FRACKING FORUM: Risks and Rewards

Monday October 6th, 2014

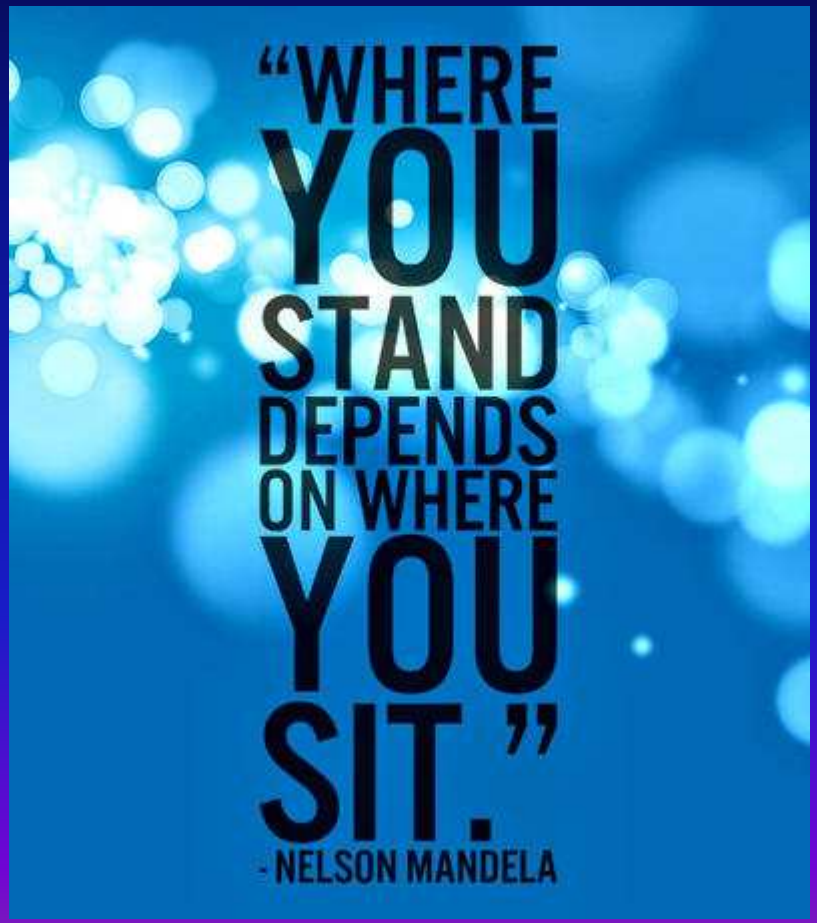
Paul E. Belanger, Ph.D.

Moderator

http://denverclimatestudygroup.com/ - fracking tab

PEBelanger@glassdesignresources.com

It’s about Energy and our Future



Or live – i.e. NIMBY

Or who you work for

Or what party you affiliate yourself

Or whether your retired or not

Or your age

Or other factors

http://img.deseretnews.com/images/top/main/26657/26657.jpg

There are Energy Impacts:

Coal:

- 2x CO_2
- Particulates
- Mercury/other
- Water contamination at waste sites
- Fugitive methane at mining sites – never discussed?

Natural Gas:

- Earthquakes from injection wells
- Water use
- Water table contamination?
- Fugitive methane
- Proximity of drilling operations

Wind/solar:

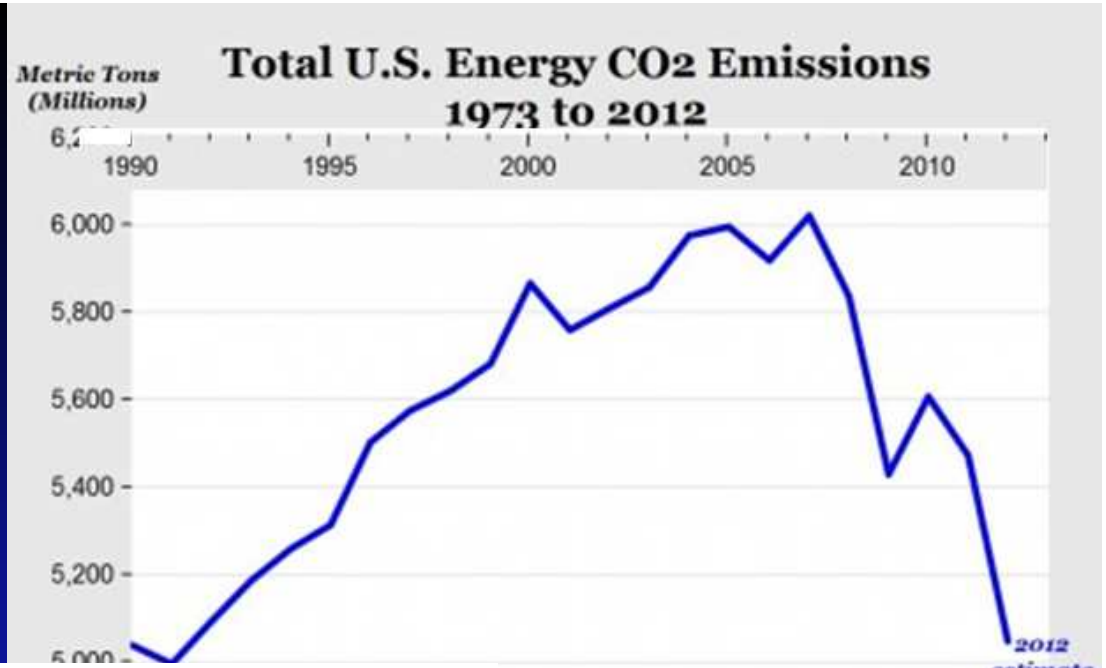
- Areal footprint
- Bird kills
- Reliability issues

What is Colorado doing about it?

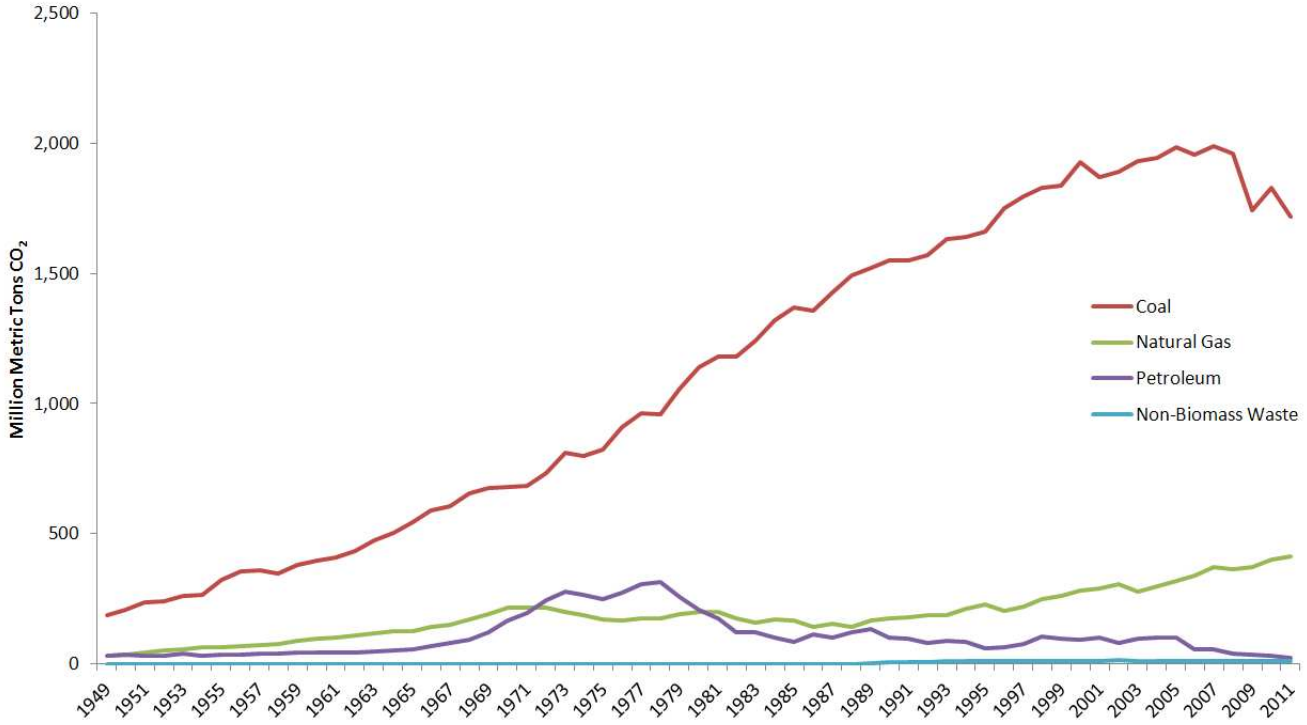
- Colorado is one of 4 states (WY, CA, OH) regulating/reducing emissions
- Colorado mandates operators address all wells within 1500’ of well-path
- Colorado mandates operators address 4 water wells within ½ mile of newly drilled well

