

# Overview of EMF 21: Multi-Gas Mitigation and Climate Change

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# Stanford Energy Modeling Forum

- Independent, economic research forum which is operated out of Stanford University. The EMF Director is Dr. John P. Weyant.
- Provides a structured forum within which energy and climate change experts from government, industry, universities, and other research organizations meet to study important issues of common interest.
- Reports of the EMF, such as the Special Issue of The Energy Journal: *The Costs Of The Kyoto Protocol: A Multi-Model Evaluation*, May, 1999, have been influential in climate change policy analyses.



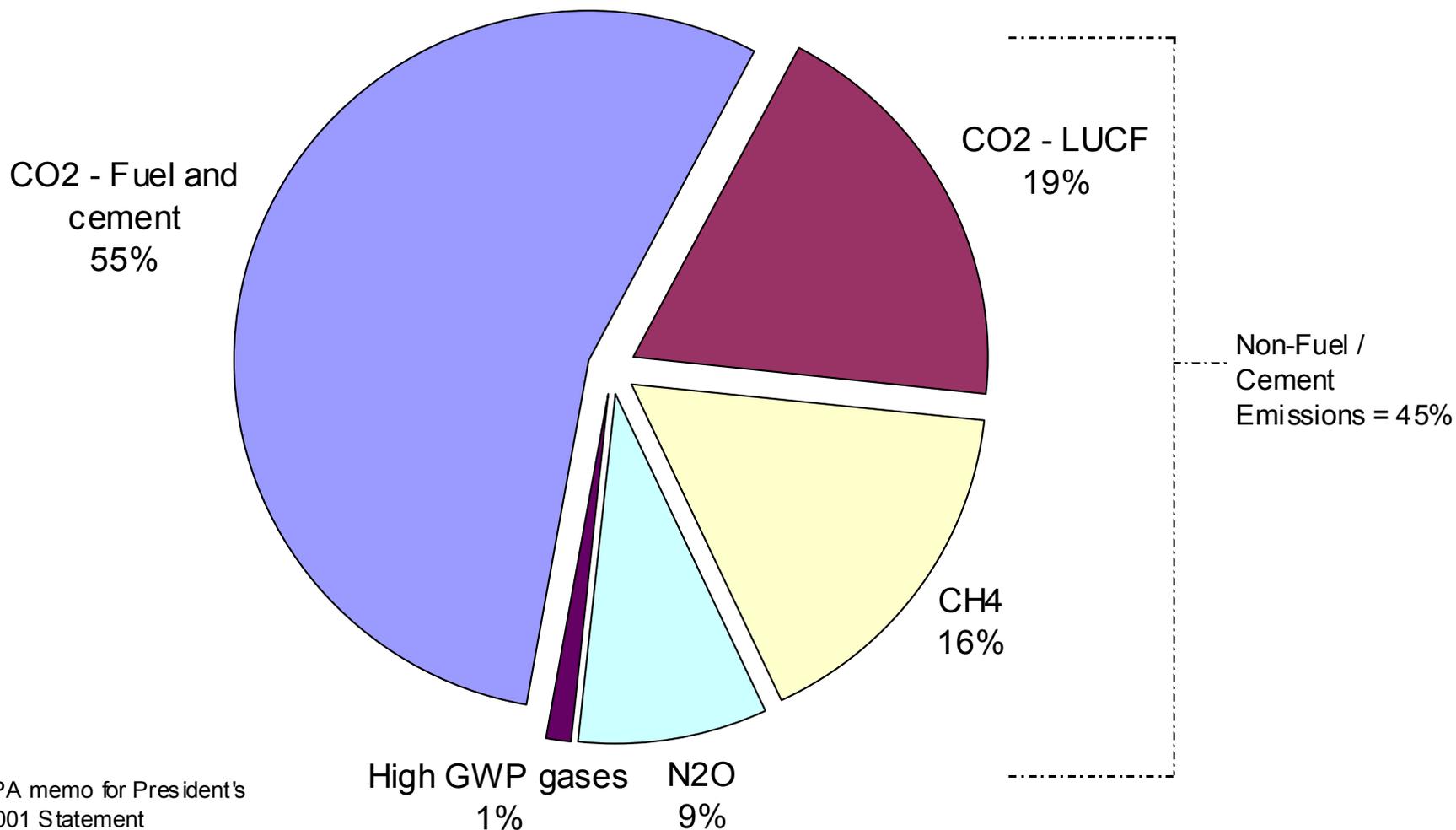
# EMF 21 Working Group Objectives

Francisco C. de la Chesnaye, Workgroup Chairman

