Minimizing Irreversible Impacts of Human-Made Climate Change

James Hansen

12 December 2013

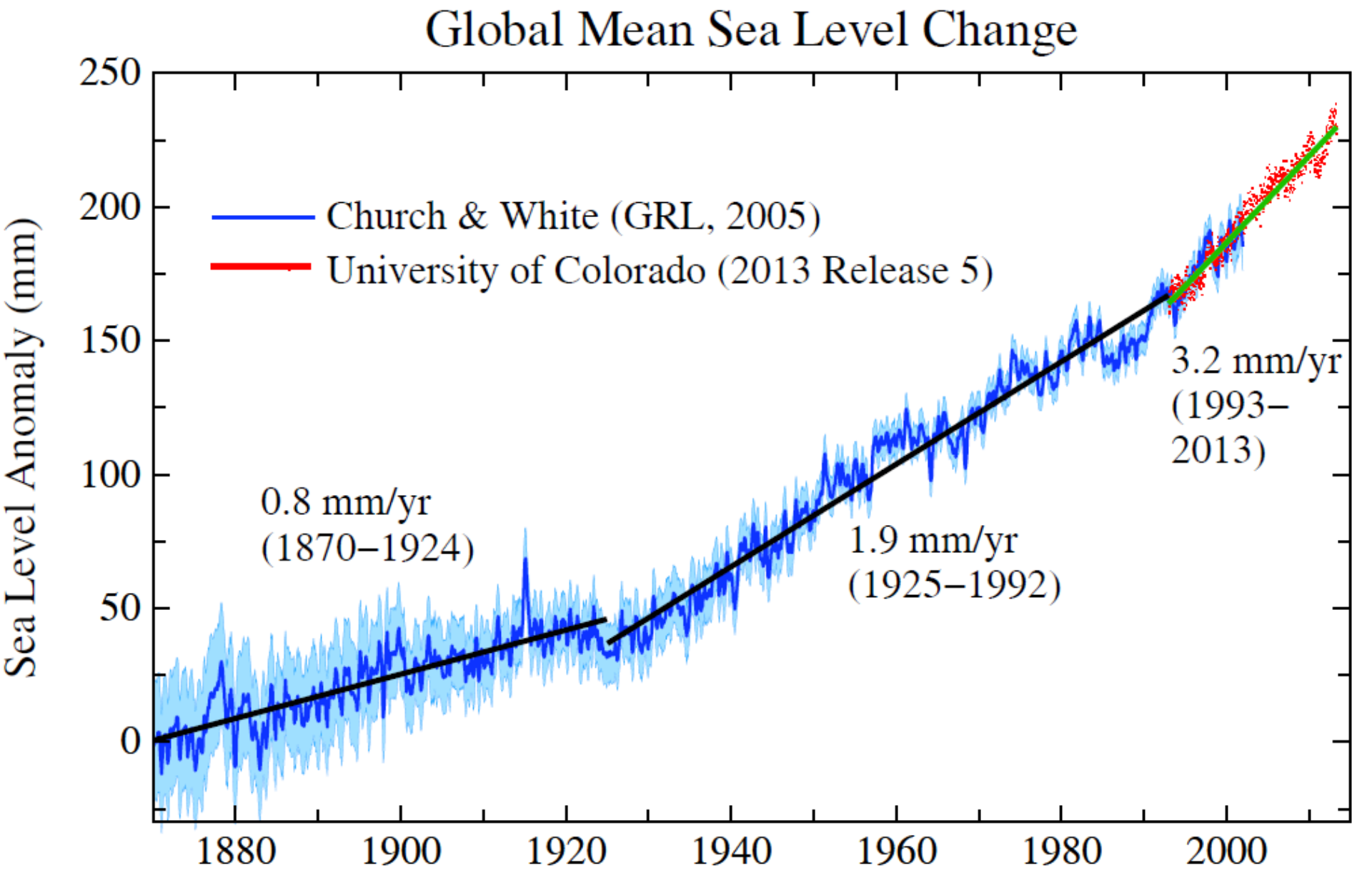
American Geophysical Union
San Francisco, CA

Climate Impacts

1. **Ice Sheet Disintegration & Sea Level**
   - Ocean Warming → Ice Shelves Melt → Ice Streams Surge → Disintegration

2. **Species Extermination**
   - Shifting Climate Zones, Multiple Stresses, Species Interdependencies

3. **Climate Extremes**
   - Heat Waves, Drought, Fires
   - Heavier Rain, Floods, Stronger Storms



Accelerating rate of sea level rise during the past century.

