Institute for Governance & Sustainable Development

INECE

Fast-action mitigation to complement cuts in CO_2 emissions

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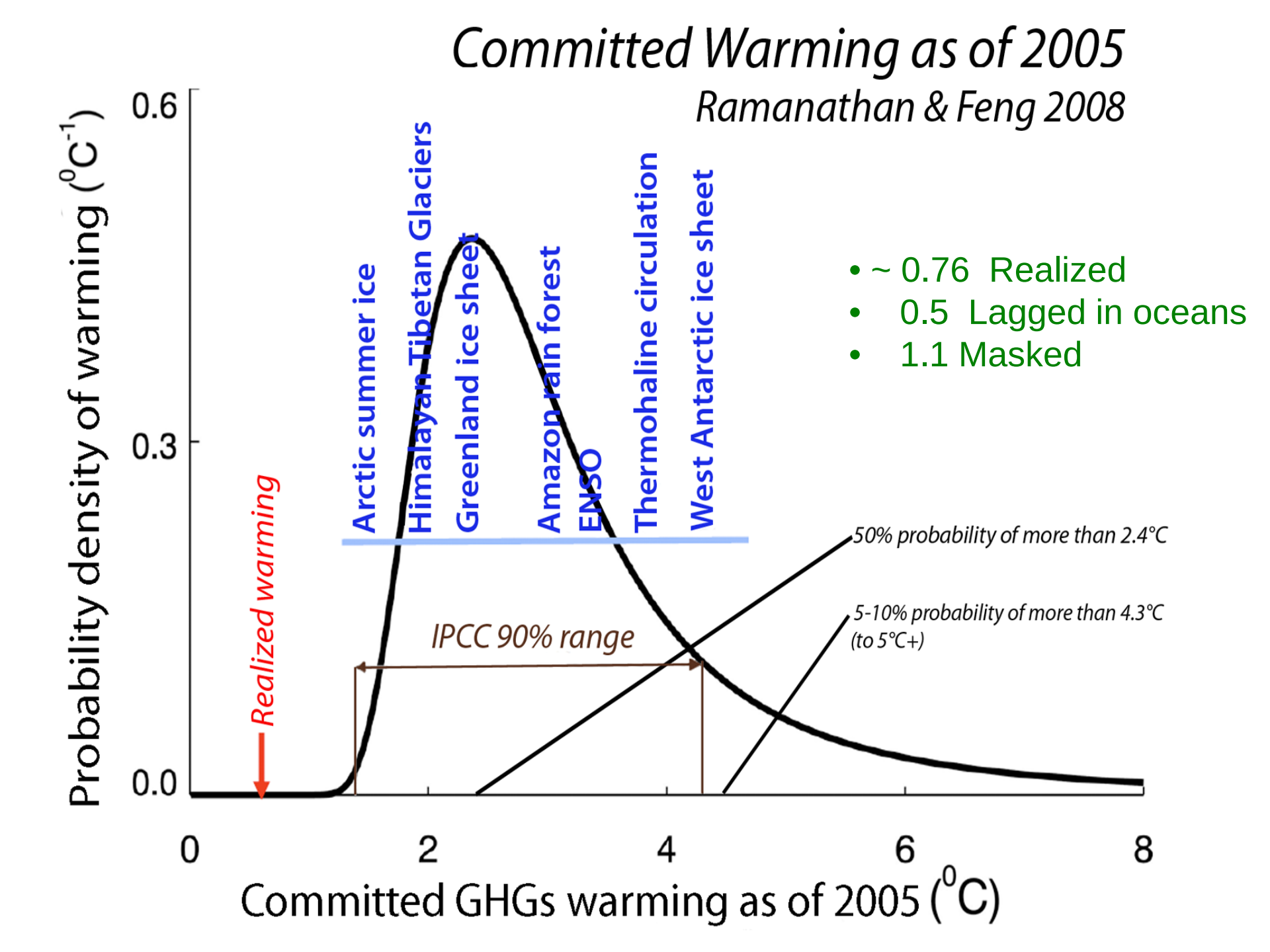
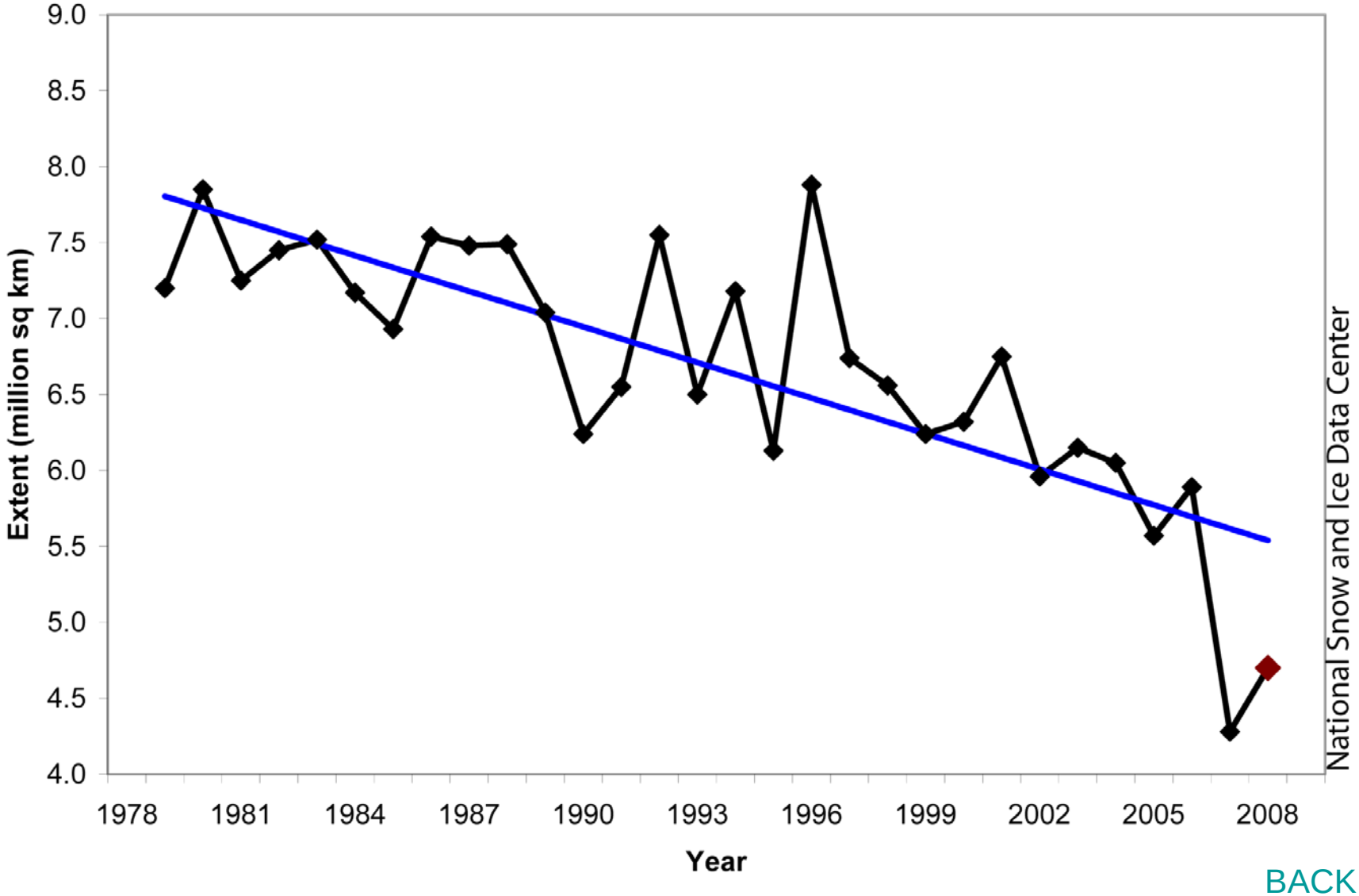

