degrees of warming projected by many prior to the INDCs.”

Christiana Figueres, executive director of the UN Framework Convention on Climate Change, October 30, 2015


'Carbon Budget' per generation for 2°C
Remaining budget for rest of mankind
Used to create fossil society
Our kids
2011-2035 (you & me)
1991 - 2010 (you & me)
Our parents
1751-1770
1771-1790
1791-1810
1811-1830
1831-1850
1851-1870
1871-1890
1891-1910
1911-1930
1931-1950
1951-1970
1971-1990
1991-2010
2011-2035
2035-2050
2051-2200
@LarsBoelen - stormglas.wordpress.com

What is Canada doing?

Does Canada’s current climate policy make sense?

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- Massive economic, political, and social commitment to carbon-based resource extraction

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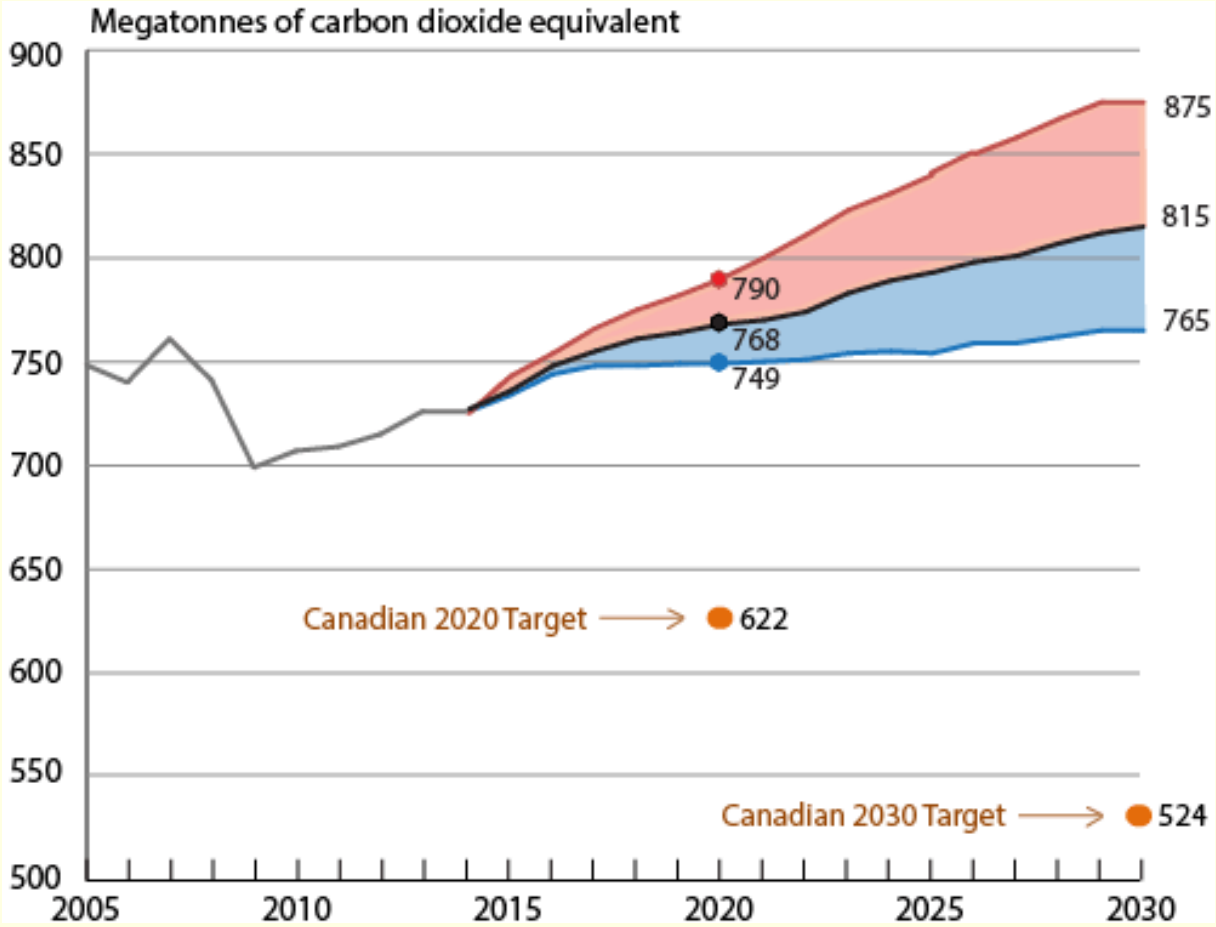
- Emerging federal policy on reducing carbon emissions

Does Canada's current climate policy make sense?