- 1) Conduct a new comprehensive, multi-gas policy assessment to improve the understanding of the affects of including non-CO<sub>2</sub> GHGs (NCGGs) and sinks (terrestrial sequestration) into short- and long-term mitigation policies. Answer the question: *How important are NCGGs in climate policies?*.
- 2) Advance the state-of-the-art in integrated assessment / economic modeling
- 3) Strengthen collaboration between NCGG and Sinks experts and modeling teams
- 4) Publish the results as a special journal issue

# Why Multi-gas Mitigation (1) ?

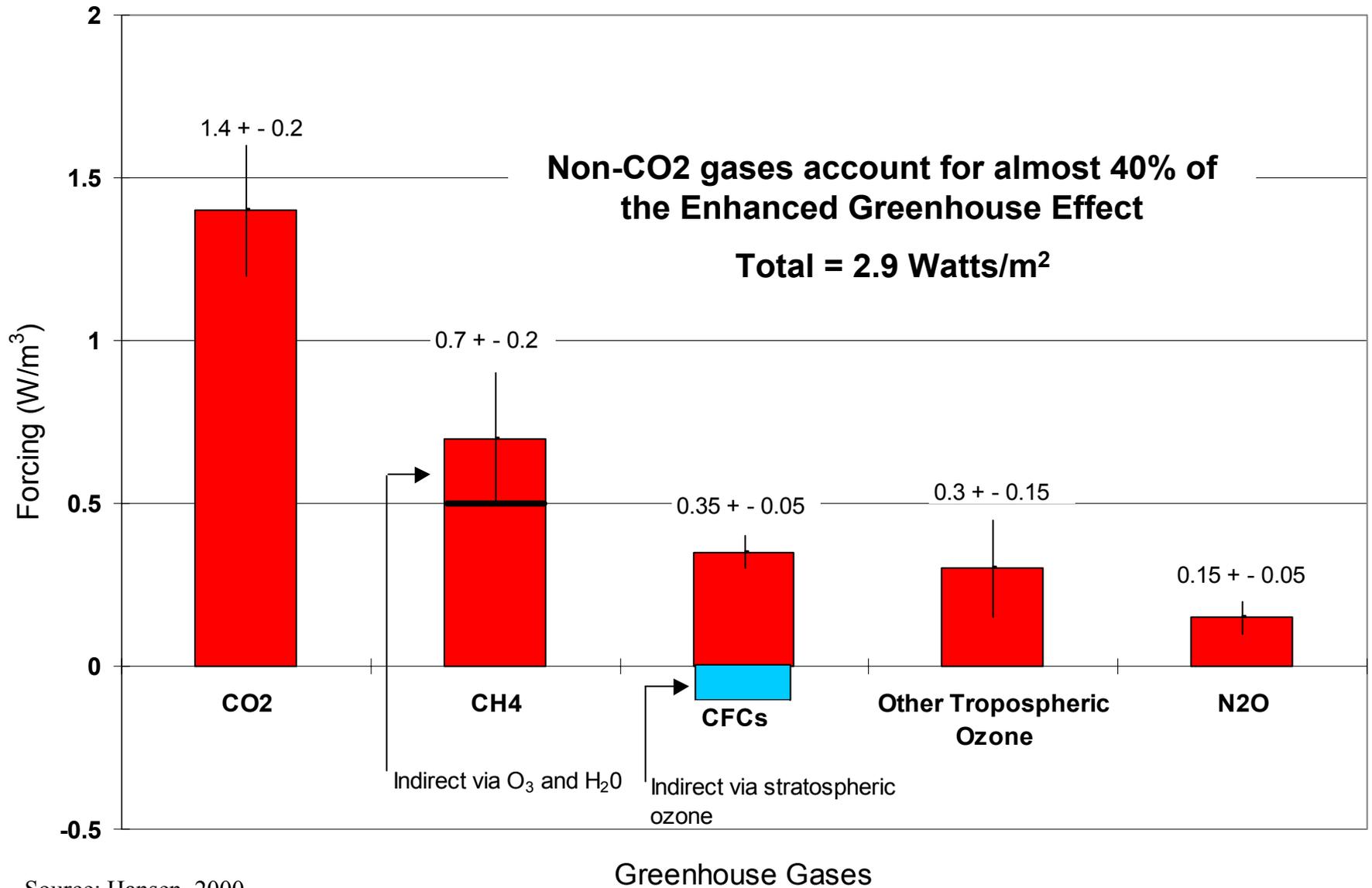
Global Net Emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, High GWP gases, and LUCF (Total 40,702 Mt CO<sub>2</sub> Eq.)