Committed Warming as of 2005
Ramanathan & Feng 2008
Probability density of warming ($^0C^{-1}$)
0.6
0.3
0.0
Arctic summer ice
Himalayan-Tibetan Glaciers
Greenland ice sheet
Amazon rain forest
ENSO
Thermohaline circulation
West Antarctic ice sheet
Realized warming
IPCC 90% range
50% probability of more than 2.4°C
5-10% probability of more than 4.3°C
(to 5°C+)
• ~ 0.76 Realized
• 0.5 Lagged in oceans
• 1.1 Masked
0
2
4
6
8
Committed GHGs warming as of 2005 (^0C)

Abrupt Climate Changes from Committed Warming

- Arctic summer sea ice (2+ x global ave.)
- Himalaya-Tibetan glaciers (3 x)
- Greenland Ice Sheet (2+ x)
- West Antarctic Ice Sheet

NEXT

September Arctic Sea Ice Extent 1978-2008



BACK

Hindu-Kush-Himalaya-Tibetan glaciers
Rivers originating in HKHT

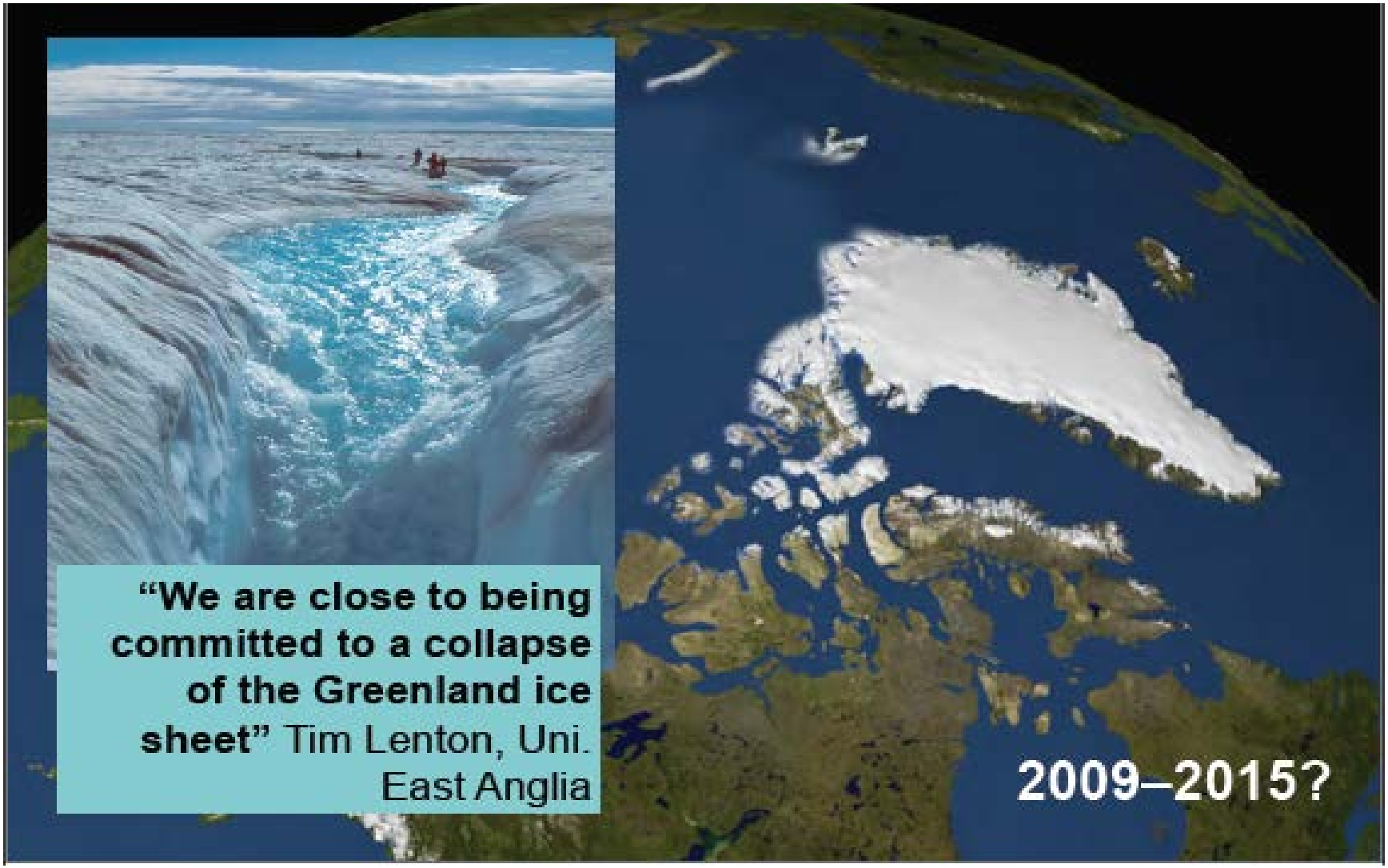
NEXT

IPCC Prediction

- 80% of 500,000 km^2 Himalaya-Tibetan Plateau snow and ice gone by 2030
  - Floods followed by drought
  - Billions affected
  - National security threat from water conflicts among 3 nuclear powers