Paleoclimate Guidance

Eemian sea level +5-9 meters

- **Eemian temperature +2°C***

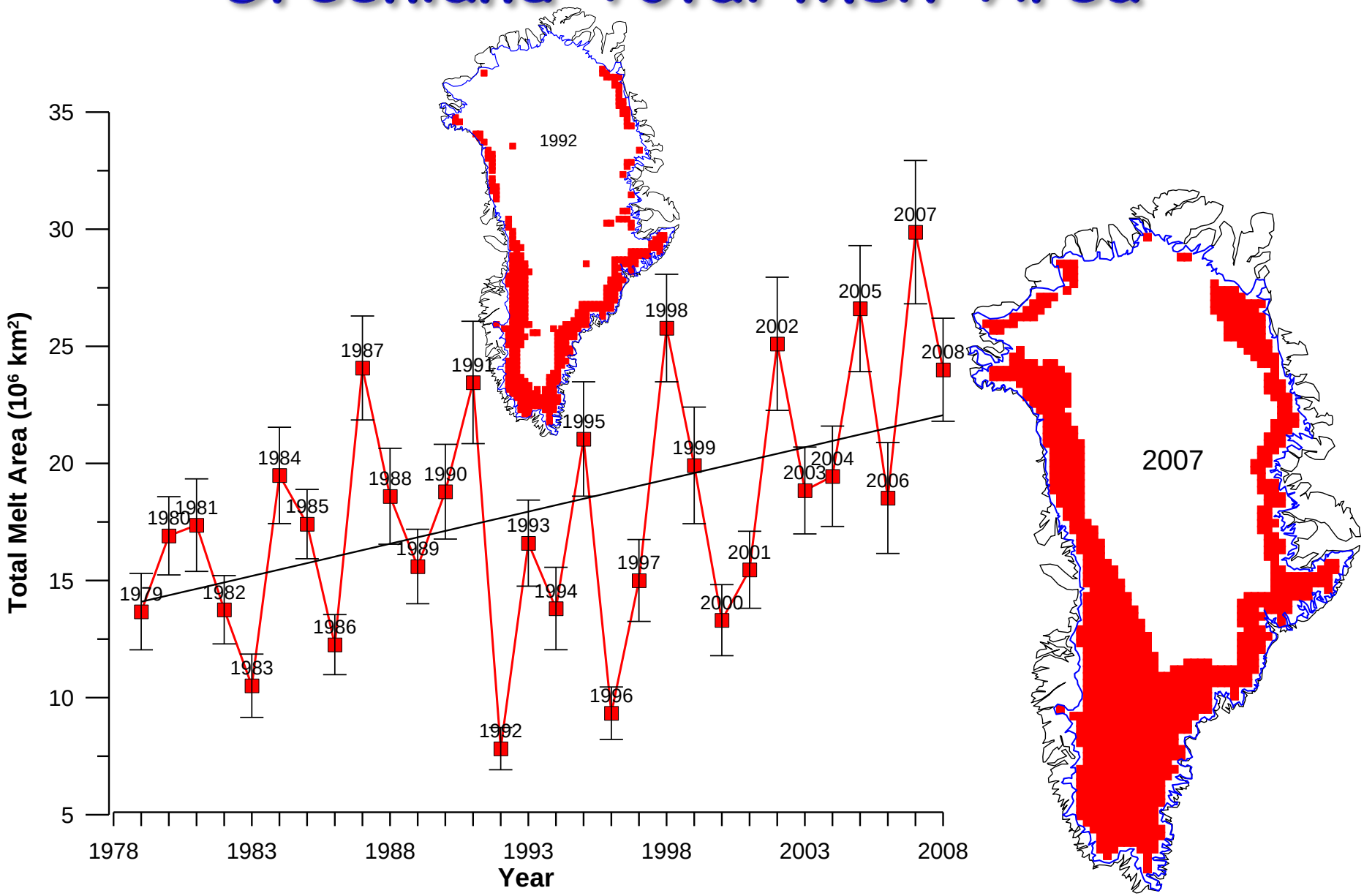
Pliocene sea level up to +15-25 meters

- **Pliocene temperature +3-4°C***

Ice sheet response time uncertain, but it is shorter than the lifetime of fossil fuel carbon and resulting global warming

***relative to pre-industrial times**

Greenland Total Melt Area



Area on Greenland with snowmelt.

Graph credit: Konrad Steffen, Univ. Colorado

Surface Melt on Greenland

Melt descending into a moulin, a vertical shaft carrying water to ice sheet base.

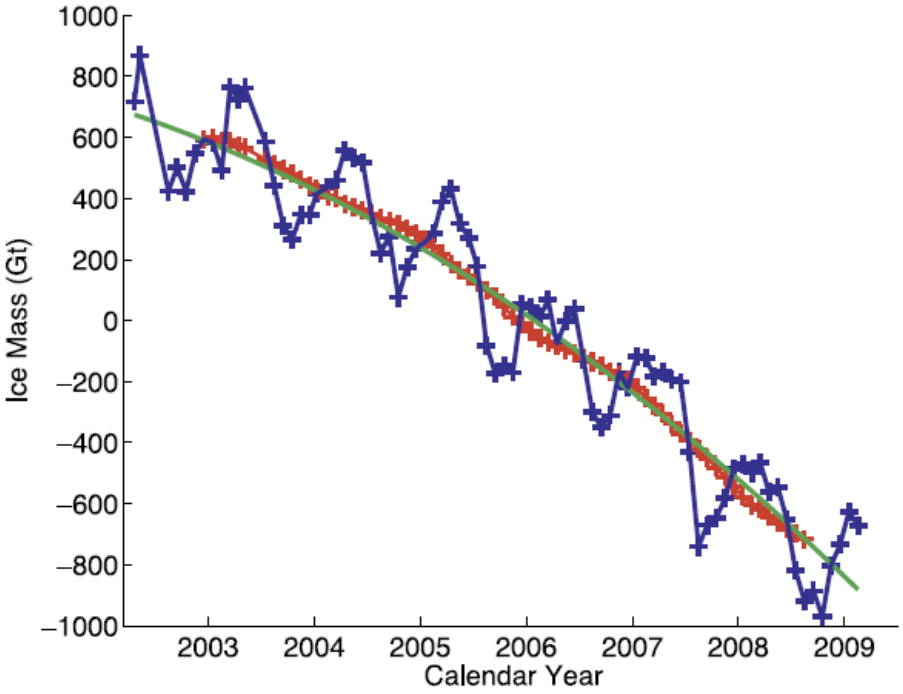
Source: Roger Braithwaite, University of Manchester (UK)

Jakobshavn Ice Stream in Greenland

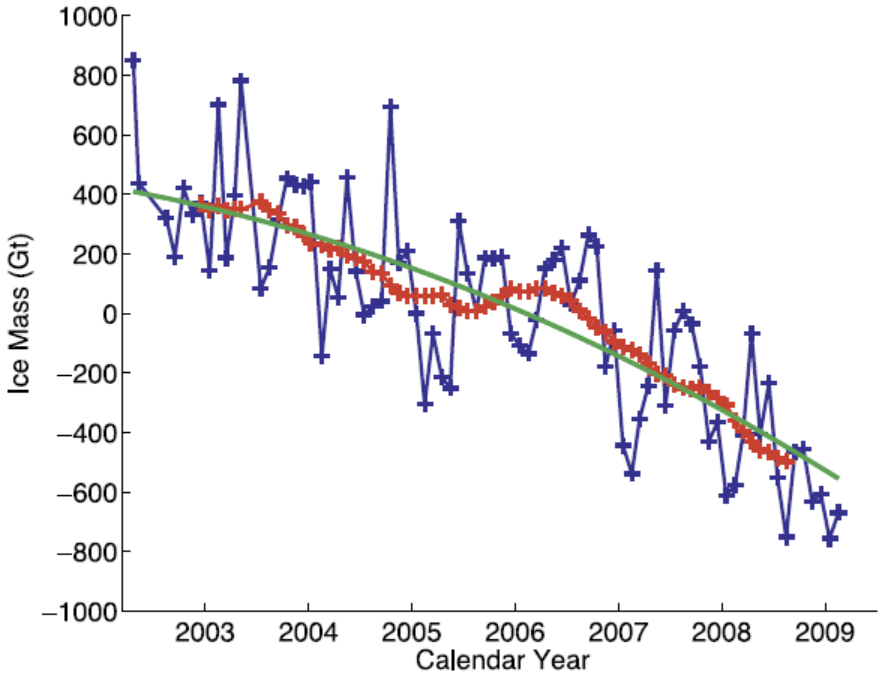
Discharge from major Greenland ice streams is accelerating markedly.