## Global 2000 Emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, High GWP gases (Mt CO<sub>2</sub> Eq.)

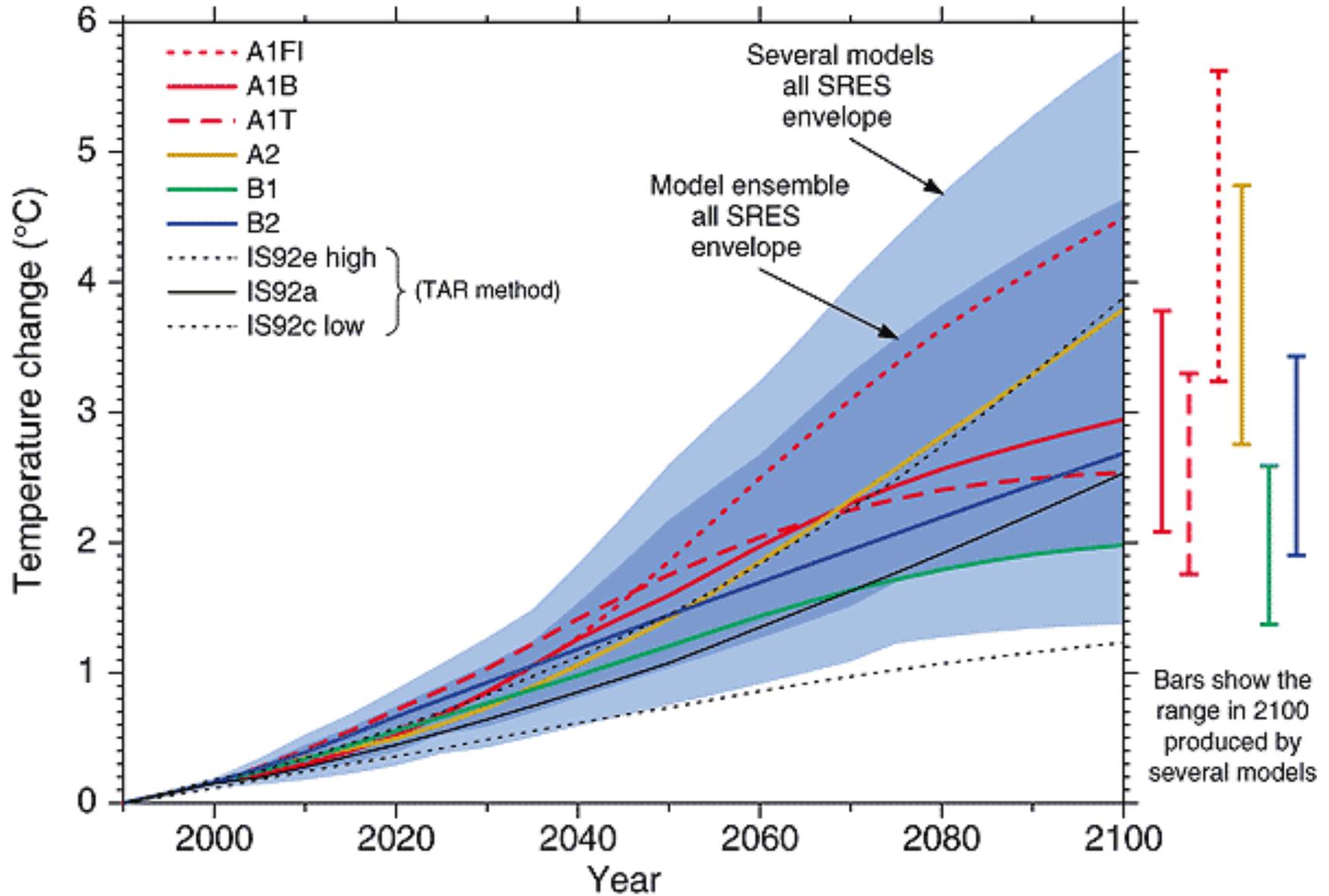
	Total	Percent	Annex 1	Percent	Non-Annex 1	Percent
CO <sub>2</sub> - Fuel and cement	22,340	55%	13,145	75%	9,195	40%
CO <sub>2</sub> - LUCF (net)	7,712	19%	67	0.4%	7,645	33%
CH <sub>4</sub>	6,701	16%	2,417	14%	4,284	19%
N <sub>2</sub> O	3,503	9%	1,559	9%	1,944	8%
High GWP gases	447	1%	360	2%	87	0.4%
<b>Total</b>	<b>40,702</b>		<b>17,547</b>		<b>23,155</b>	
			<b>% of total</b>	<b>43%</b>	<b>% of total</b>	<b>57%</b>