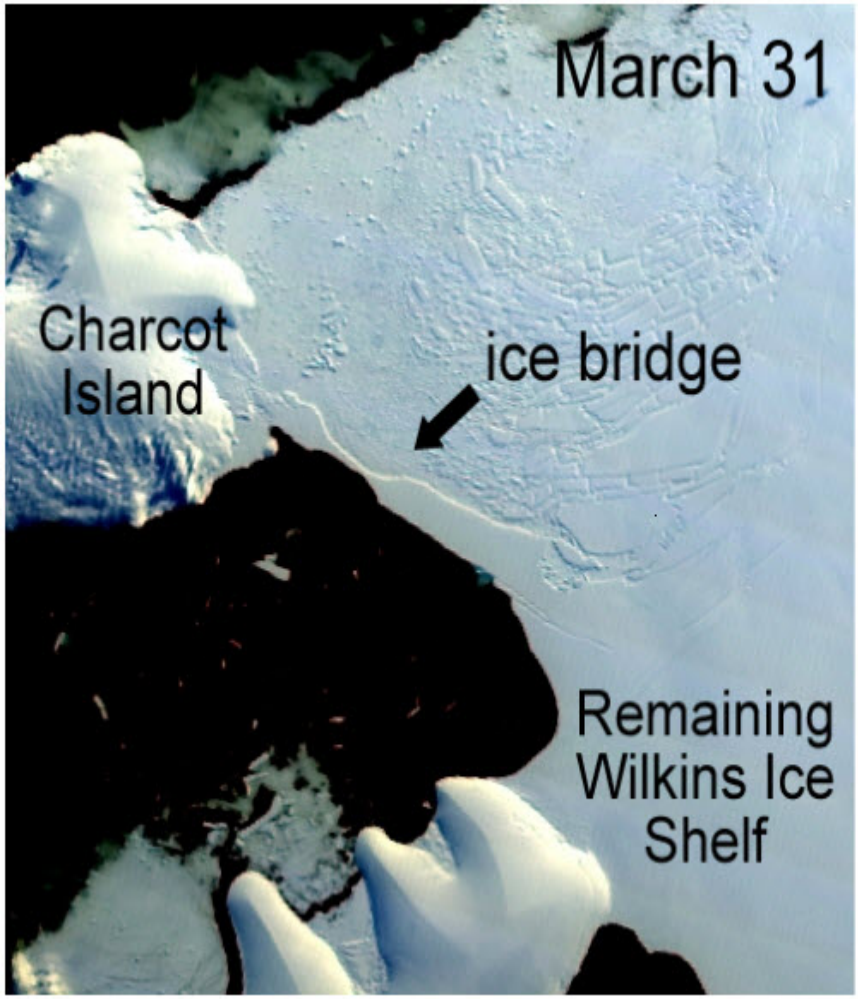
BACK

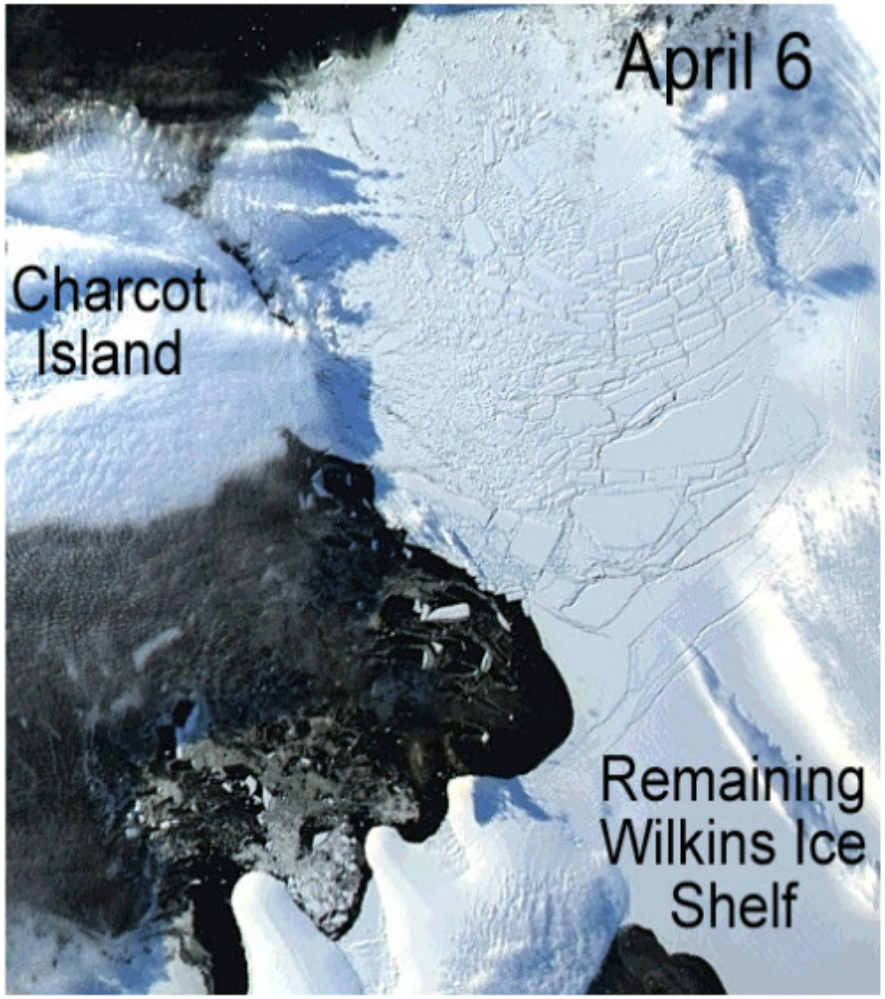
Greenland Ice Sheet



BACK

Antarctic Ice Bridge Collapse





collapse of the ice bridge connecting the remainder of Wilkins Ice Shelf to Charcot Island

BACK

CO_2 Cuts Alone Not Sufficient

Ramanathan & Feng (PNAS 2008):

"*Even the most aggressive CO_2 mitigation steps … can only limit further additions to the committed warming, but not reduce the already committed GHGs warming of 2.4° C.*"

Solomon, et al. (PNAS 2009):

"Climate change that takes place due to increases in carbon dioxide concentrations is largely irreversible for 1,000 years after emissions stop."

Bad News Summary