Source: Prof. Konrad Steffen, Univ. of Colorado

Gravity Satellite Ice Sheet Mass Measurements

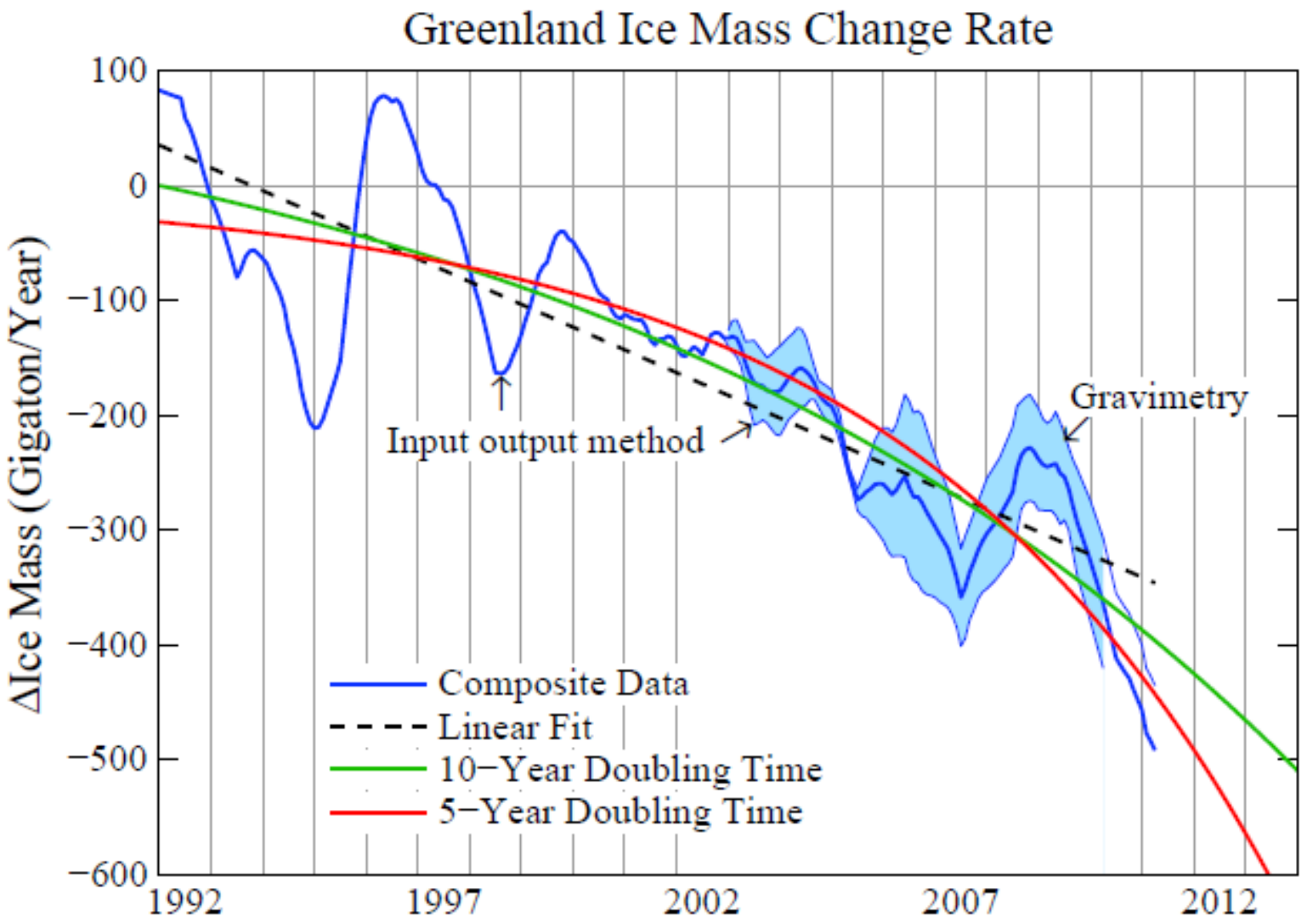


Greenland Ice Sheet



Antarctic Ice Sheet

Source: Velicogna, I. *Geophys. Res. Lett.*, **36**, L19503, doi:10.1029/2009GL040222, 2009.


Greenland Ice Mass Change Rate
ΔIce Mass (Gigaton/Year)
100
0
−100
−200
−300
−400
−500
−600
1992
1997
2002
2007
2012
Input output method
Gravimetry
Composite Data
Linear Fit
10−Year Doubling Time
5−Year Doubling Time

Threat of Mass Exterminations

Multiple Human-Made Stresses

Overharvesting, Land use changes, Nitrogen fertilization, Introducing exotic species, etc.

in Combination with

Rapid Shifting of Climate Zones

Figure 1. The broken-wing female Monarch on our butterfly bush.

Figure 2. The larvae devouring the milkweeds.

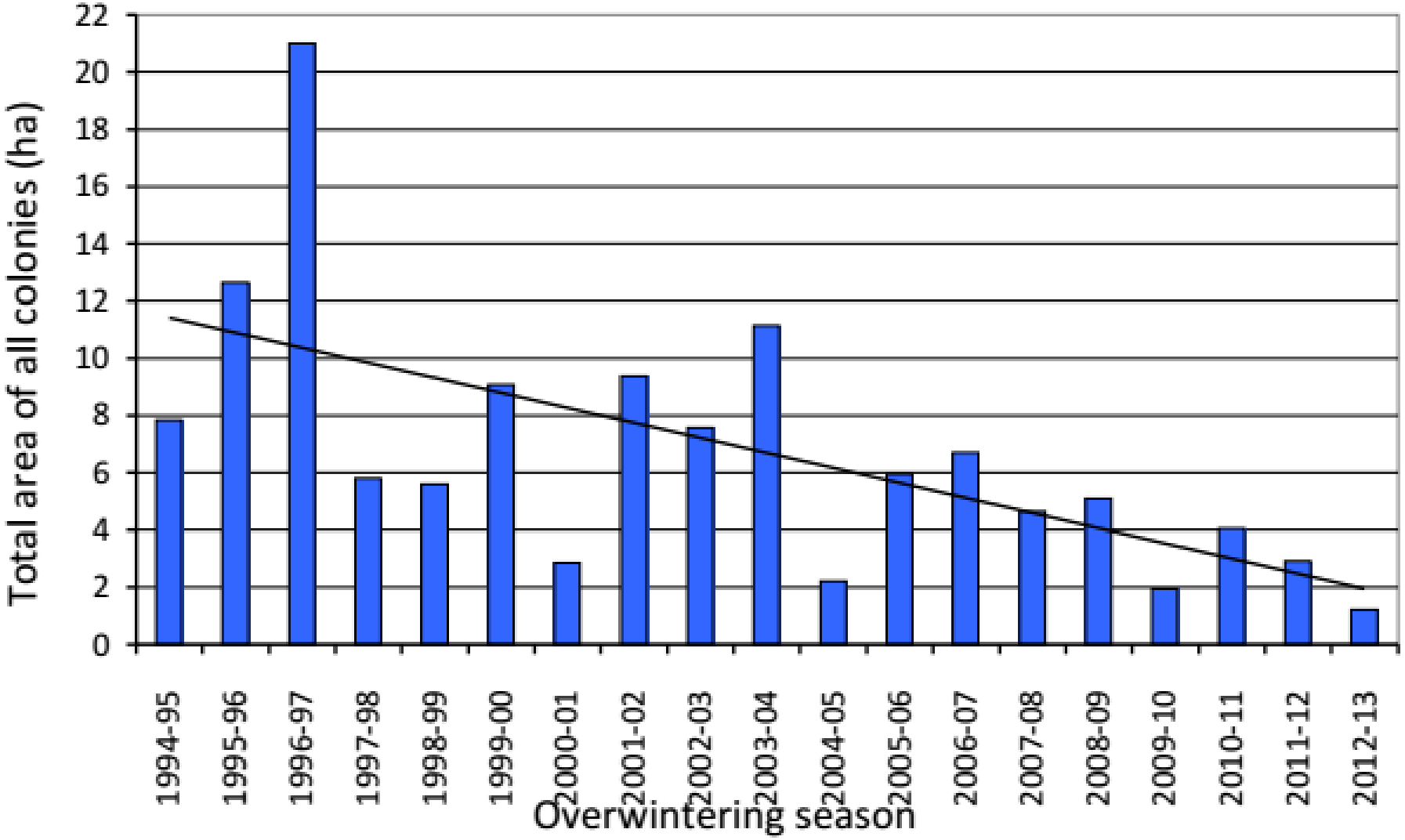
Newly emergent Monarchs, each beside its popped chrysalis, waiting for its wings to dry.

Figure 6. The male Monarch after its first landing, on the butterfly bush.

