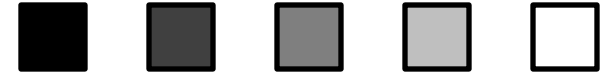
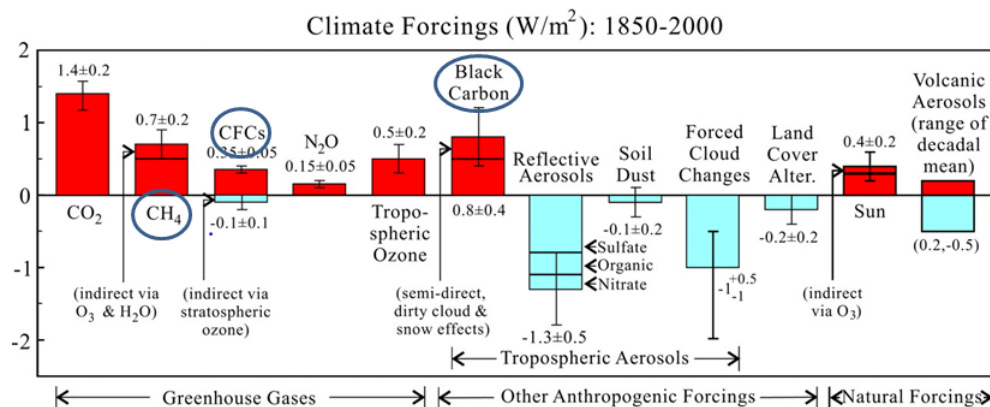


Carbon Zero Institute



Why Methane Matters

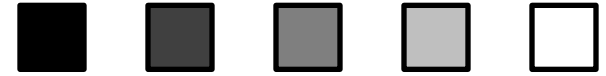
Prepared for June 13, 2013
Public Workshop for
The 2013 Update to
AB 32 Scoping Plan