At issue is climate change

U.S. CO_2 Emissions have come down



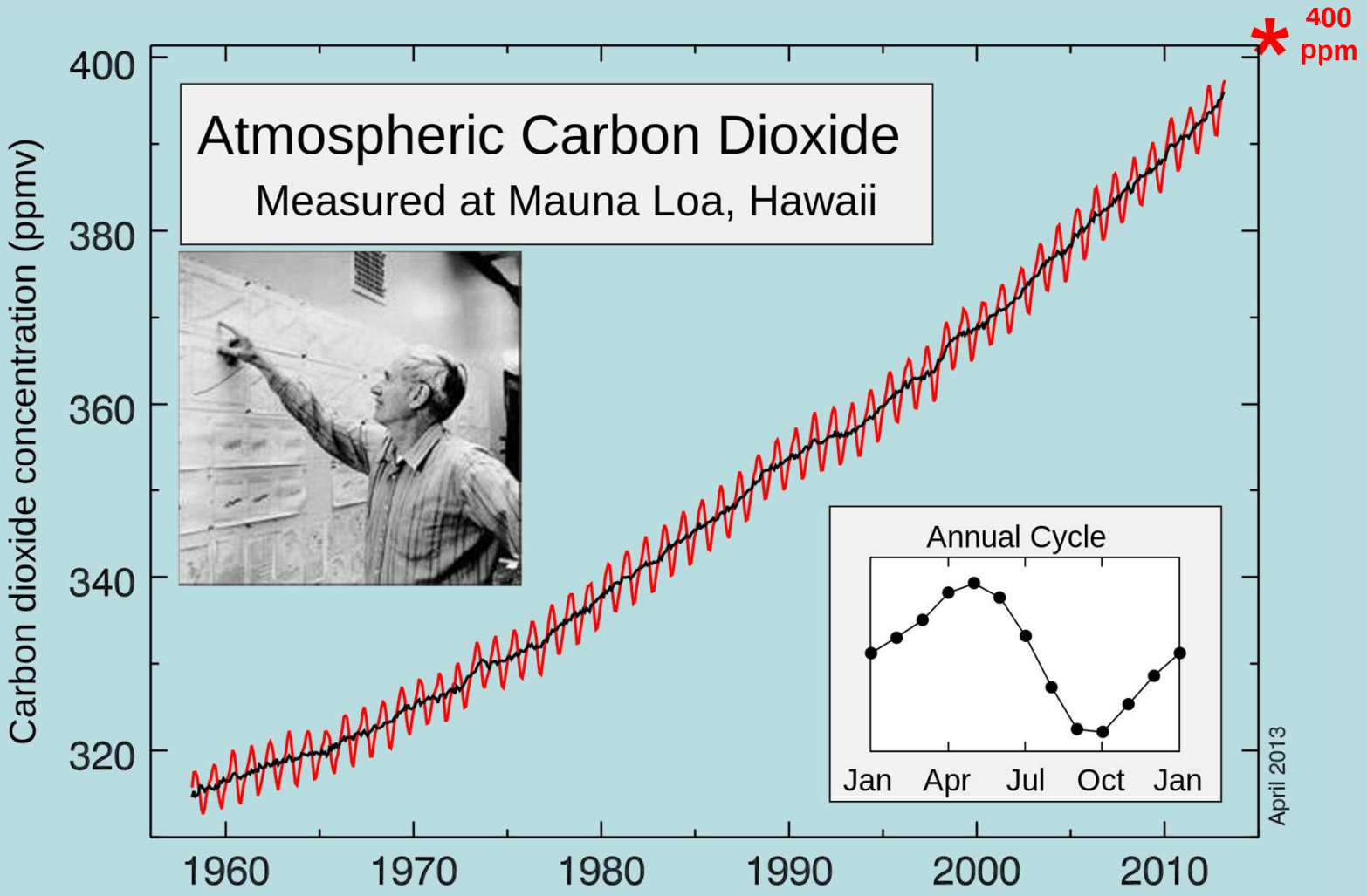
Trends in CO_2 Emissions from the U.S. Electric Power Sector, 1949 - 2011