- Massive economic, political, and social commitment to carbon-based resource extraction
- Emerging federal policy on reducing carbon emissions
- Patchwork of often incompatible provincial climate policies

Canada's current and projected emissions and targets



"Oil and gas prices and economic growth are key drivers of GHG emissions trends in Canada. Because these drivers can be quite volatile, sensitivity analysis is presented through alternative scenarios (low and high), reflecting different assumptions about oil and natural gas prices and production as well as different rates of economic growth." Environment and Climate Change Canada.

“According to [a Parliamentary Budget Office report issued on April 21, 2016], if Canada does hit the emissions targets it's aiming for right now, household incomes and Canada's gross domestic product would be affected, though the economic pain would not be ‘substantial.’

The report concluded that to meet Canada's international target of 30 per cent reduction in GHGs by 2030, Canada will have to bring its emissions down by 208 million tons.

This is equivalent to taking more than all the gasoline and diesel-powered cars and trucks in the country — including off-road vehicles — off the road.”

www.cbc.ca, April 22, 2016

TABLE A6: OIL AND GAS SECTOR: EMISSIONS BY PRODUCTION TYPE (MT CO_2 EQ)

	2005	2013	2020	2030	Change 2005 to 2020	Change 2005 to 2030
Natural Gas Production and Processing	58	54	55	60	-3	1
Conventional Oil Production	31	33	32	32	1	1
Light Oil Production	12	15	16	18	4	5
Heavy Oil Production	17	16	14	13	-3	-4
Frontier Oil Production	2	2	3	2	1	0
Oil Sands	32	62	90	116	58	84
Bitumen In Situ	10	27	45	67	35	57
Bitumen Mining	10	16	24	26	14	16
Bitumen Upgrading	13	18	22	23	9	10
Oil and Natural Gas Transmission	12	8	9	10	-3	-2
Downstream Oil and Gas	23	23	22	20	-2	-3
Petroleum Products	22	22	21	19	-2	-3
Natural Gas Distribution	1	1	1	2	0	0
Liquid Natural Gas Production	0	0	1	4	1	4
Total	**157**	**179**	**210**	**242**	**54**	**85**

Note: Numbers may not sum to the total due to rounding.