Hansen J E , and Sato M PNAS 2001;98:14778-14783

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Carbon Zero Institute



Mission: **Net Zero by Mid Century**

Focus: ***Gigaton Projects***

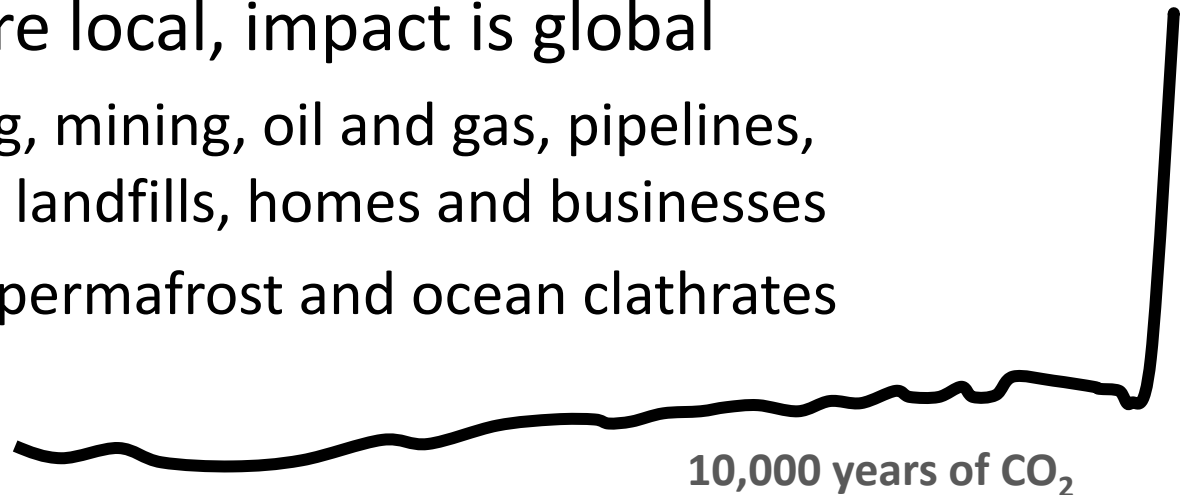
www.carbonzeroinstitute.org

Net Zero
Mid Century



Monitor Methane Worldwide

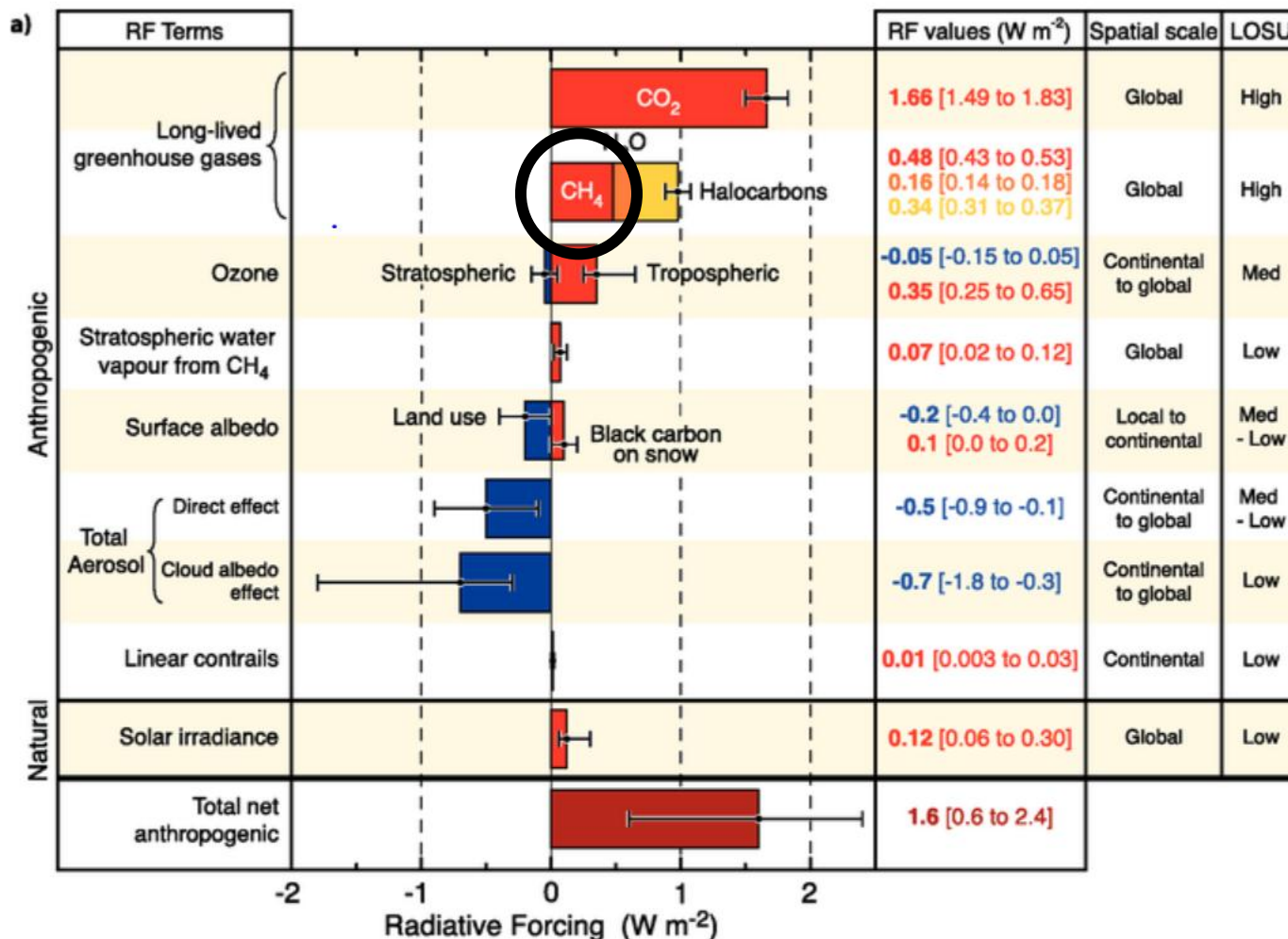
- All sources
- Sources are local, impact is global
 - Ranching, mining, oil and gas, pipelines, refining, landfills, homes and businesses
 - Tundra, permafrost and ocean clathrates