- Committed warming surpasses tipping points for Abrupt Climate Changes
- 90% of 2.4ºC warming within 50 years
- 5-10% chance 4.3 to 5ºC this century, with runaway feedback
- CO_2 cuts can't cool for at least 1,000 years
- Other: take your pick: C/forests; MIT; Copenhagen Science; US impact report….

Good News: Fast Cooling from non-CO_2

- Big: non-CO_2 = 50% of warming
  - black carbon (20-50% of CO_2 RF)
  - Tropospheric ozone (20% of CO_2 RF)
  - Methane (30% of CO_2 RF)
  - HFCs (20% of CO_2 RF)
- Fast: most are short-term forcers

Short atmospheric lifetimes

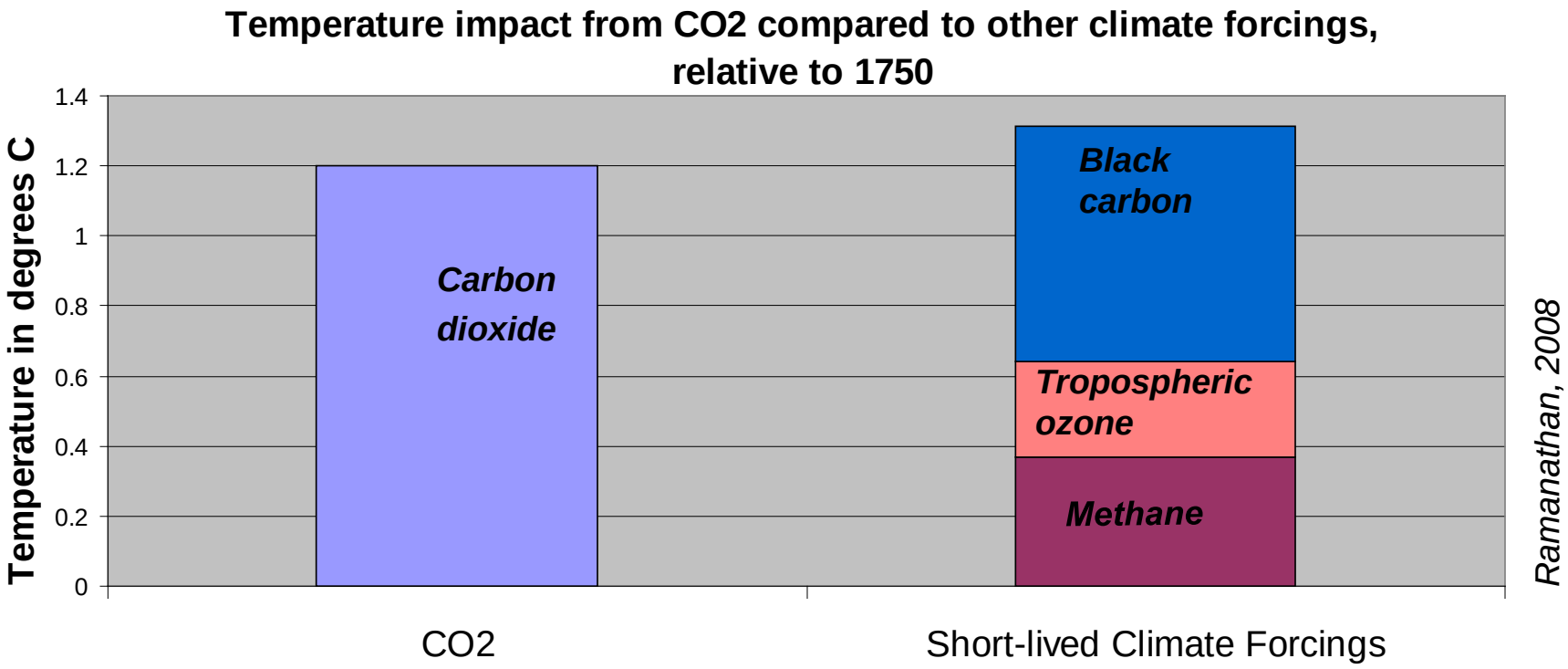
- Black carbon - days to weeks
- Tropospheric ozone - hours to days
- Methane - 10-12 yr.
- HFCs - most less than 15 yr.