http://www.texog.com/blog/2012/07/23/shale-boom-helps-us-achieve-largest-co2-reductions-in-the-world/

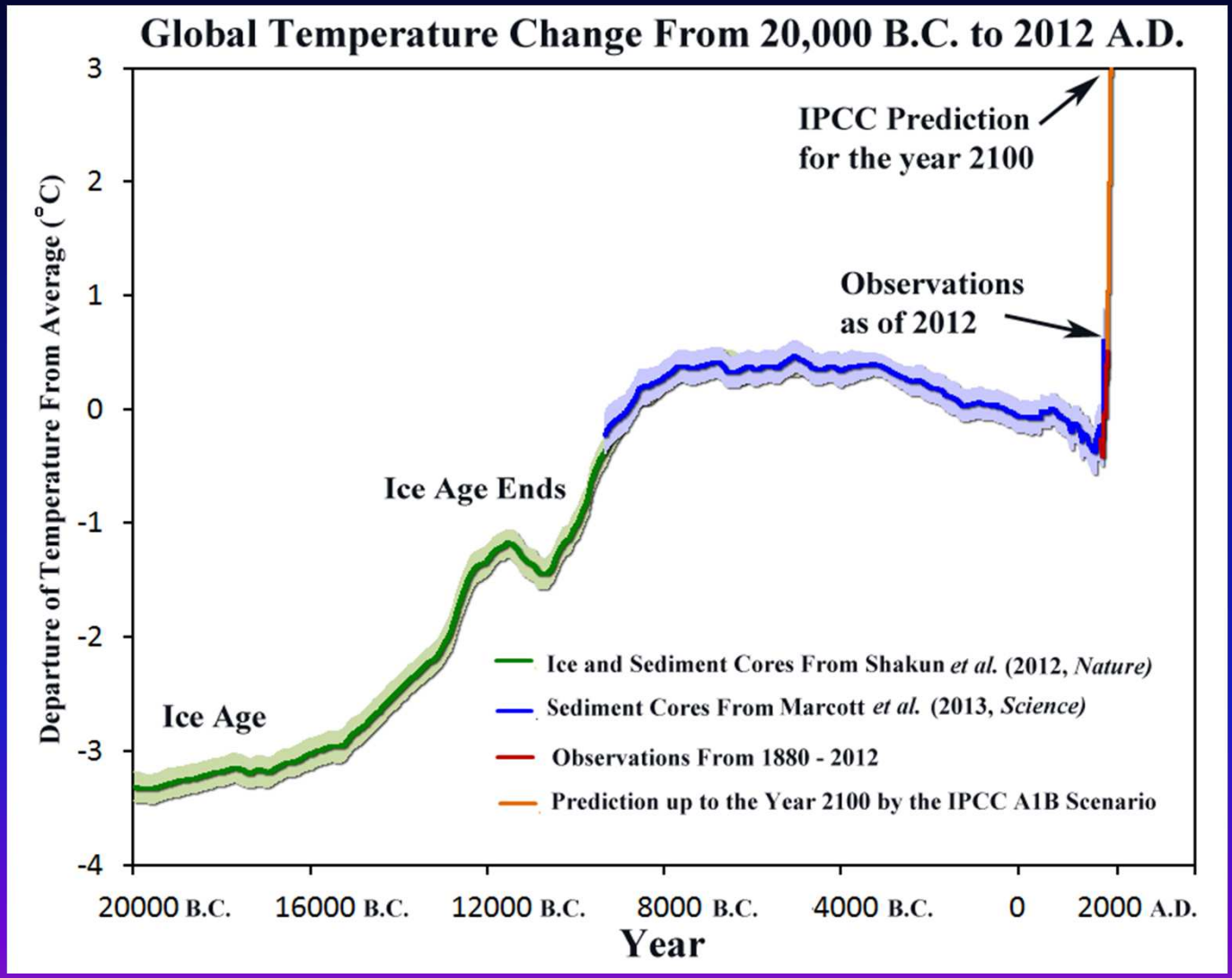
http://www.c2es.org/facts-figures/us-emissions/electric-power