Methane is Powerful Warming Agent

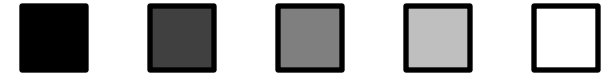
100 Year GWP

GLOBAL MEAN RADIATIVE FORCINGS



©IPCC 2007: WG1-AR4

More Potent than CO₂

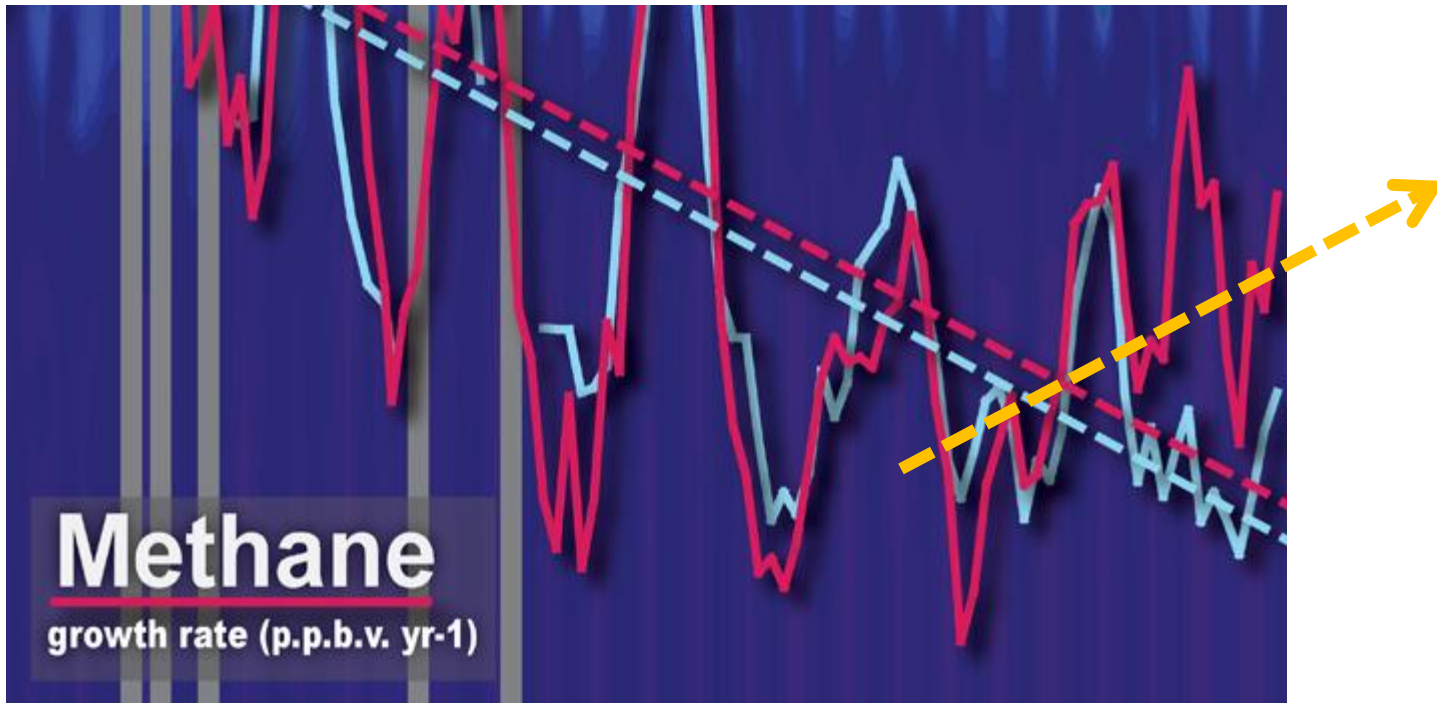
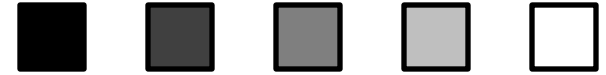


Twenty to 70+ *times* the global warming potential (GWP) of CO₂ depending on timeframe

		Lifetime (years)	GWP 20-yr	GWP 100-yr
Carbon dioxide	CO ₂		1	1
Methane	CH₄	12	72x	25x
Nitrous oxide	N ₂ O	114	289x	298x
HFC-23	CHF ₃	270	12,000x	14,800x

Methane Rising Again

Why?



NASA and UC Irvine

1995 to 2011

Yellow line added

p.p.b.v is parts per billion by volume

Chart cropped by NASA, full chart is available online:

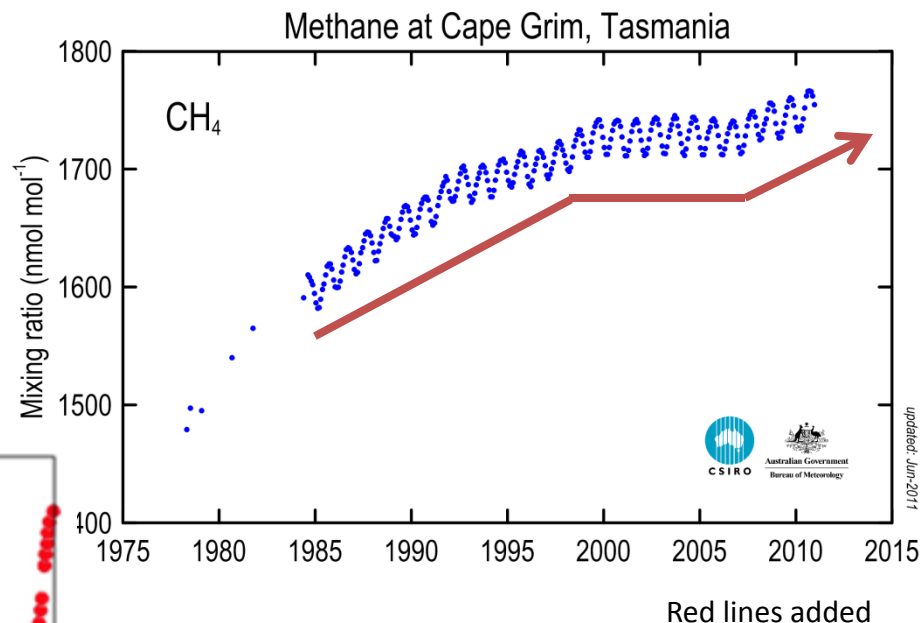
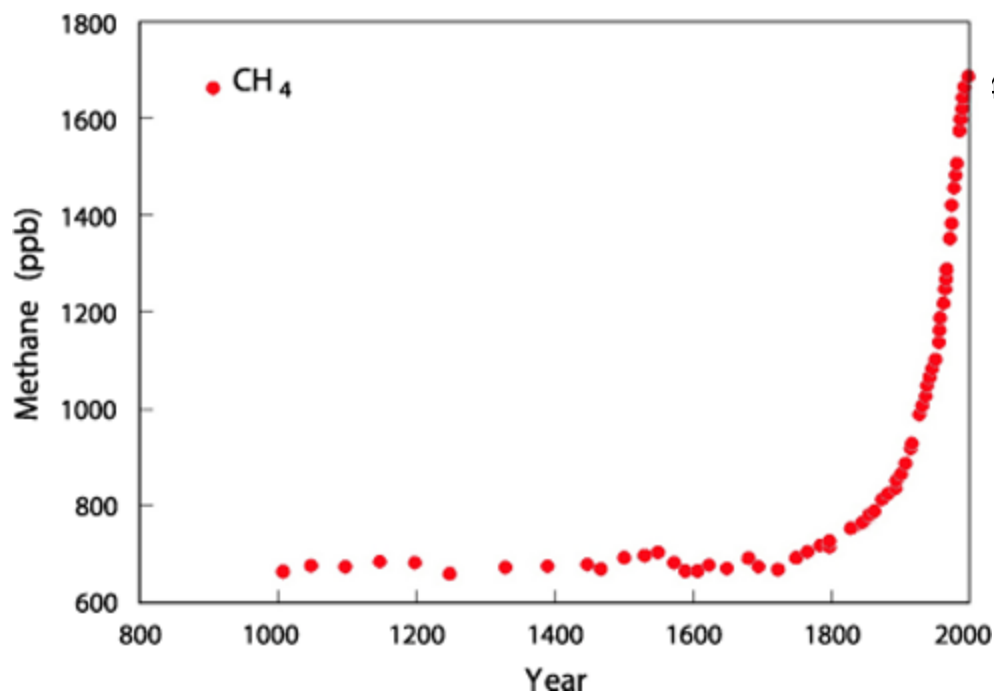
<http://www.jpl.nasa.gov/news/news.php?release=2012-263>

<http://www.nasa.gov/topics/earth/features/earth20120828.html>

Need Better Monitoring



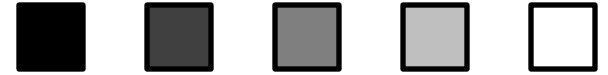
**With a 12-year Life,
We Should Be Able to
Reduce Atmospheric
Methane**



http://www.cmar.csiro.au/research/capegrim_graphs.html

<http://www.environment.gov.au/soe/2001/publications/theme-reports/atmosphere/atmosphere02-16.html>