IPCC AR4

Black Carbon

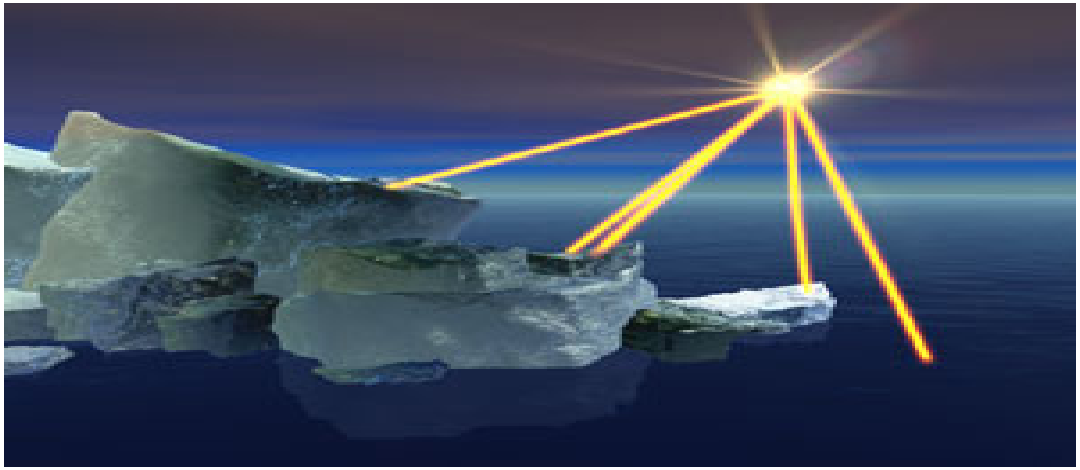
- Incomplete combustion
  - Diesel engines
  - Inefficient residential stoves
  - Open biomass burning

BC contribution to warming



Arctic and other snow & ice regions especially vulnerable to BC pollution

Without soot, rays reflected



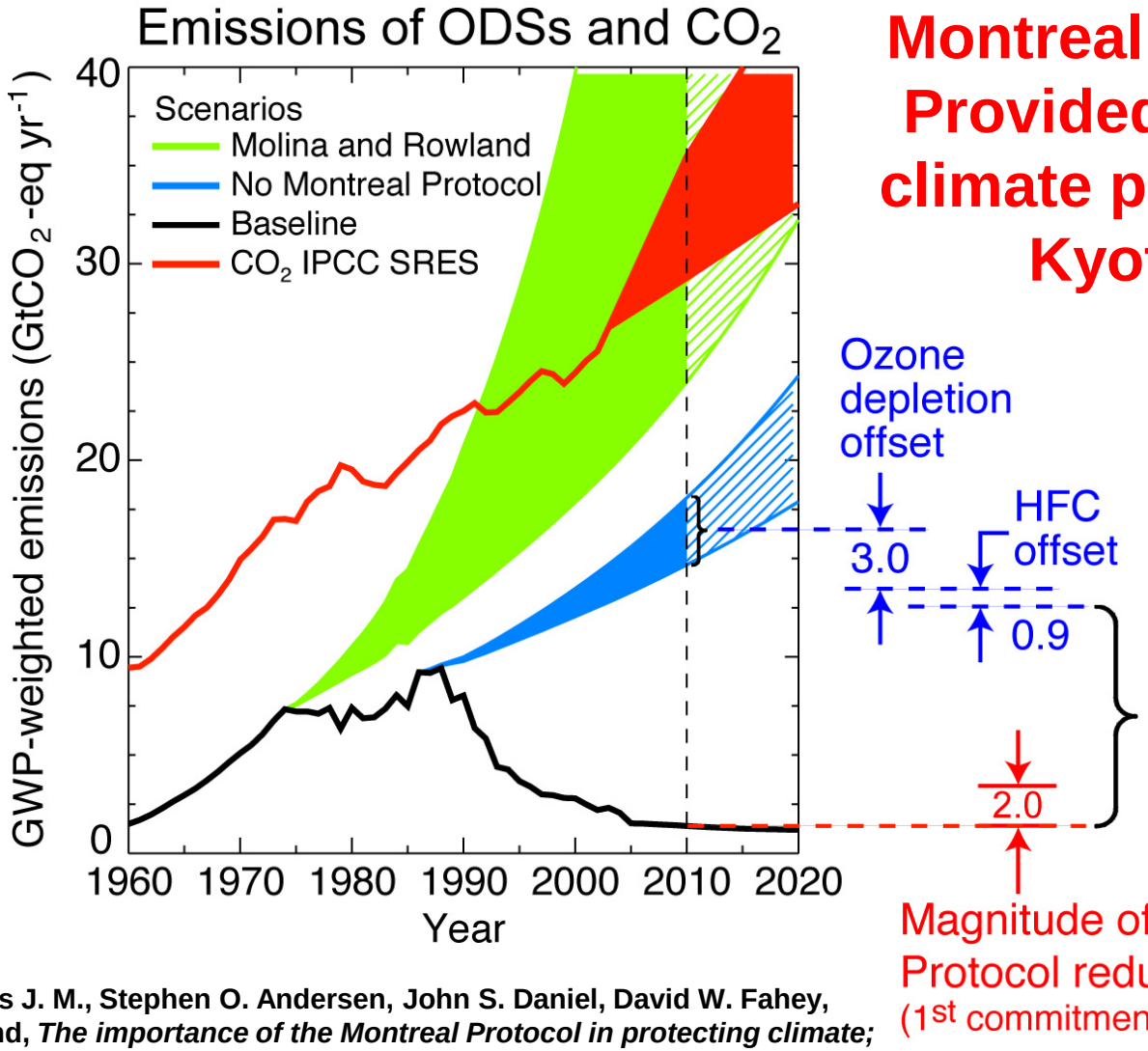
With soot, rays (and heat) absorbed

BC is 50% of 1.9 C warming in Arctic since 1890 (Shindell & Faluvagi 2009)

BC and its organic co-pollutants are responsible for just under half of the total springtime melt in the Himalayas (Flanner et al. 2009)