Figure 7. The female Monarch on the remains of a wildflower.

Current U.S. Drought Monitor

June 2011: Record 7.6% of U.S. in ‘Exceptional’ drought category, simultaneous with record flooding on Mississippi River.

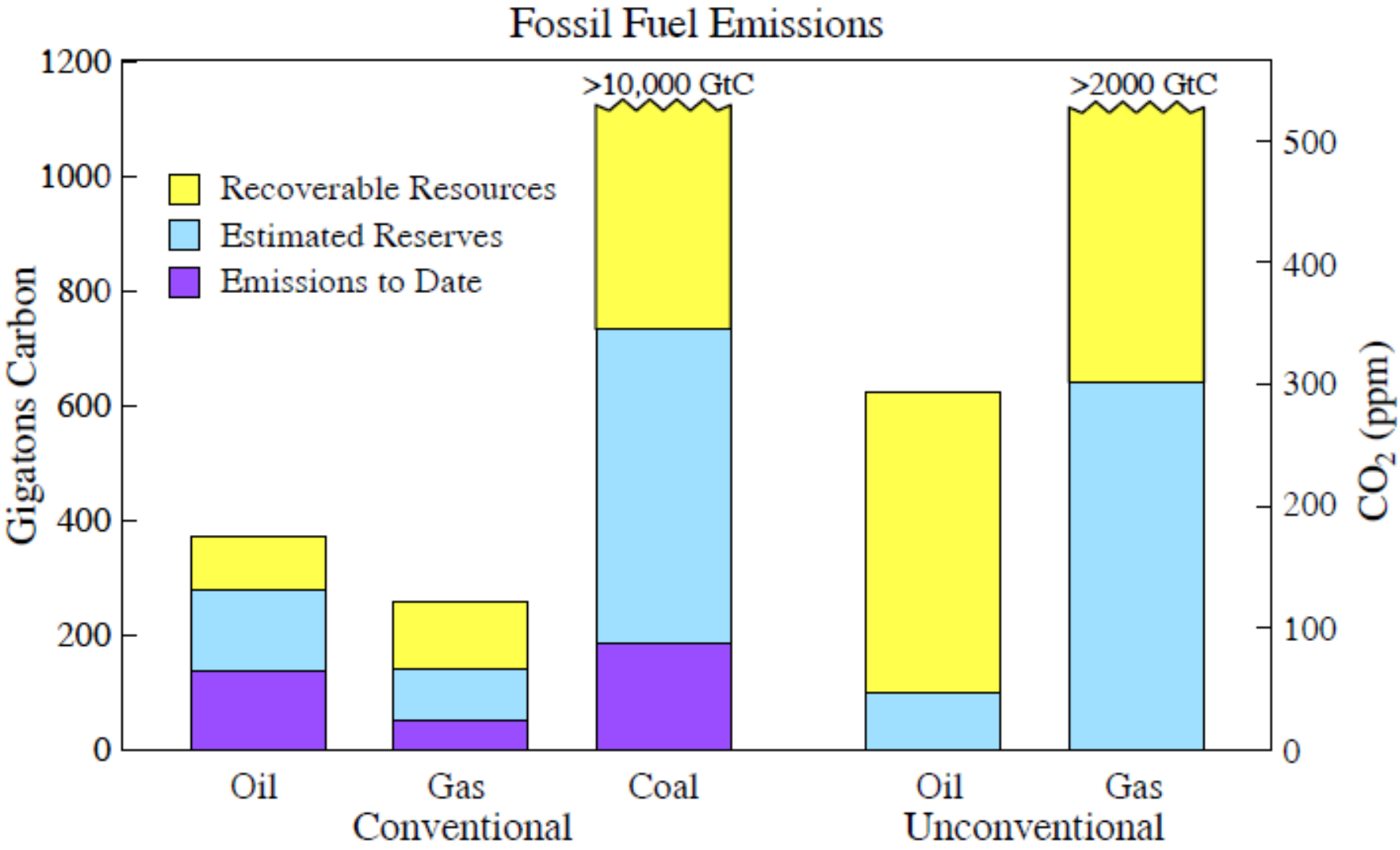


Area occupied by overwintering monarch butterflies

Source: Brower, LP, et al., Insect Conservation and Diversity 5, 95-100, 2012.

Stresses on Coral Reefs

Coral Reef off Fiji (Photo: Kevin Roland)



Fossil fuel emissions; purple are emissions through 2012.

1 GtC (gigaton carbon) = 1 billion tons of carbon or ~3.7 $GtCO_2$; 1 ppm CO_2 ~2.12 GtC

Assessing “Dangerous Climate Change”: Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature

James Hansen, Pushker Kharecha, Makiko Sato, Valerie Masson-Delmotte, Frank Ackerman, David J. Beerling, Paul J. Hearty, Ove Hoegh-Guldberg, Shi-Ling Hsu, Camille Parmesan, Johan Rockstrom, Eelco J. Rohling, Jeffrey Sachs, Pete Smith, Konrad Steffen, Lise Van Susteren, Karina von Schuckmann, James C. Zachos

PLOS ONE: December 03, 2013
DOI: 10.1371/journal.pone.0081648

Media Contact: Julia Olson, E.D. and Chief Legal Counsel
OUR CHILDREN'S TRUST
415-786-4825

IMPORTANT U.S. COURT ACTIONS PENDING:

U.S. Court of Appeals, D.C. Circuit

7 supporting *Amicus Curiae* Briefs from legal, scientific, national security, government, indigenous, faith and human rights perspectives

Alaska Supreme Court (case argued, decision pending)

In the Court of Appeals of TX, NM, WA, and OR

IMPORTANT RULEMAKING ACTIONS UNDERWAY:

Pennsylvania, Massachusetts, Maine, Iowa, NY, Florida, Arizona, Kansas

FILM ADVOCACY: www.ourchildrenstrust.org

Discussion re status of legal actions

Wednesday, 2 PM, lobby Intercontinental Hotel

Fossil Fuel Emissions/Targets

370 GtC = Emissions through 2012

+100 GtC from deforestation – but must bookkeep separately

500 GtC Target for Fossil Fuel Emissions

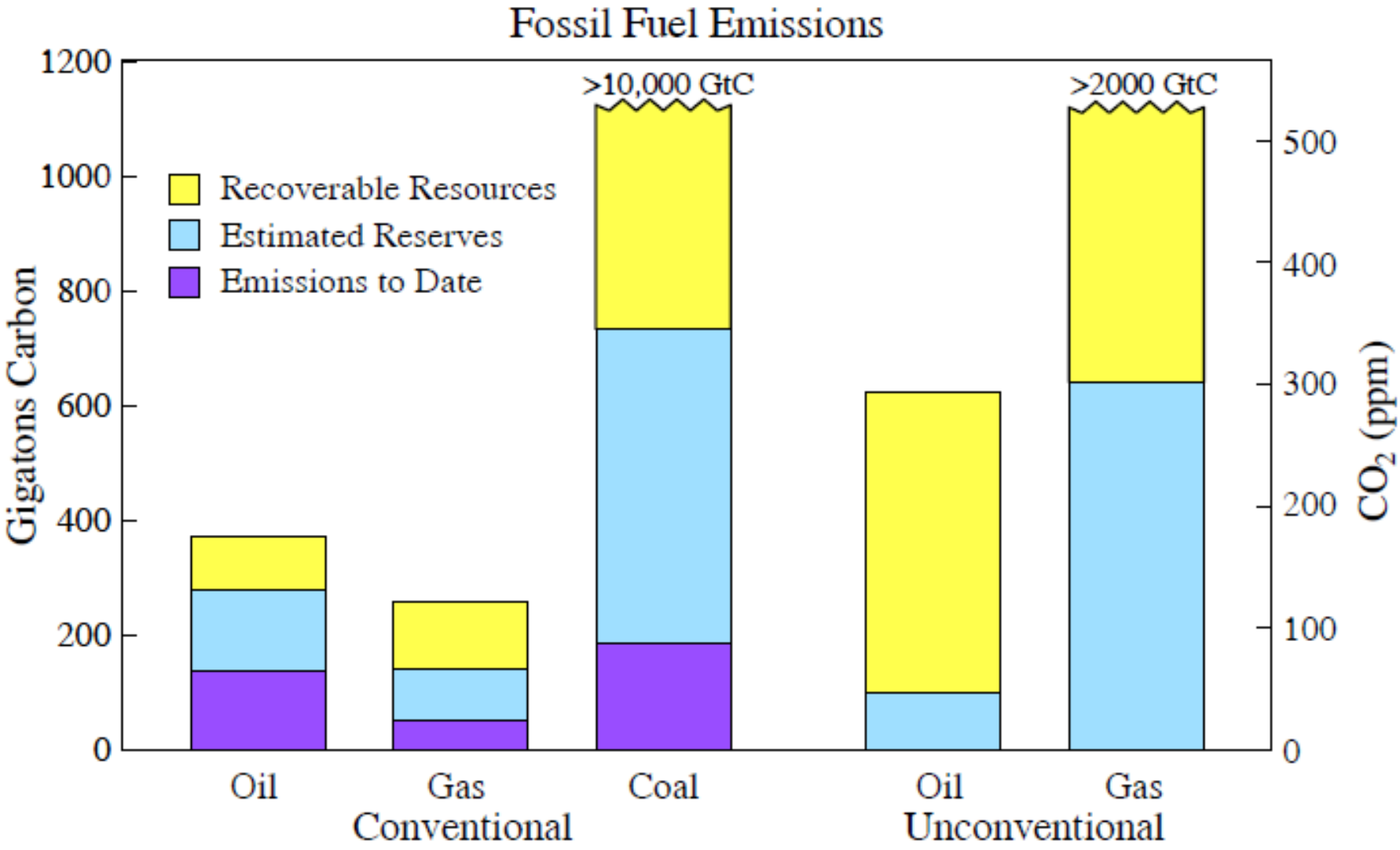
& store 100 GtC in forests and soil via improved practices

Result: energy balance at about 1°C above pre-industrial

Stays close to Holocene range; slow feedbacks minimized

1000 GtC Target for Fossil Fuel Emissions

Slow feedbacks (ice sheet melting, forest movement, GHG release) surely come into play → warming > 2°C



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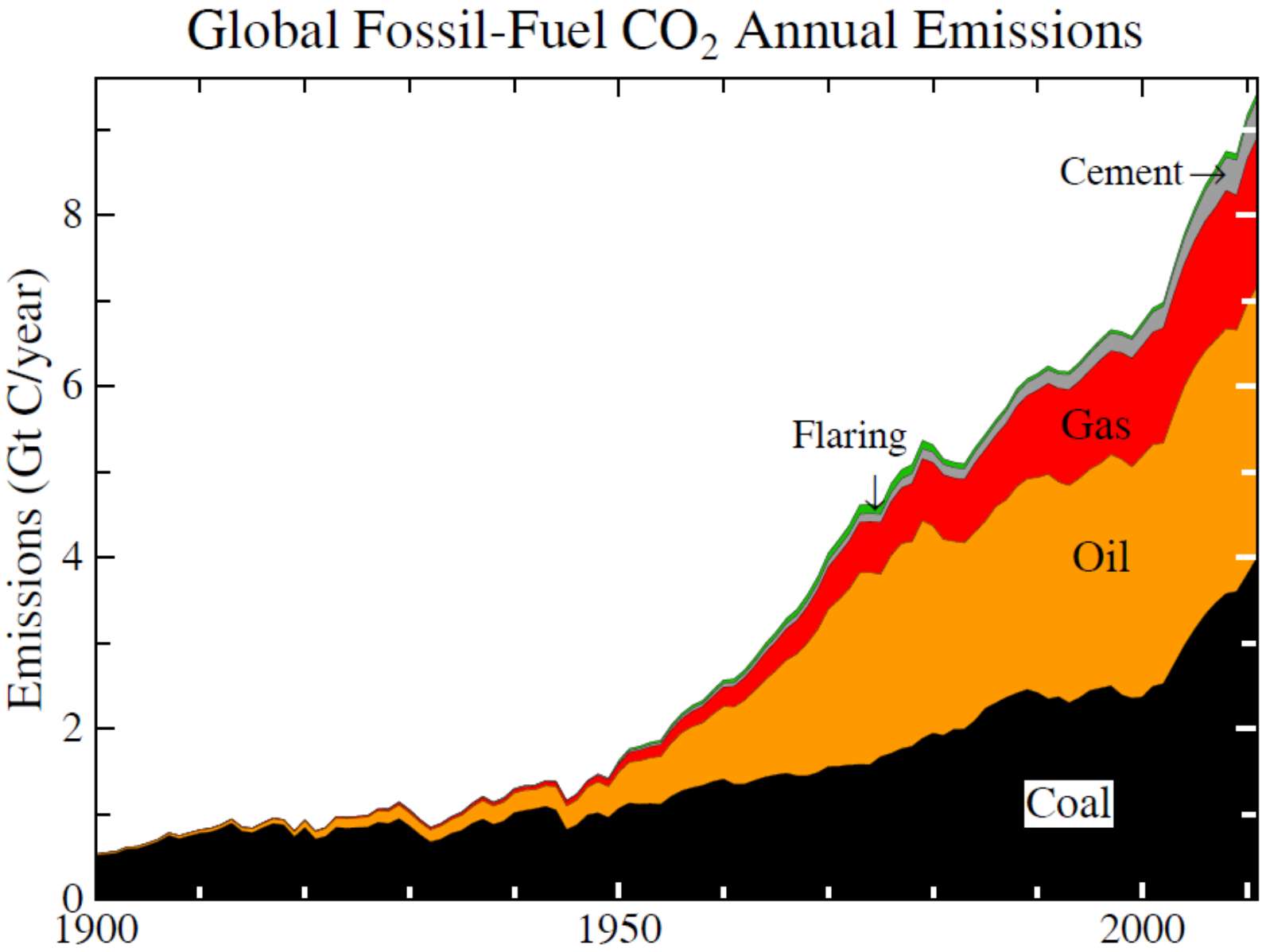
Climate Stabilization is Possible, But…

Essential Requirements

1. **Quick Coal Phase-Out Necessary**
   Coal emissions halted in next few decades

2. **No Unconventional Fossil Fuels**
   Tar sands, Tar shale, Methane hydrates

3. **Don’t Pursue Last Drops of Oil**
   Polar regions, Deep ocean, Pristine land



Source: Boden, TA, G Marland, and RJ Andres. 2011. Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge Natl Lab, U.S. Department of Energy http://cdiac.ornl.gov/trends/emis/meth_reg.html#

Discussion

It is distressing that, despite the clarity and imminence of the danger of continued high fossil fuel emissions, governments continue to allow and even encourage pursuit of ever more fossil fuels. Recognition of this reality and perceptions of what is "politically feasible" may partially account for acceptance of targets for global warming and carbon emissions that are well into the range of "dangerous human-made interference" with climate. Although there is merit in simply chronicling what is happening,
there is still opportunity for humanity to exercise free will.
Thus our objective is to define what the science indicates is needed, not to assess political feasibility.