# GHG Climate Forcings



# Range of global mean temperature change from 1990 to 2100

Figure 9.14, IPCC WG1, TAR



# Why Multi-gas Mitigation (2) ?

- A multi-gas strategy implies:
  - Lower costs: 40% to 60% vs CO<sub>2</sub> only in KP
  - More domestic action, diversification of mitigation options across sectors
- NCGGs are very important, more so in Non-Annex I countries:
  - In a CO<sub>2</sub> and methane abatement strategy with small reductions from reference (10%), methane contributes 40 to 55% of abatement in most developed countries and 65 to 80% in developing countries

# **Economy, Technology, & Integrated Assessment Models (19)**

## **Asia / Australia**

ABARE (Brian Fisher & Kate Woffenden) with GTEM

Energy Research Institute China (Jiang Kejun)

IAE Japan (Atsushi Kurosawa) with GRAPE

National Institute for Environmental Studies, Japan (Junichi Fujino) with AIM

## **Europe**

CEA - IDEI (Marc Vielle) with GEMINI-E3

Cntr for European Econ Research-(C. Boehringer & A. Loschel) with EU PACE

Copenhagen Economics (Jesper Jensen) with the EDGE Model

ECN (Koen Smekens) with MARKAL Europe

Hamburg Univ. (Richard Tol) with FUND

IIASA (Keywan Riahi & Leo Schrattenholzer)

Oldenburg University, Germany (Claudia Kemfert)

RIVM (Tom Kram & Detlef van Vuuren) with IMAGE

UPMF (Patrick Criqui) & CIRAD (Daniel Deybe) with POLES/AGRIPOL

## **US**

Argonne Nat Lab (Don Hanson) & EPA (Skip Laitner) with AMIGA

Energy Information Agency (Andy Kydes) with SAGE

EPRI (Rich Richels) & Stanford Univ (Alan Manne) with MERGE

MIT (John Reilly) with EPPA

PNNL (Jae Edmonds, Hugh Pitcher & Steve Smith) with SGM & MiniCAM

Univ of Colorado (Thomas Rutherford)