NASA, Black Soot and Snow: A Warmer Combination, 2004

Montreal Protocol also protects climate

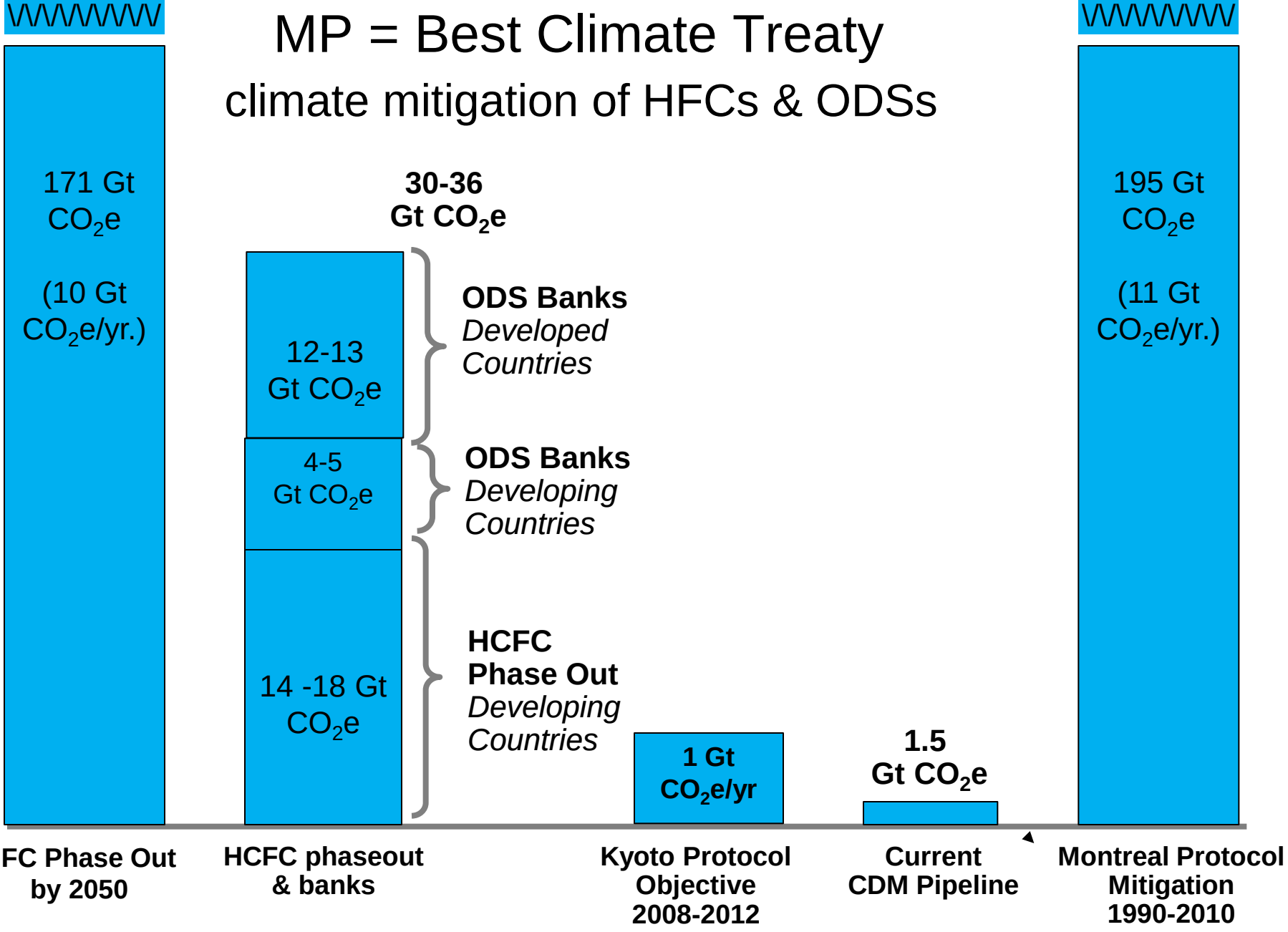


Montreal Protocol has Provided 10-11 times climate protection that Kyoto seeks

From: Velders Guus J. M., Stephen O. Andersen, John S. Daniel, David W. Fahey, and Mack McFarland, *The importance of the Montreal Protocol in protecting climate;* Proceedings of the National Academy of Sciences, published online Mar 8, 2007.