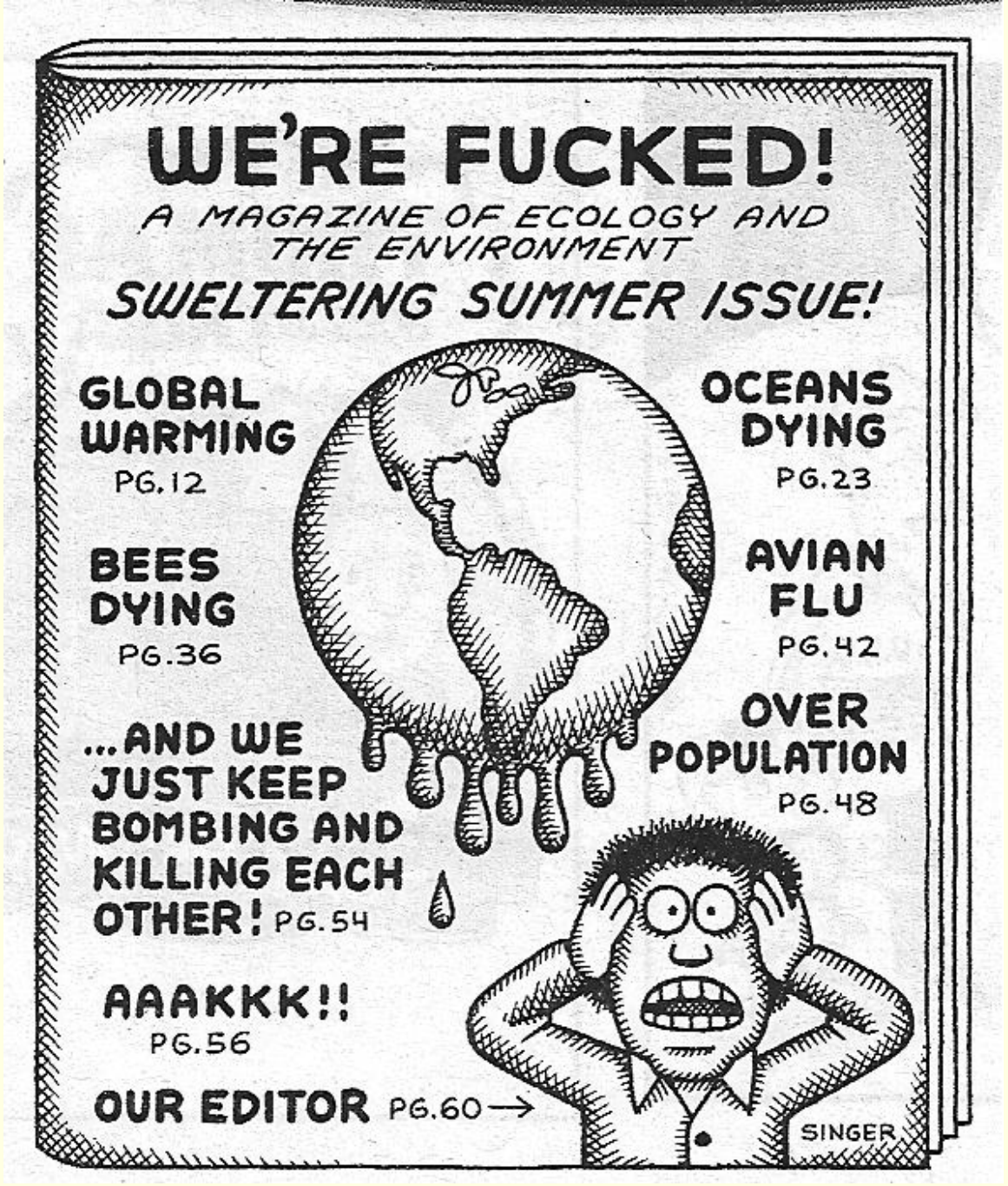
Graph from the Second Biennial Report on Climate Change. Graph courtesy of Environment Canada

Does Canada's current climate policy make sense?

NO

So what should Canada do?

ONE POSSIBLE RESPONSE:



Key issues
(focus on emissions)