Lest we forget: CO_2 is still going up



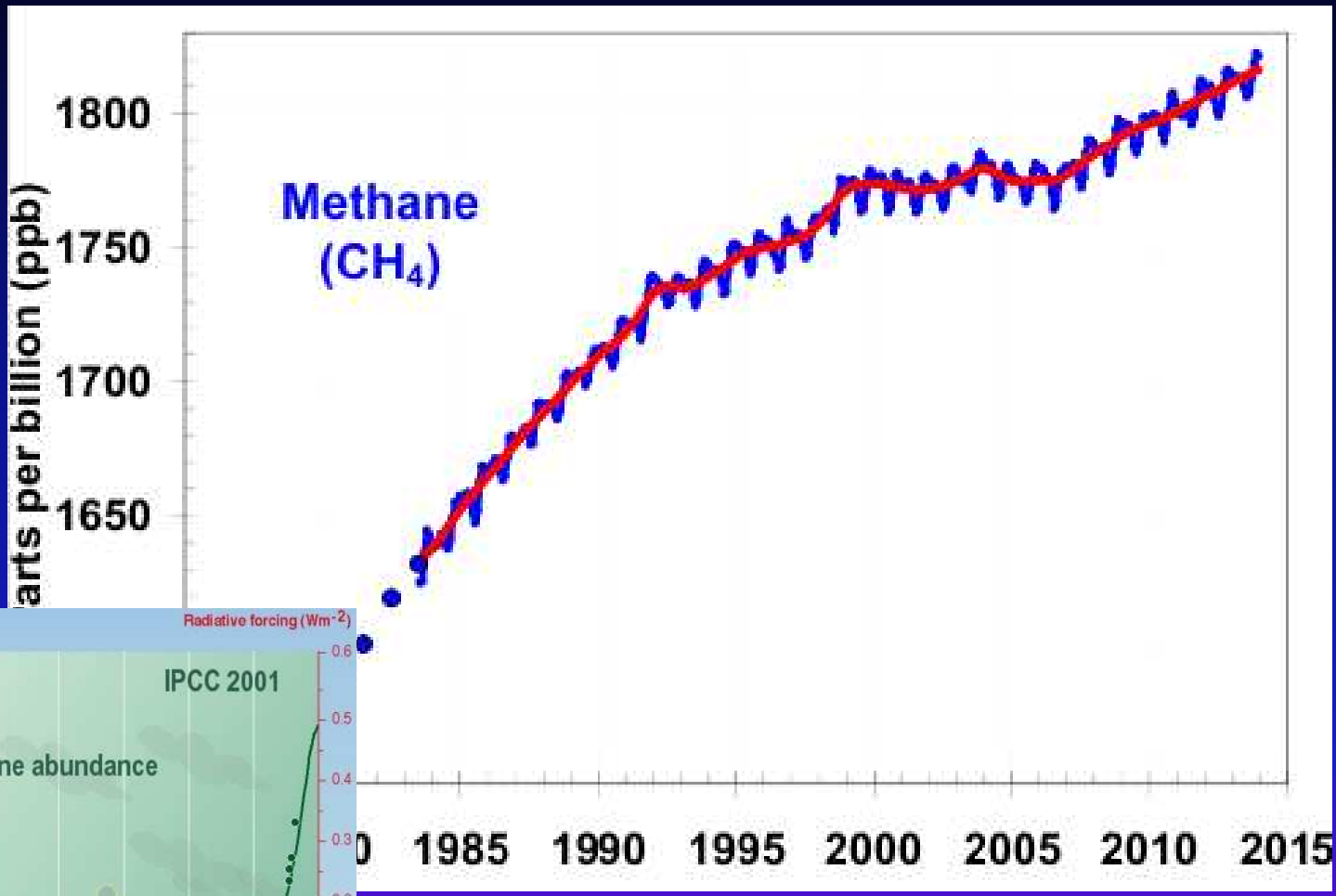
http://en.wikipedia.org/wiki/Keeling_Curve