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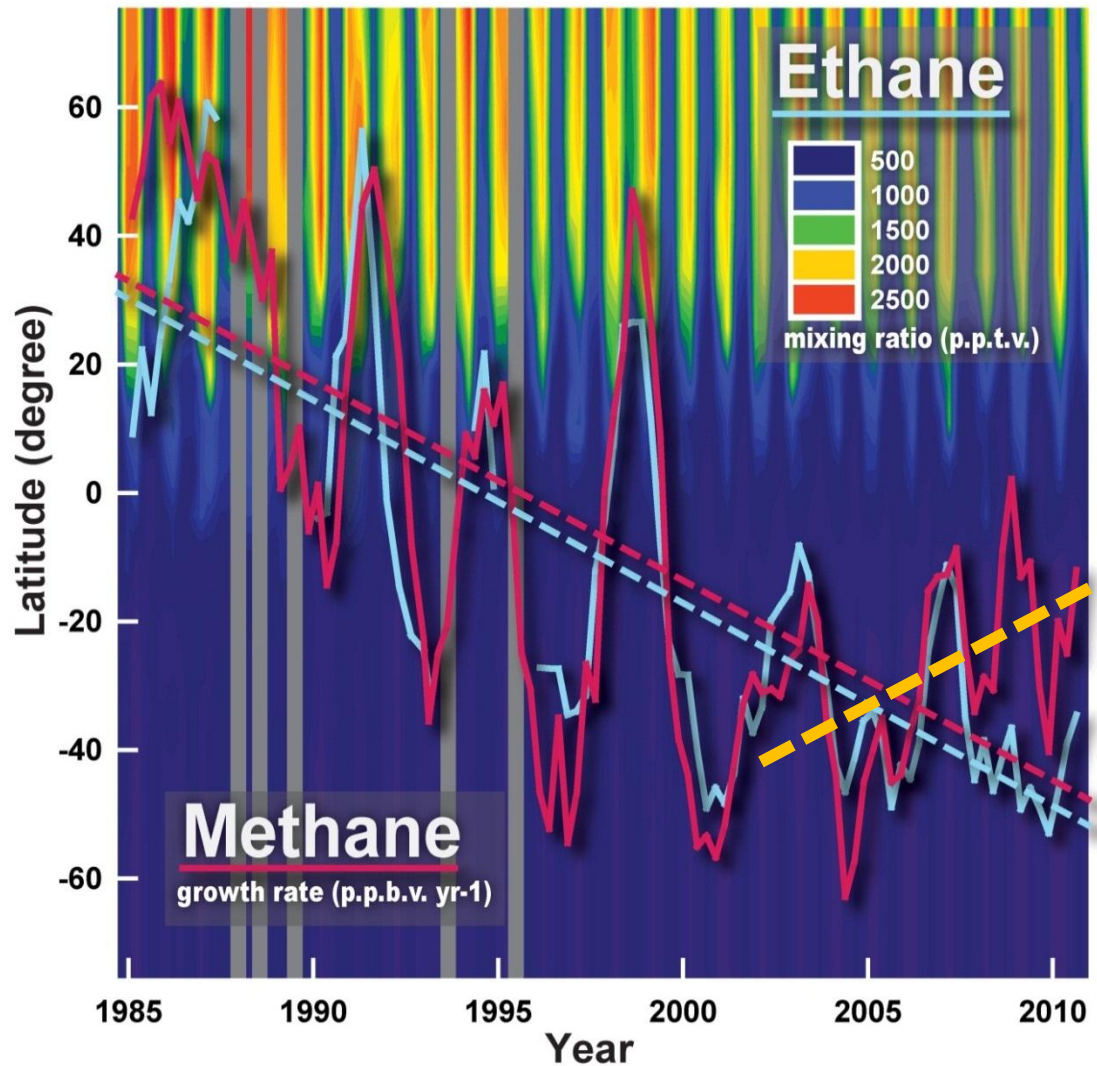


An Advocate for Net zero emissions Mid century



Stylized graph of CO₂ levels over the past 10,000 years from ice cores and measurements at Mauna Loa
<http://www.skepticalscience.com/are-humans-too-insignificant-to-affect-global-climate.html>

Appendix



UC Irvine and NASA

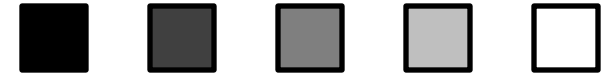
p.p.b.v is parts per billion by volume

Yellow line added

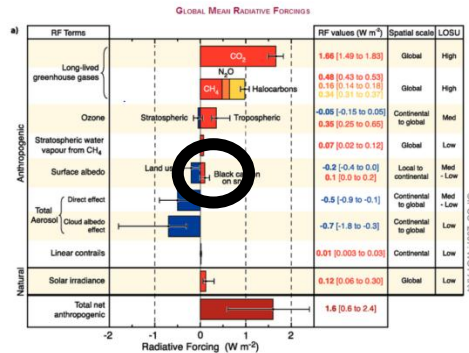
<http://www.jpl.nasa.gov/news/news.php?release=2012-263>