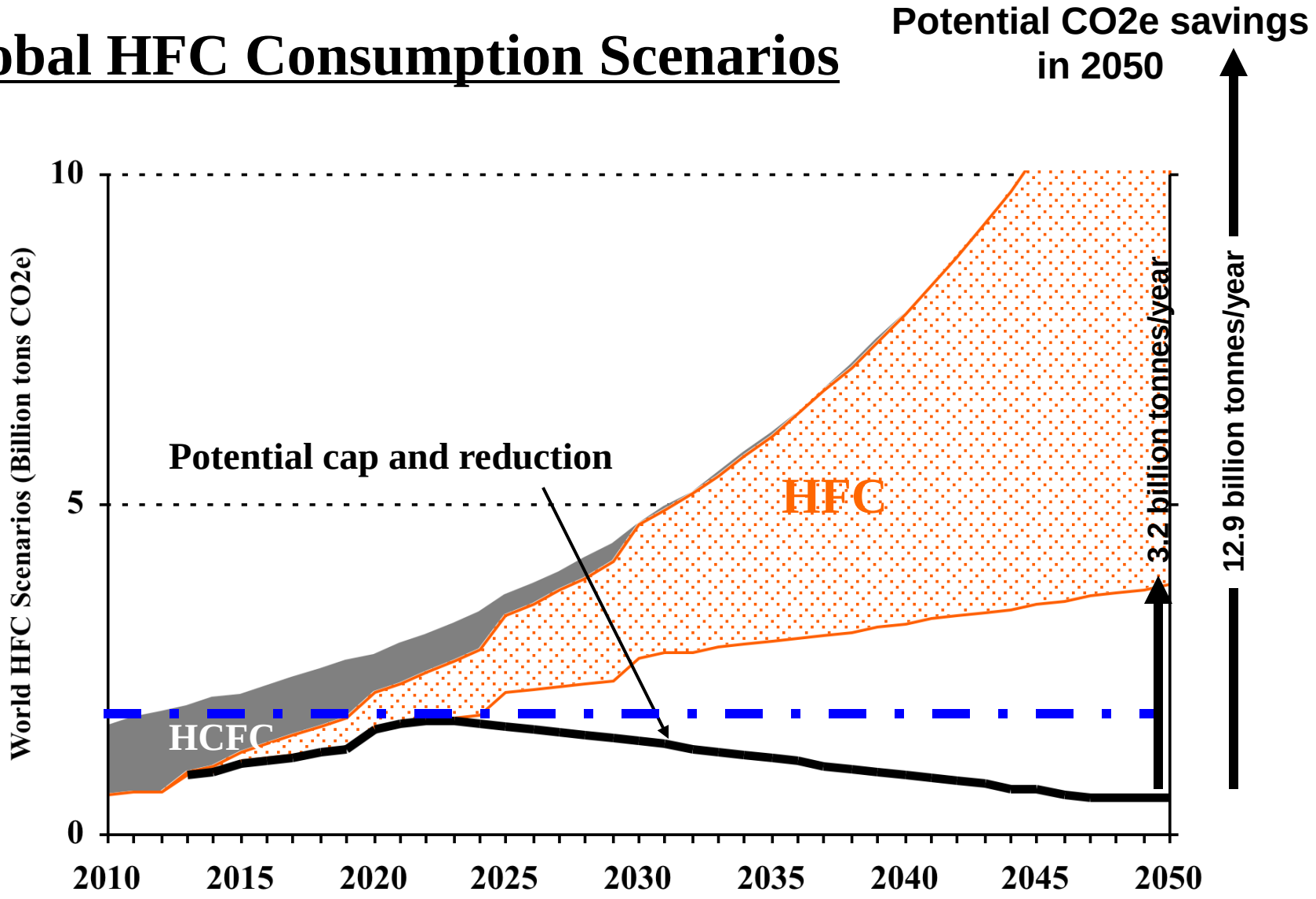
MP = Best Climate Treaty

climate mitigation of HFCs & ODSs

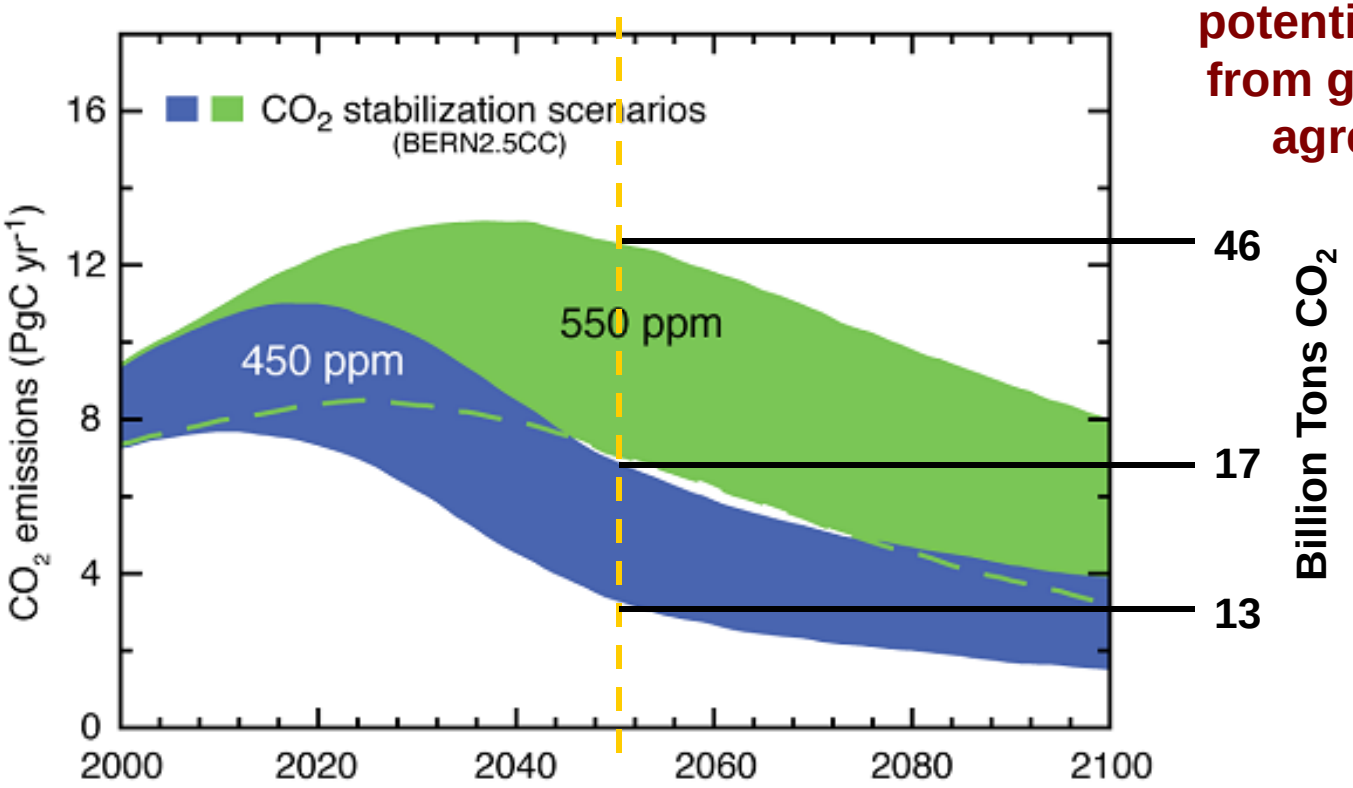


Sources. *ODS estimates: TEAP report to decision XVIII-12 ; Kyoto: UNDP estimates; CDM: UNEP Riso March 2009; Mack McFarland, Environmental Fellow, DuPont Fluoroproducts, Presentation at the 20th Meeting of the Parties to the Montreal Protocol in Doha, Qatar: Potential Climate Benefits of a Global Cap and Reduction Agreement for HFCs (Nov. 18, 2008).*