1. Market mechanisms, carbon pricing

2. Regulations

3. Oil sands (including market access)

4. New technologies

5. Affordability

GET READY FOR A GPT TRANSITION
GPT = General Purpose Technology

Railroads

Electricity

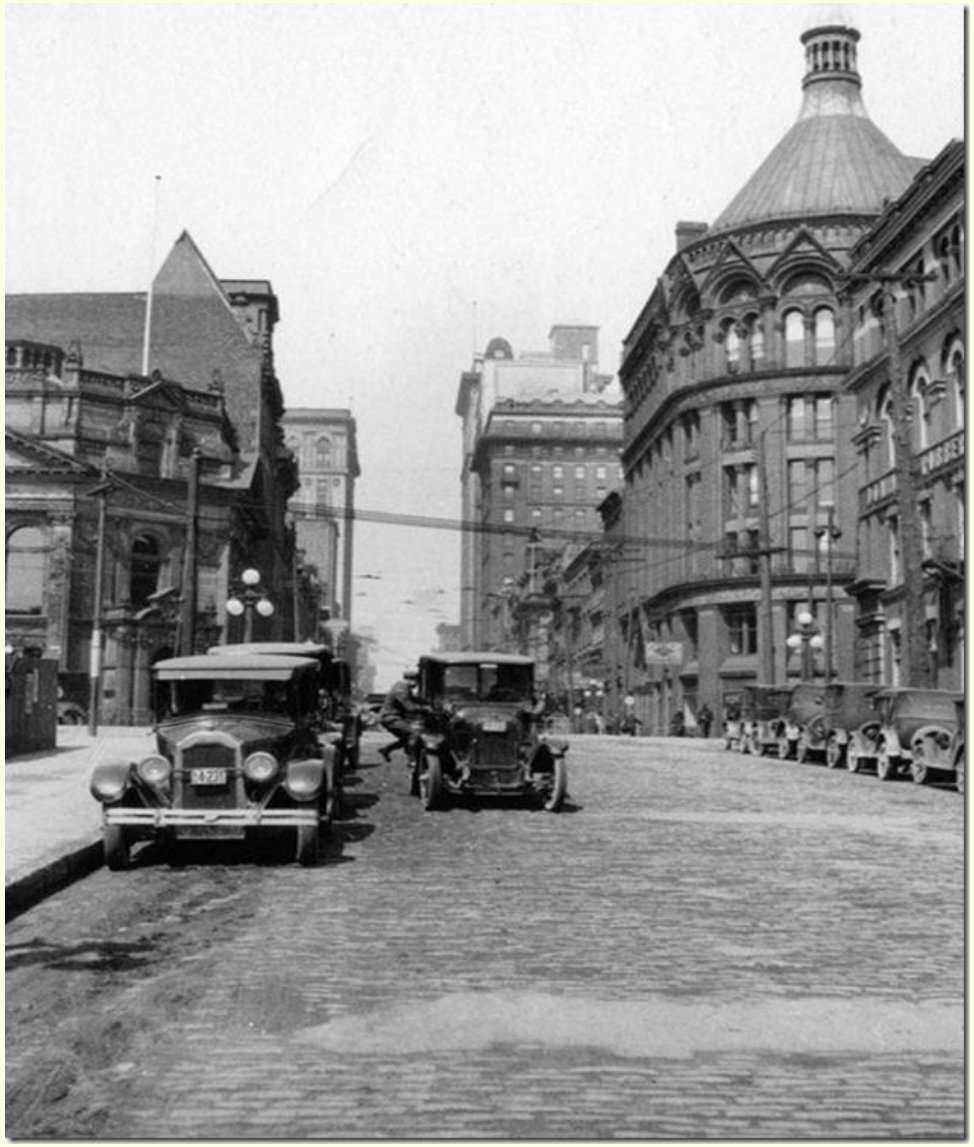
Internal combustion engine

Personal computer

“Green” energy technologies?

And it can happen faster than widely assumed. From this . . .

. . . to this, in a few decades



But we must price CARBON

EXTREME EVENTS

AND IMPACTS ON GLOBAL FOOD PRODUCTION

WILL DRIVE WORLD RESPONSE TO CLIMATE CHANGE

WE CAN EXPECT A GLOBAL CARBON PRICE BY 2030


What about this?


6+ MILLION BARRELS OF
OUTPUT PER DAY BY
2030

We can’t turn this sow’s ear
into a
silk purse


Worth1000.com

We can’t turn this sow’s ear into a silk purse

WHY?

We can't turn this sow's ear into a silk purse

WHY?

1. Bitumen is junk energy

We can't turn this sow's ear into a silk purse

WHY?

1. Bitumen is junk energy

2. Its product is burned in a distributed transportation system

Decarbonization:
Close to a Global Flip?