<http://www.nasa.gov/topics/earth/features/earth20120828.html>

Differing Estimates of the Impact of Black Carbon



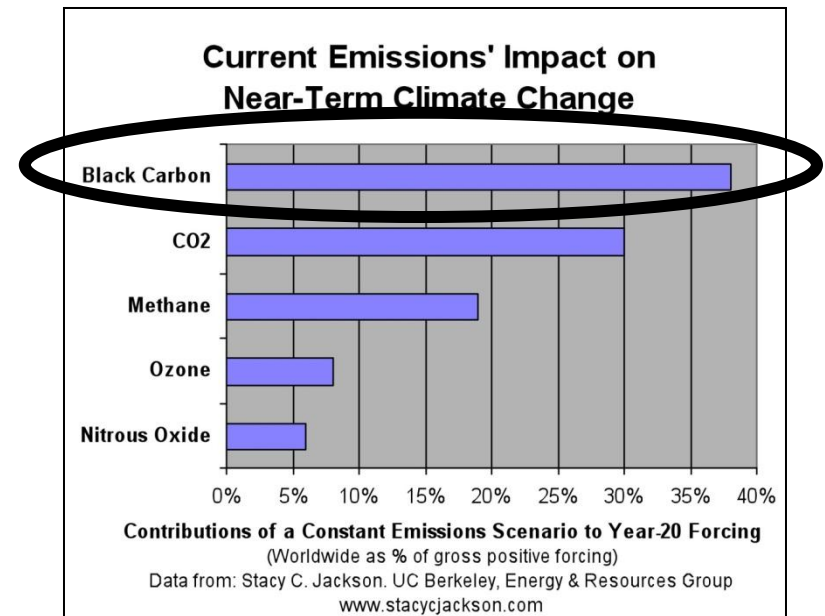
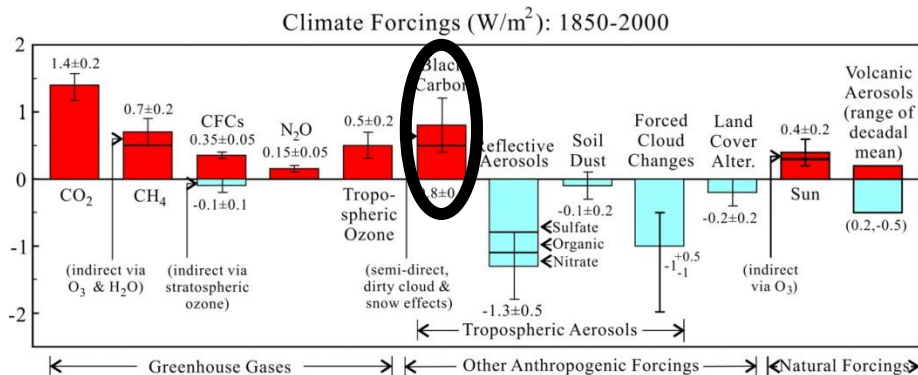
Low
IPCC