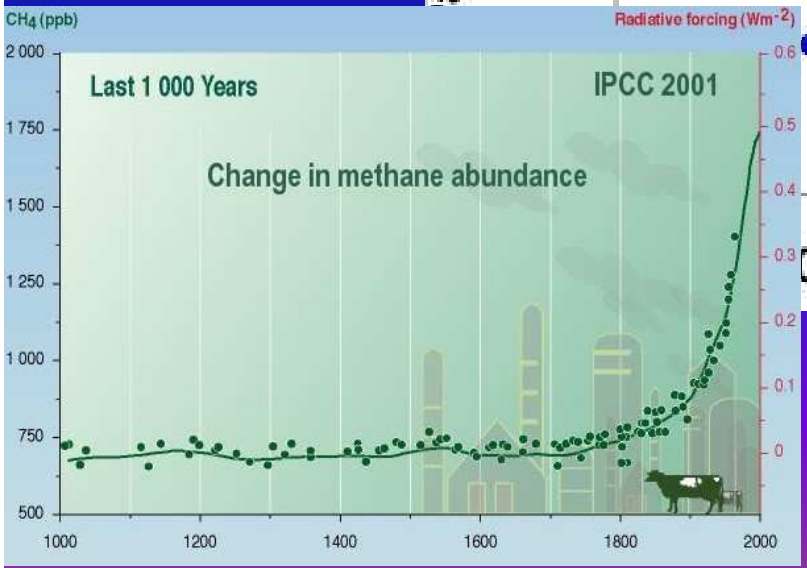
…and so are temperatures



http://tamino.wordpress.com/2013/03/22/global-temperature-change-the-big-picture/

What about Methane?