Three interacting trends

1. Political mobilization around issue

2. Renewables rapid price decline

3. Financial market pressures

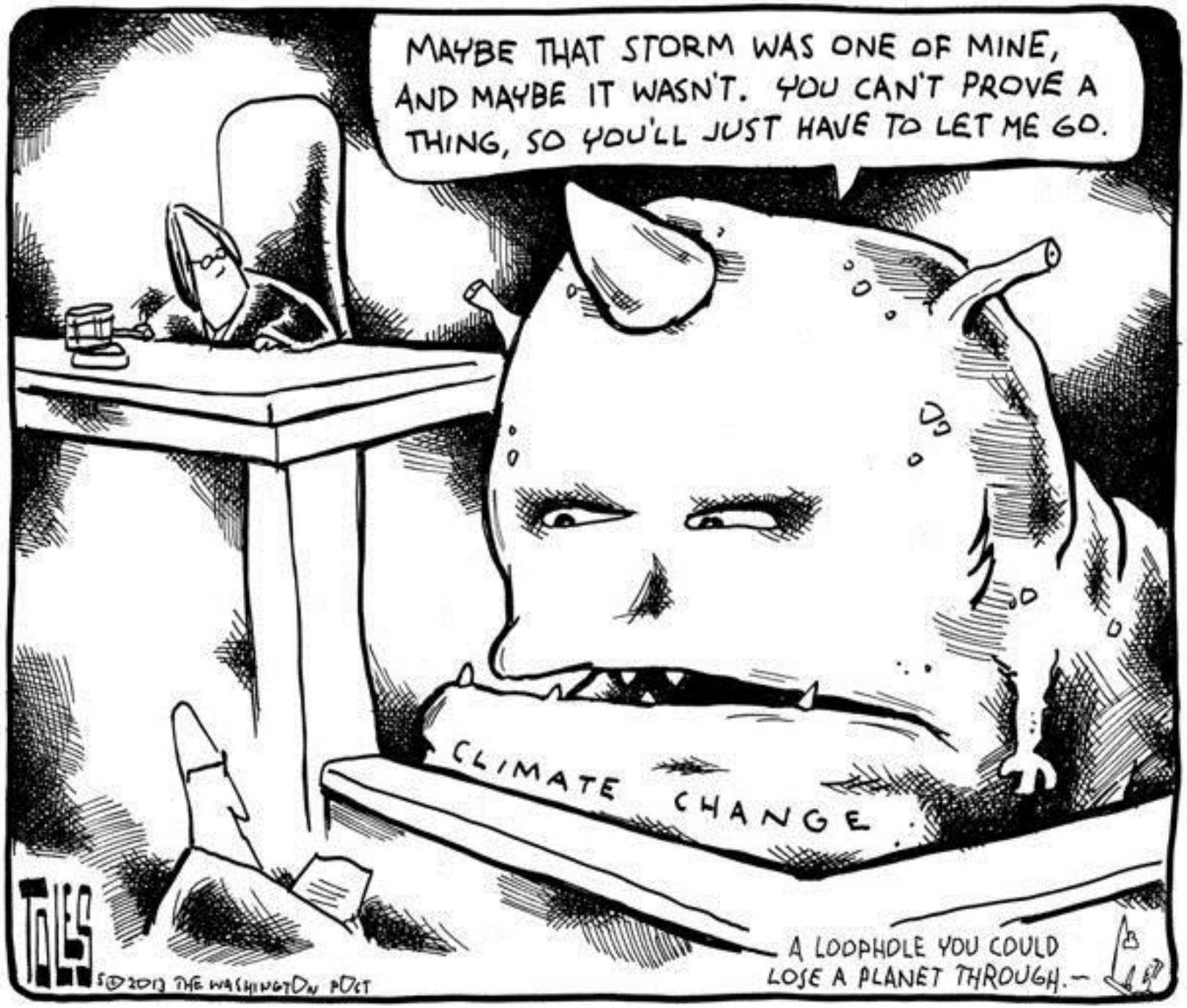
Financial system pressures: the wild card

Fiduciary responsibility
(pension funds, mutual funds, public corporations)

1. Climate-damage risk

2. Carbon-pricing risk (stranded carbon)

3. Attribution and liability


MAYBE THAT STORM WAS ONE OF MINE, AND MAYBE IT WASN'T. YOU CAN'T PROVE A THING, SO YOU'LL JUST HAVE TO LET ME GO.
CLIMATE CHANGE
TOLES
©2013 THE WASHINGTON POST
A LOOPHOLE YOU COULD LOSE A PLANET THROUGH.—

Two big issues

Can “proximate solar” renewables do the job by themselves?

What is the role of conventional nuclear power?

Two big issues

Can “proximate solar” renewables do the job by themselves?

No, because of intermittency and low power-density

What is the role of conventional nuclear power?