Impact varies by location, methodology and timeframe

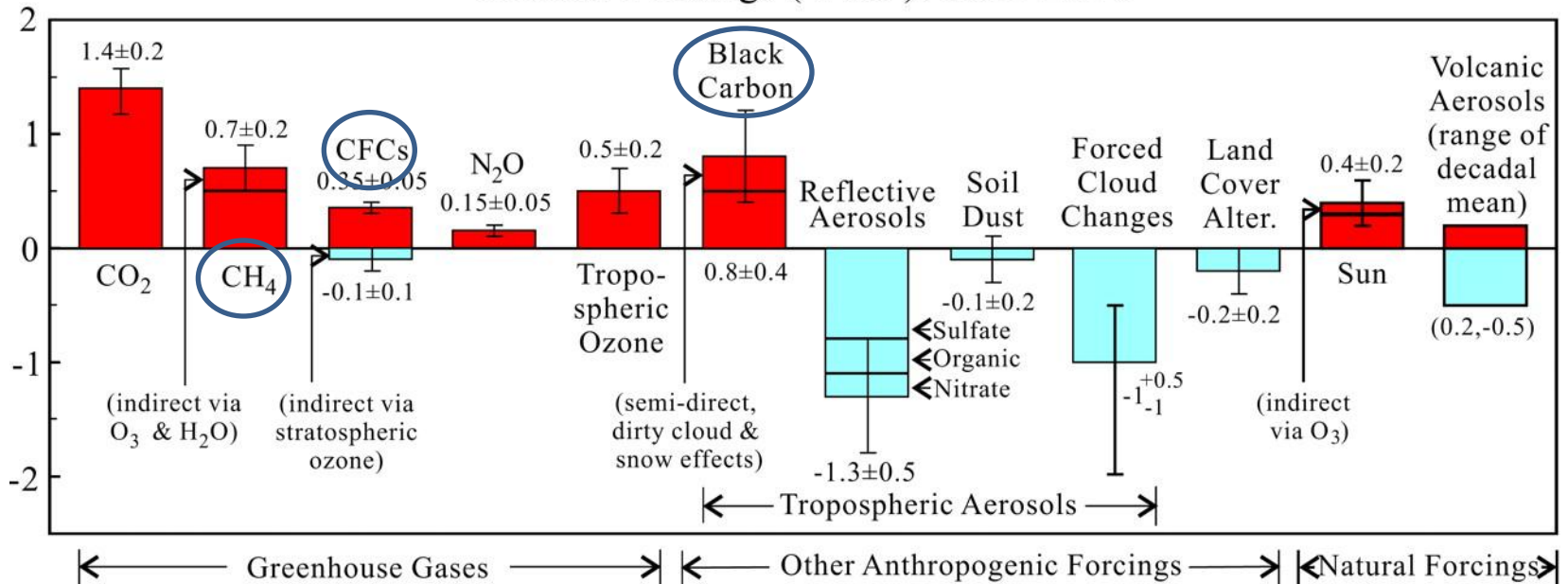
High
Jackson, UCB

Medium
Hansen & Sato



Hansen and Sato

Climate Forcings (W/m^2): 1850-2000



Hansen J E , and Sato M PNAS 2001;98:14778-14783

Twenty year GWP

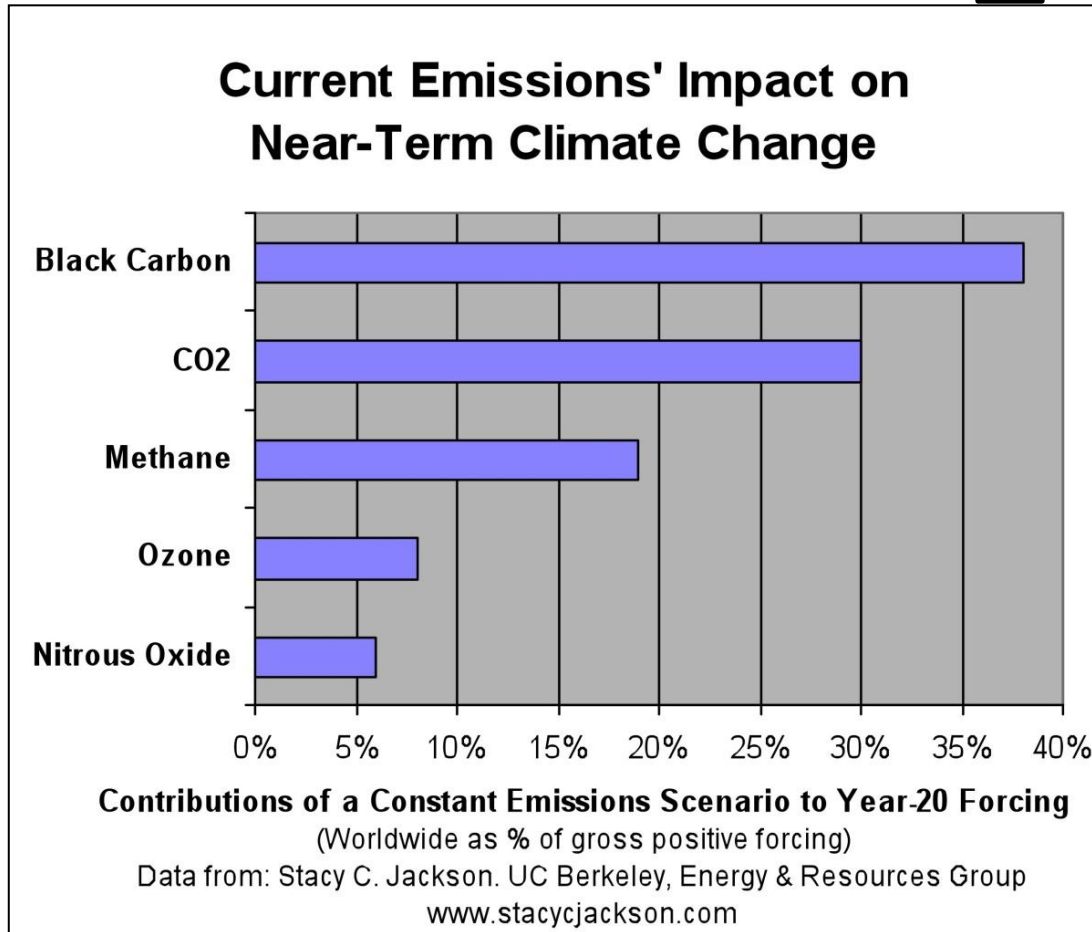


Chart from *Addicted to Energy*, research by Stacy Jackson, UC Berkeley

[http://www.stacycjackson.com/images/Copenhagen_Conference_Handout - Mar 2009.pdf](http://www.stacycjackson.com/images/Copenhagen_Conference_Handout_-_Mar_2009.pdf)

Global Sources of Pollutants, in detail

Contributions of Future Emissions to Year 20 Forcing
(as % of gross positive forcing)

Legend	
As percentage of gross positive forcing:	
2 to 5%	-2 to -5%
5 to 10%	-5 to -10%
over 10%	below -10%

	Carbon Dioxide (CO2)	Nitrous Oxide (N2O)	Methane (CH4)	Ozone (O3)	Black Carbon (BC)	Total (Gross)	Sulfur Dioxide (SO2)	Organic Carbon (OC)	Total (Net)	
Fossil Fuel Combustion										
Industry FF combustion	4%	0%	0%	0%	3%	8%	-7%	0%	0%	} as % of gross: 47% Fossil fuel
Power generation (FF)	9%	0%	0%	0%	0%	9%	-16%	0%	-7%	
Resid. & Comm'l FF combustion	3%	0%	0%	0%	3%	6%	-2%	0%	4%	
Road transport (FF)	4%	0%	0%	1%	4%	10%	-1%	0%	9%	
Non-road land transport (FF)	0%	0%	0%	0%	3%	3%	-1%	0%	3%	
Other FF use	2%	0%	0%	0%	0%	2%	-2%	0%	0%	
Fossil Fuel Production										
FF production (gas, coal, oil, gasoline)	2%	0%	6%	1%	0%	9%	-4%	0%	4%	} 45% Land and food
Land Use & Food Production										
Deforestation	3%	0%	1%	1%	6%	10%	0%	-3%	6%	
Savannah burning	0%	0%	1%	1%	8%	10%	-1%	-4%	5%	