Call for Papers – Responding to Climate Change

"Responding to Climate Change" Collection in the journal *PLOS ONE*

Publishing papers in all areas of research aimed at returning the Earth to a state of energy balance, including:

- Atmospheric Chemistry
- Geoengineering
- Alternative Energy
- Science Policy
- Economics
- Behavioral Psychology
- Conservation Biology

All research articles will be published immediately after passing peer review and acceptance, appropriate papers will be added to the Collection.

Multidisciplinary scope and broad publication criteria gather diverse research into a single venue.

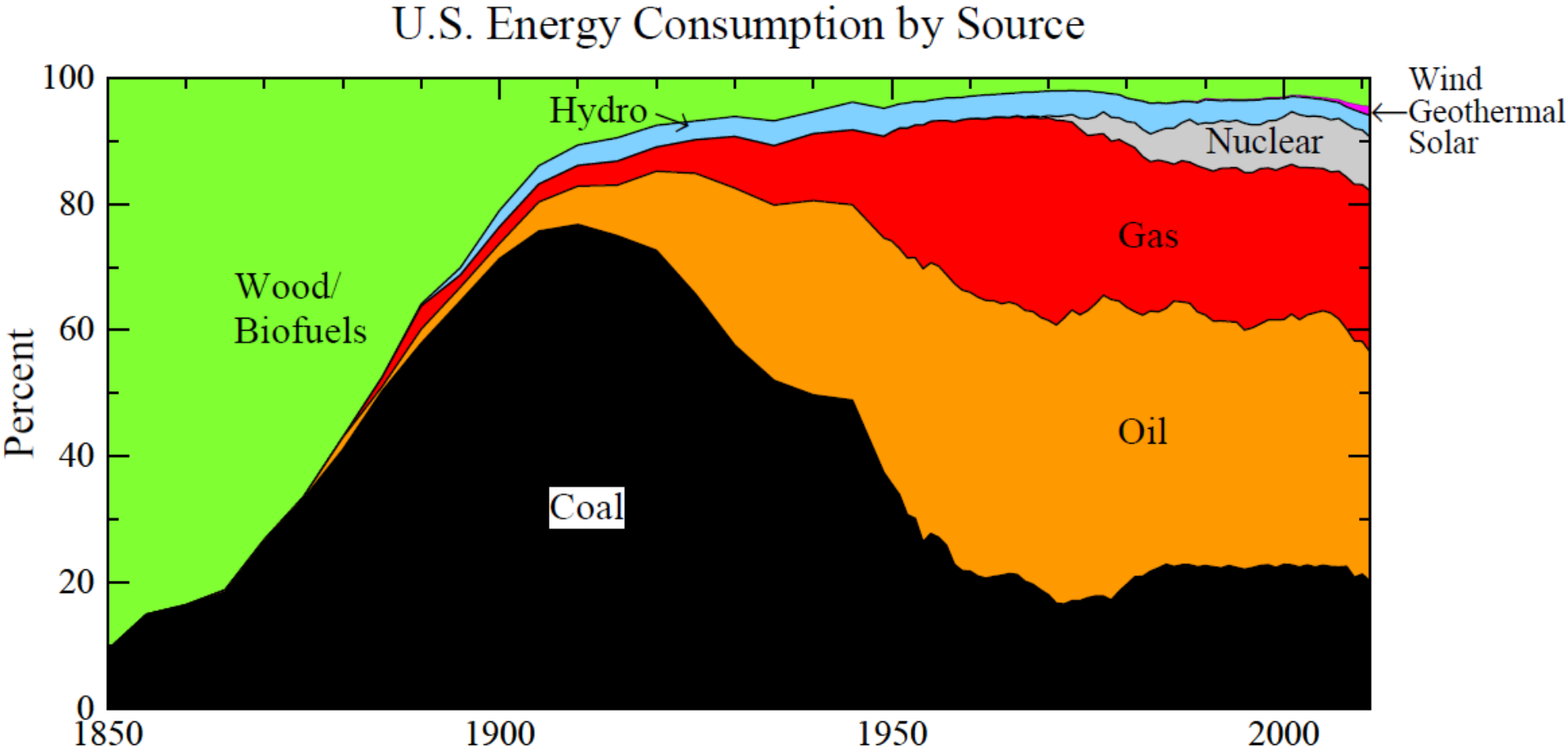
Utilizing the power of Open Access - freely and immediately available for a global audience to read and reuse.

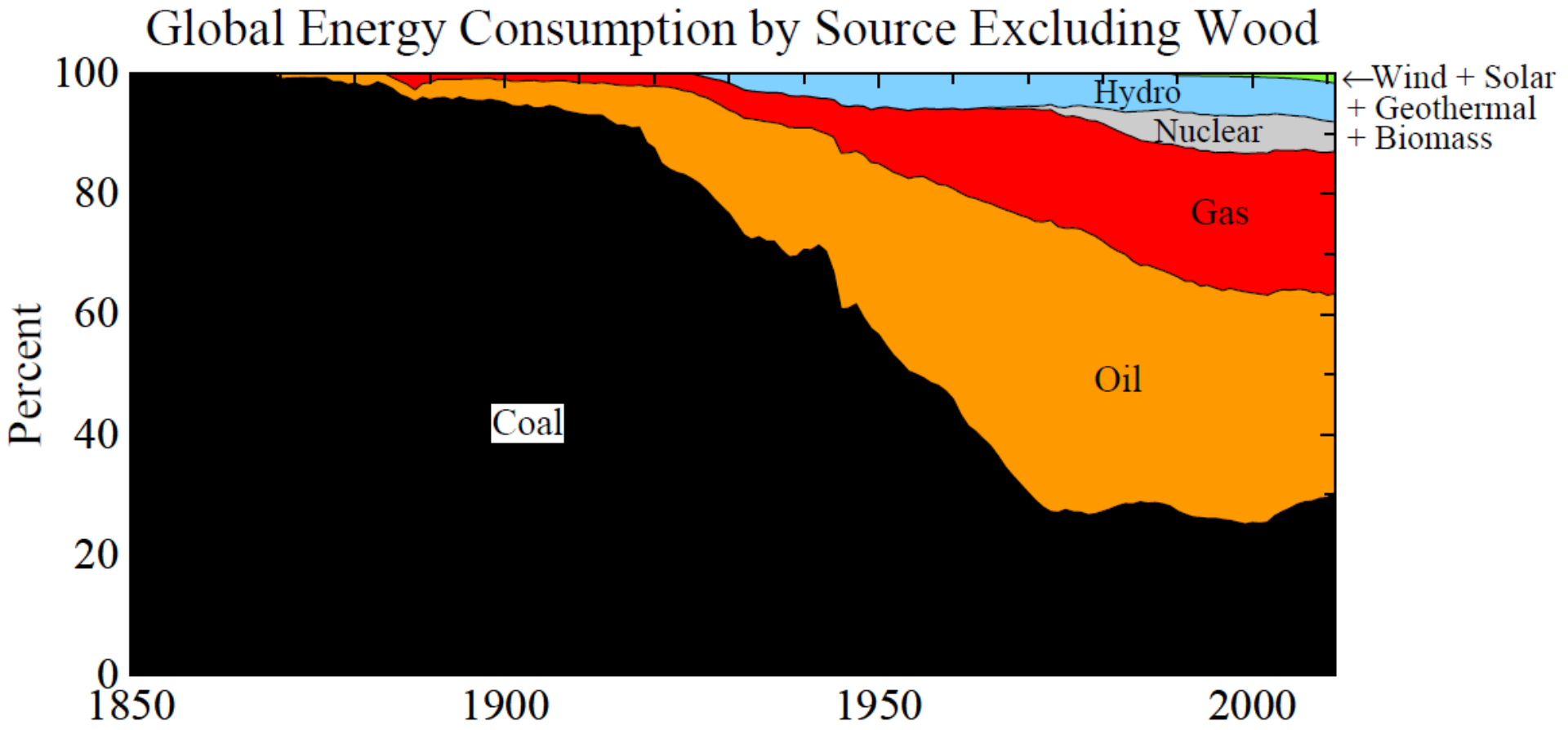
More information available at *PLOS ONE* booth #301