## **Non-CO<sub>2</sub> GHG Experts**

Paul Freund and John Gale, IEA Greenhouse Gas R&D Programme

## **Methane & N<sub>2</sub>O**

Ann Gardiner, Judith Bates, AEA Technology

Casey Delhotal, Dina Kruger, Elizabeth Scheehle, USEPA

Chris Hendriks, Niklas Hoehne, Ecofys

## **Fluorinated (HGWP) Gases**

Jochen Harnish, Ecofys, Germany

Deborah Ottinger and Dave Godwin, USEPA

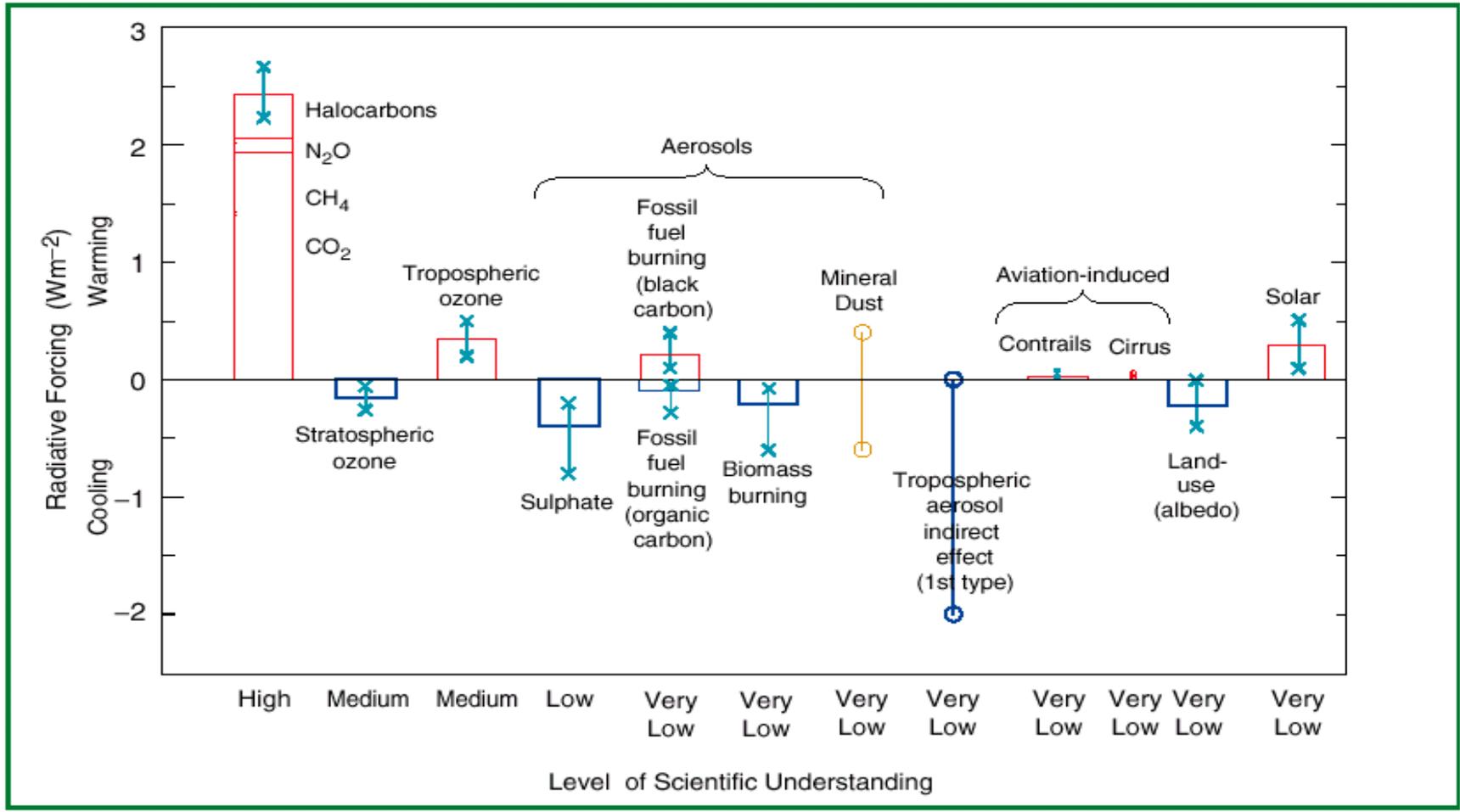
## **Sinks (Terrestrial Sequestration)**

Roger Sedjo, RFF and Brent Sohngen, Ohio State Univ

Bruce McCarl, Texas A&M

Ken Andrasko, USEPA & Jayant Sathaye, LBNL

# Radiative contributors (since 1750)



Source: IPCC-TAR WG I (TS)