Residential biofuel combust.	0%	0%	1%	1%	5%	8%	-1%	-1%	5%	
Other fires	0%	0%	0%	0%	3%	4%	0%	-1%	3%	
Livestock	0%	2%	5%	0%	0%	7%	0%	0%	7%	
Agriculture	0%	4%	2%	0%	0%	6%	0%	0%	6%	
Human Waste Management										
Human waste management	0%	0%	3%	0%	0%	4%	0%	0%	4%	
Industrial Processes										
Industrial processes (cement, chemicals)	1%	0%	0%	1%	0%	2%	-9%	0%	-7%	} 8% Other
Other	0%	0%	0%	0%	2%	2%	0%	0%	2%	
Total	30%	6%	19%	8%	38%	100%	-46%	-10%	44%	



Recommendations from Stacy Jackson's website associated with the prior chart (2009)

Policy Implications of Findings

Separate policies for CO₂, methane, black carbon, and ozone precursors are essential:

- **Large near-term contribution** of each pollutant
- **Unique impacts** of short-lived (black carbon, ozone): regional, seasonal
- **Unique roles** of methane as a *near-term* lever and carbon dioxide as a *long-term* lever: linking them in trade reduces ability to independently manage the levers
- **Wide variation in measurability:** different policy instrument types are appropriate
- **Urgency of near-term climate change:** need maximum reduction of each pollutant

Offsets that trade a capped pollutant for a non-capped pollutant should be avoided:

- **Mismatched trade** of well- and poorly-measured emissions
- **Disincentive for regulation of “offset-eligible activities”:** regulation requires forfeiture of the offset revenue stream
- **Dilution of environmental outcome** resulting from diminished reductions of capped pollutant and lack of regulations on non-capped pollutants