OPEN ACCESS

INTERGENERATIONAL INJUSTICE

"OUR PARENTS DID NOT KNOW THAT THEIR ACTIONS COULD HARM FUTURE GENERATIONS. WE WILL ONLY BE ABLE TO PRETEND THAT WE DID NOT KNOW."


U.S. Energy Consumption by Source
Percent
100
80
60
40
20
0
1850
1900
1950
2000
Wood/
Biofuels
Hydro
Coal
Oil
Gas
Nuclear
Wind
Geothermal
Solar


Global Energy Consumption by Source Excluding Wood
Percent
100
80
60
40
20
0
1850
1900
1950
2000
Coal
Oil
Gas
Nuclear
Hydro
←Wind + Solar
+ Geothermal
+ Biomass

Problem & Solution

1. Fossil Fuels are Cheapest Energy
   - Subsidized & Do Not Pay Costs
   - Solution: Rising Price on Carbon
2. Regulations also Required
   - Efficiency of Vehicles, Buildings,e.g.
   - Carbon Price Provides Enforcement
3. Technology Development Needed
   - Driven by Certainty of Carbon Price
   - Government Role Limited

Fee & Dividend

Fee: Collected at Domestic Mine/Port of Entry

Covers all Oil, Gas, Coal → No Leakage

Dividend: Equal Shares to All Legal Residents

Not One Dime to the Government.

Merits:

Transparent. Market-based. Stimulates Innovation.

Does Not Enlarge Government.

Leaves Energy Choices to Individuals & Free Competition.

A Conservative Energy & Climate Plan.

Fee & Dividend Addresses

1. **Economy: Stimulates It**
   - Puts Money in Public's Hands – A Lot
   - Provides Certainty to Businesses and Entrepreneurs
2. **Energy: Solves Fossil Fuel Addiction**
   - Stimulates Innovation – Fastest Route to Clean Energy
   - Complements Efficiency Regulations & Energy RD&D
3. **Climate: Viable International Approach**
   - Border Duties on Products from Nations without Fee
   - Most Coal & Unconventional Fossil Fuel left in Ground

Web Sites

www.columbia.edu/~jeh1

www.350.org

www.CitizensClimateLobby.org

www.OurChildrensTrust.org

Bilateral Agreement: China+U.S.&/or EU

Rising Internal Carbon Fees

- Spurs life style changes & Innovation
- Stimulates economies

Border Duty, Products of Nations w/o Fee

- WTO rules allow equivalent duty
- Strong incentive to join with fee/tax

Technology Cooperation Required

- Includes advanced generation nuclear power with safeguards

Effective Global Agreement Requires

1. Rising Carbon Fee (Tax)

China +U.S. &/or EU

Border duty on products of non-participants

2a. Improved Forestry & Agriculture

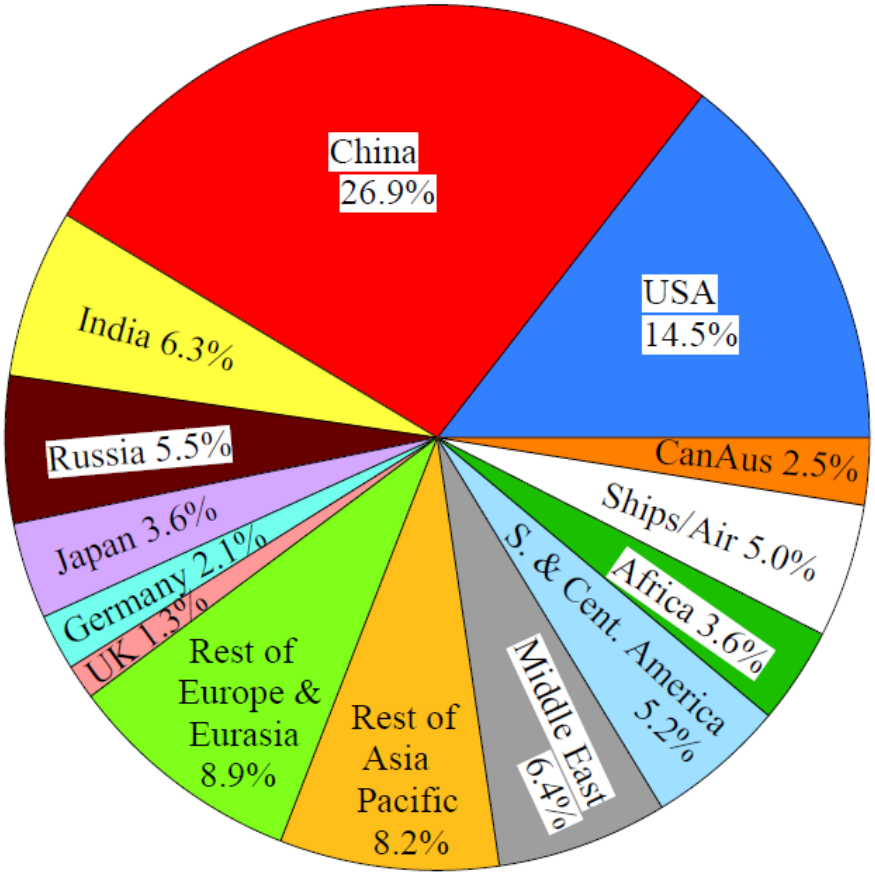
Need to Store ~ 100 GtC in Biosphere/soil