Global HFC Consumption Scenarios



HFCs up to 45% of CO_2 Stabilization Scenarios



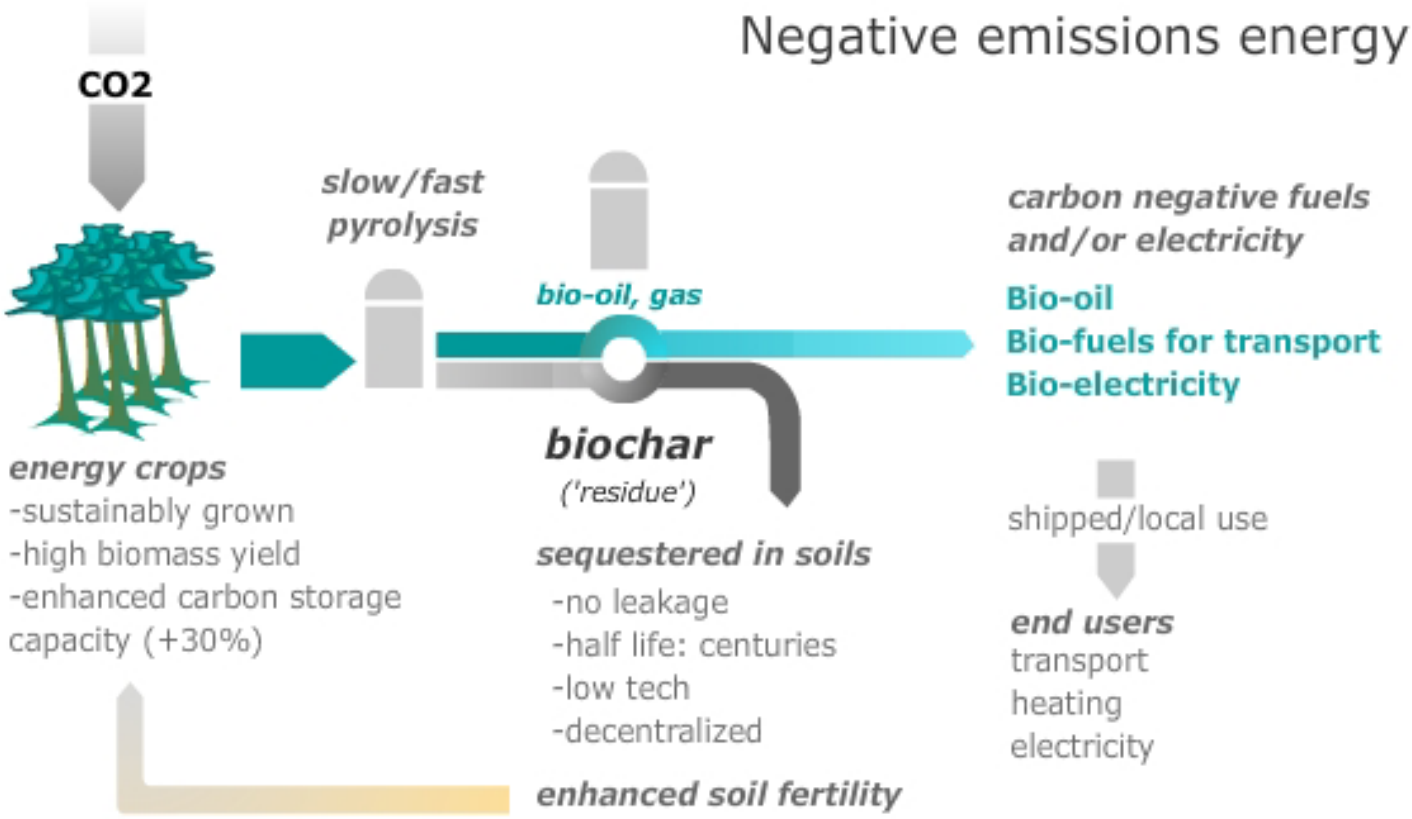
Compare to 10 to 12.9 billion tons CO_2e/yr potential savings from global HFC agreement

Adapted from Figure 10.22 from IPCC AR4 WG I

More Good News: Bio-sequestration and Biochar

- Up to 3+ Gt CO_2-eq./yr from ag waste
- Up to 20-35 Gt CO_2-eq./yr by 2100
- Only way to return to safety of 350 ppm within decades

Carbon negative bio-energy energy with charcoal CCS



Policy Principles

- Expand solutions
- Bottom up and top down
- Regulatory measures
- Strong compliance
- Start and strengthen
- Carbon negative

Lay down the tracks and
get ready to go to scale

BC Policies

- CoP 15 decision on fast-action work plan
- Borrow existing governance structures
  - international (IMO, ICAO, etc.)
  - regional (NAFTA, ASEAN haze treaty, Arctic)
  - Clean Air Initiative in Latin American Cities
- Ensure eligibility in all climate funds
- Strengthen domestic and focus on health

HFC Policy Discussions

- Montreal Protocol amendments in 2009
  - FS Micronesia/Mauritius proposal
  - US actively considering
- Copenhagen (and ”borrow” MP in 2010)
- Domestic (e.g., Waxman-Markey)
- China, India, and HFC-23 CDM projects

Advantages of Montreal

- Experience, confidence, trust

- Up-to-date assessments
- MLF funding
- Grace period
- Ozone units in 145 A5 Parties
- Obligations for all
- Adjustment process

Biochar Policies

- Local enabling policies
- Pilot projects (dead forests)
- Guidelines for avoiding conflicts with food production
- CDM methodology

Good News Summary

- BC: 3+ Gt CO_2-eq./yr + co-benefits
- HFC: up to 10+/yr
- ODS banks: 6 by 2015
- Biochar: 3+/yr up to 20-35/yr + soil
- Other: albedo, C negative cement,…..
- Current: 49/yr
- 2050 stabilization: 13-17/yr

Conclusion:

CO2 emission cuts are *essential but not sufficient*

Need non-CO2 to complement

+

Need bio-sequestration to return to safety of 350 ppm

Start, Strengthen