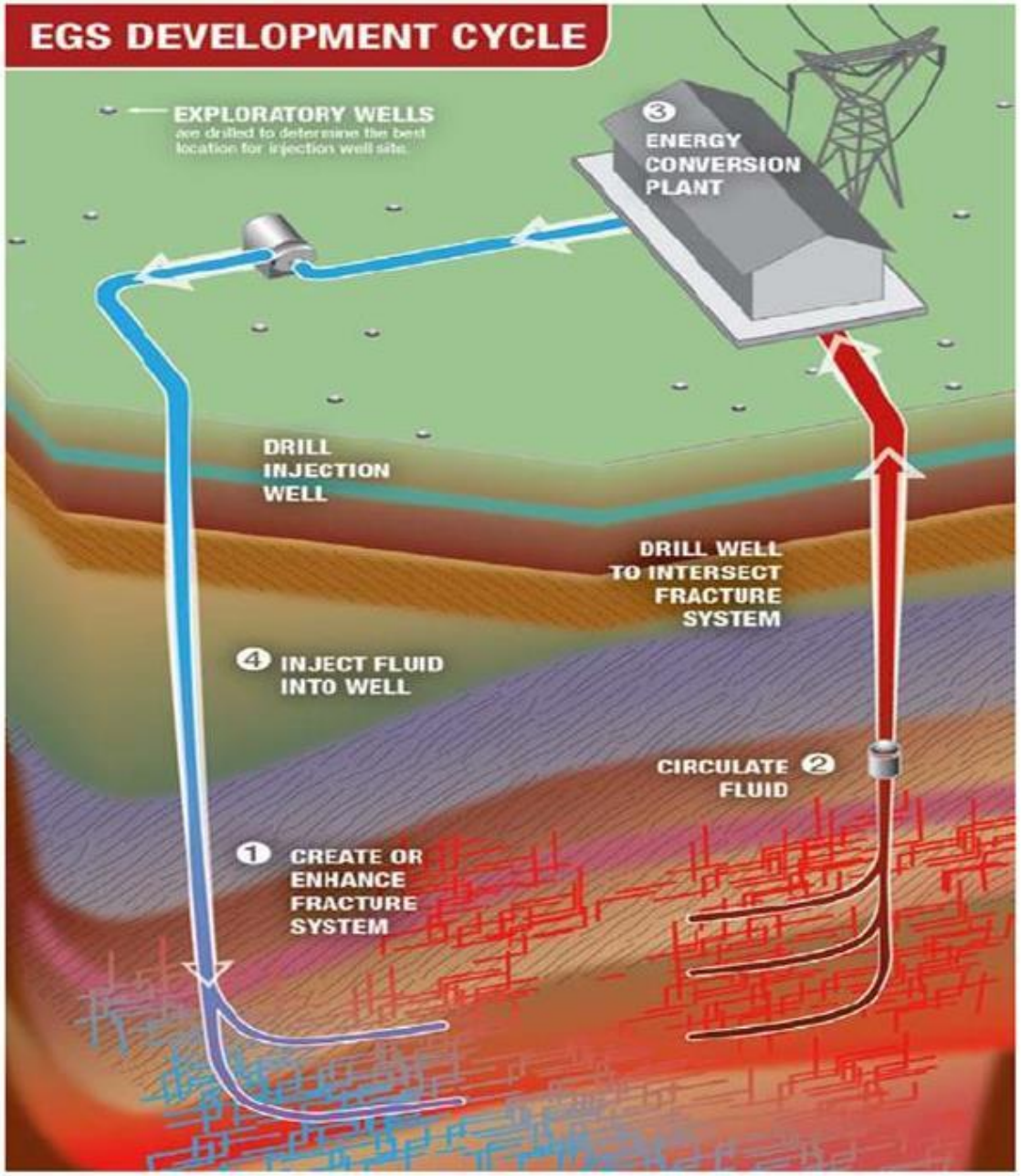
Limited, because of escalating capital costs

Unconventional technologies

Underground coal gasification (UCG)

Thorium fission

Ultra-deep (“enhanced”) geothermal power


EGS DEVELOPMENT CYCLE
EXPLORATORY WELLS
are drilled to determine the best location for injection well site.
3
ENERGY CONVERSION PLANT
DRILL INJECTION WELL
DRILL WELL TO INTERSECT FRACTURE SYSTEM
4
INJECT FLUID INTO WELL
CIRCULATE
2
FLUID
1
CREATE OR ENHANCE FRACTURE SYSTEM

Canada's comparative advantages in a zero-carbon world

(in which electricity will be the main energy carrier)

Huge hydro resources, although few large basins remain untapped, and development of most of those will be blocked for environmental reasons

Significant uranium deposits and nuclear expertise, but country's nuclear industry is wedded to an outmoded technology

Vast un-mineable coal deposits suitable for UCG with carbon sequestration

Enormous experience poking deep holes in the ground

What might Canada's zero-carbon energy future look like?