Developed Countries must Support This

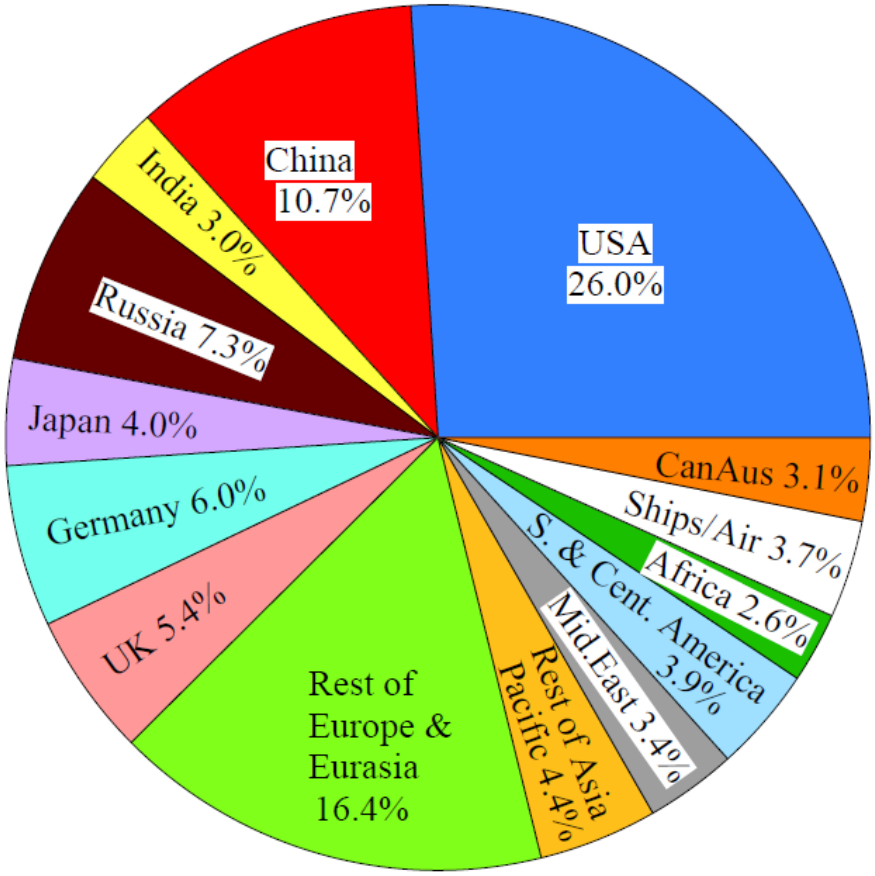
2b. Non-CO_2 Climate Forcings (GHGs, BC)

Much of this is also in Developing Countries

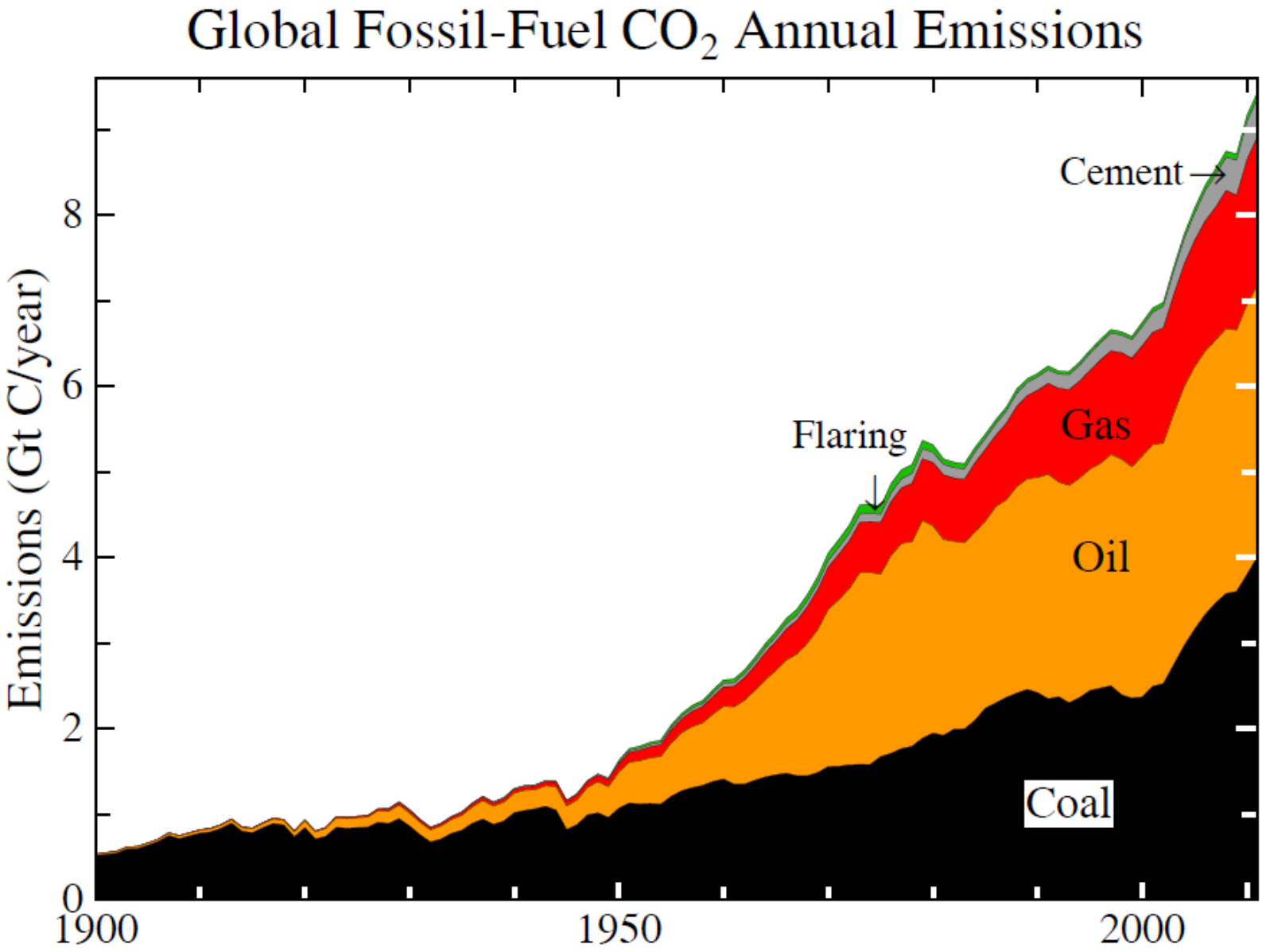
(a) 2012 Annual Emissions (9.6 GtC/yr)



(b) 1751−2012 Cumulative Emis. (384 GtC)



Syngas



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Can Emissions Be Decreased Rapidly?

1. **Germany in One Decade (2001-2011)**
   - Non-hydro Renewable (4% → 19%)
   - Hydro + Nuclear (34% → 21%)
   - Fossil Fuels (62% → 60%)
2. **France in One Decade (1977-1987)**
   - Nuclear Power Increased 15-fold
   - Nuclear Portion of Electricity (8% → 70%)

200,000 People at 1979 No Nukes Concert in New York City

“We are eliminating programs that are no longer needed, such as nuclear power research and development.”

President William Clinton,
1993 State of the Union address

Argonne National Laboratory was ready to construct a commercial-scale reactor that:

(1) Burns >99% of nuclear fuel, compared with ~1% in existing reactors,

(2) Leaves a smaller waste pile with half-life of decades rather than millennia,

(3) Can utilize nuclear waste, depleted uranium and excess weapons material as fuel,

(4) Can shut down automatically in the event of an anomaly (e.g., earthquake),

(5) Does not require power to cool reactor in case of shut down,

(6) Does not require uranium mining for centuries; indeed, it has been demonstrated that fuel can be sieved from the ocean – the supply will last billions of years.