Shift to Electricity:

- Extensive renewables: hydro, wind, and solar
- Some nuclear
- Perhaps UCG with CCS
- Smart grids, with distributed and partially autonomous supply

Focus on Innovation:

- UCG
- Ultra-deep geothermal

The transition is affordable

Global Commission on the Economy and Climate
New Climate Economy Report

"[C]ountries at all levels of income now have the opportunity to build lasting economic growth at the same time as reducing the immense risks of climate change. This is made possible by structural and technological changes unfolding in the global economy and opportunities for greater economic efficiency. The capital for the necessary investments is available, and the potential for innovation is vast."

Elements of a near-term "grand bargain"
(aka what Justin could do now)

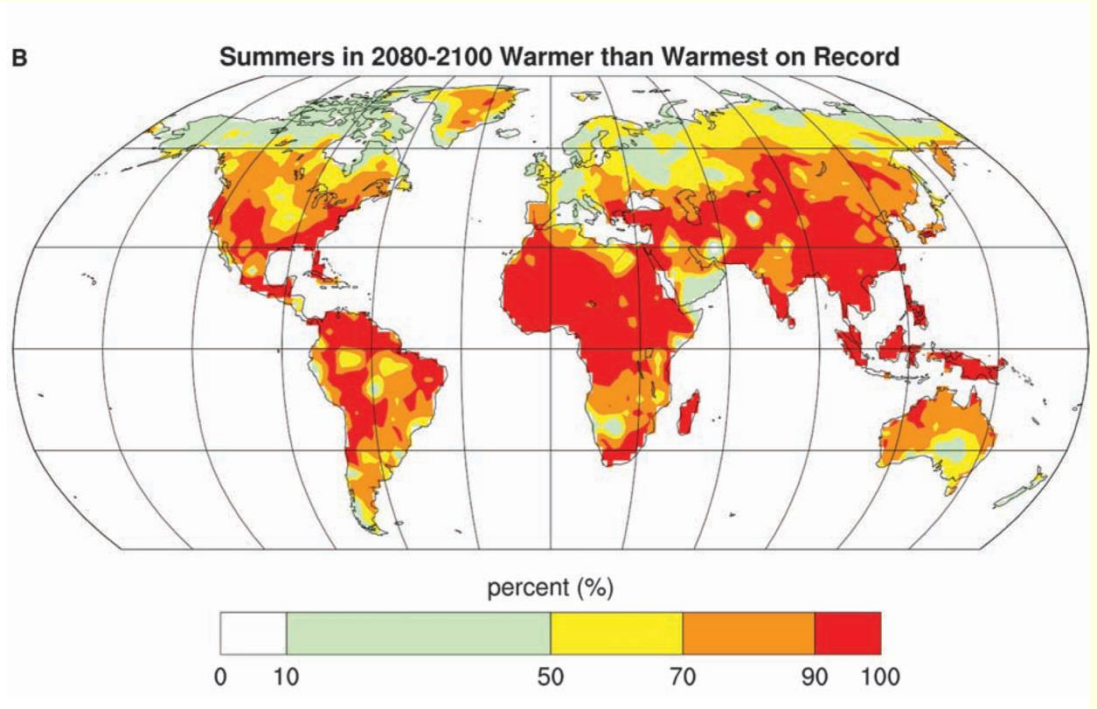
Set escalating federal carbon-tax floor

- Tracy Snoddon, CD Howe Institute: "A federal minimum price on carbon will ultimately be necessary to ensure emissions in all provinces are covered by the same carbon price."
- Will require some kind of non-discriminatory border tax adjustments

Approve Kinder Morgan Trans Mountain pipeline

Ramp up regulations and incentives

Begin massive investment in zero-carbon energy R&D


B
Summers in 2080-2100 Warmer than Warmest on Record
percent (%)
0
10
50
70
90
100