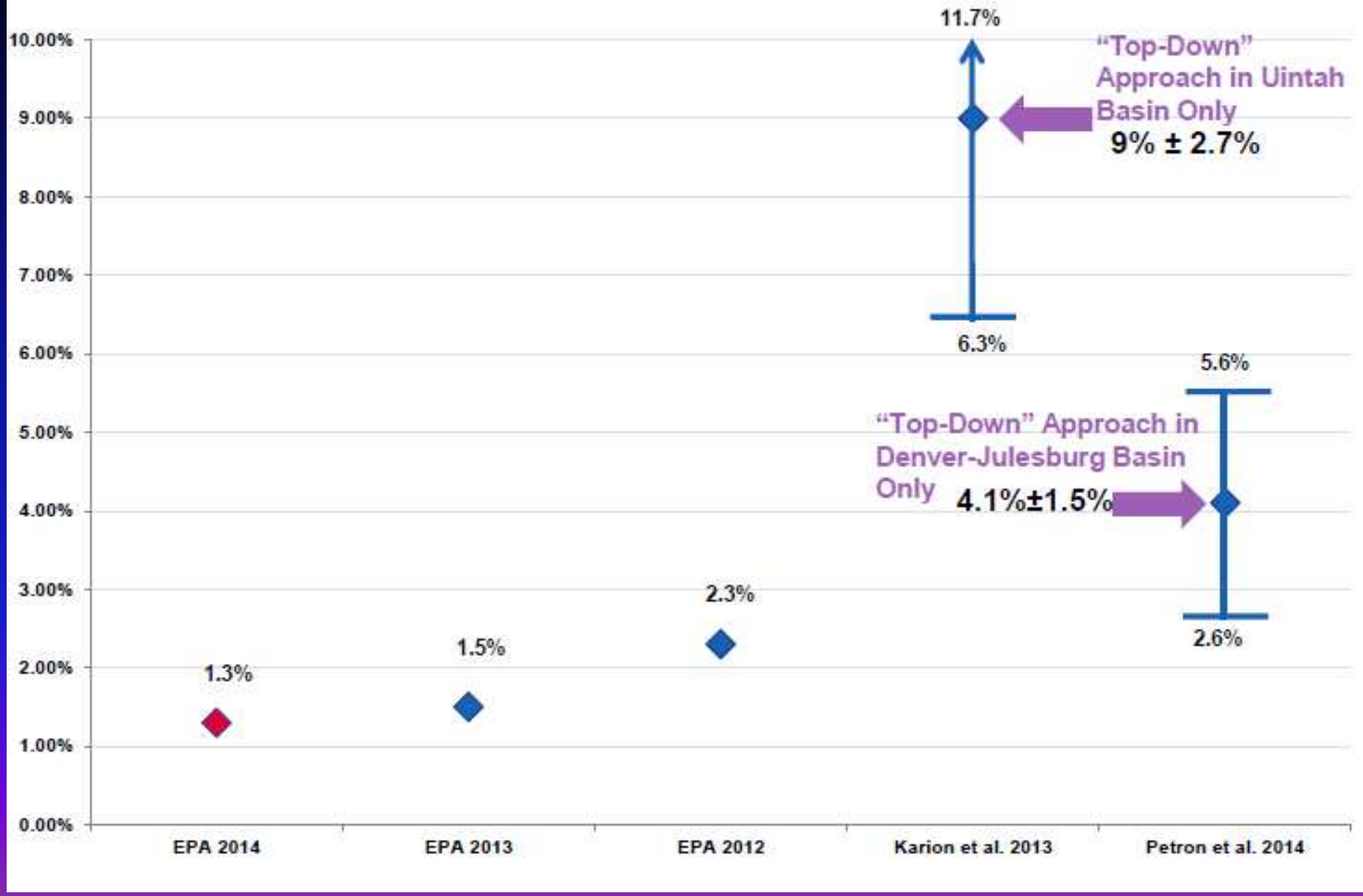




http://www.esrl.noaa.gov/gmd/aggi/aggi.html

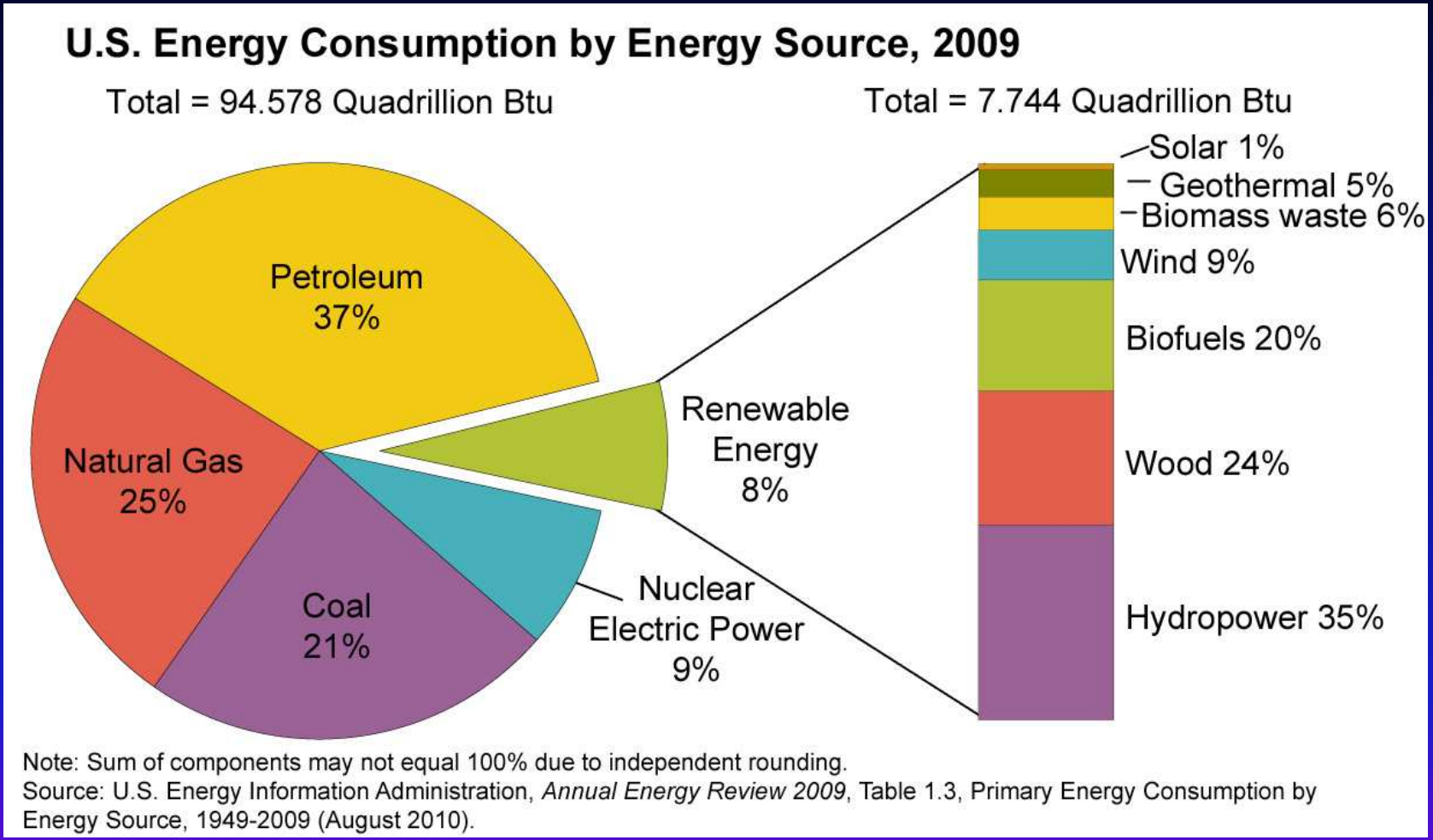
http://clathrates.blogspot.com/2012/04/threat-of-methane-release-from.html

How Much Methane do We Need to Reduce?



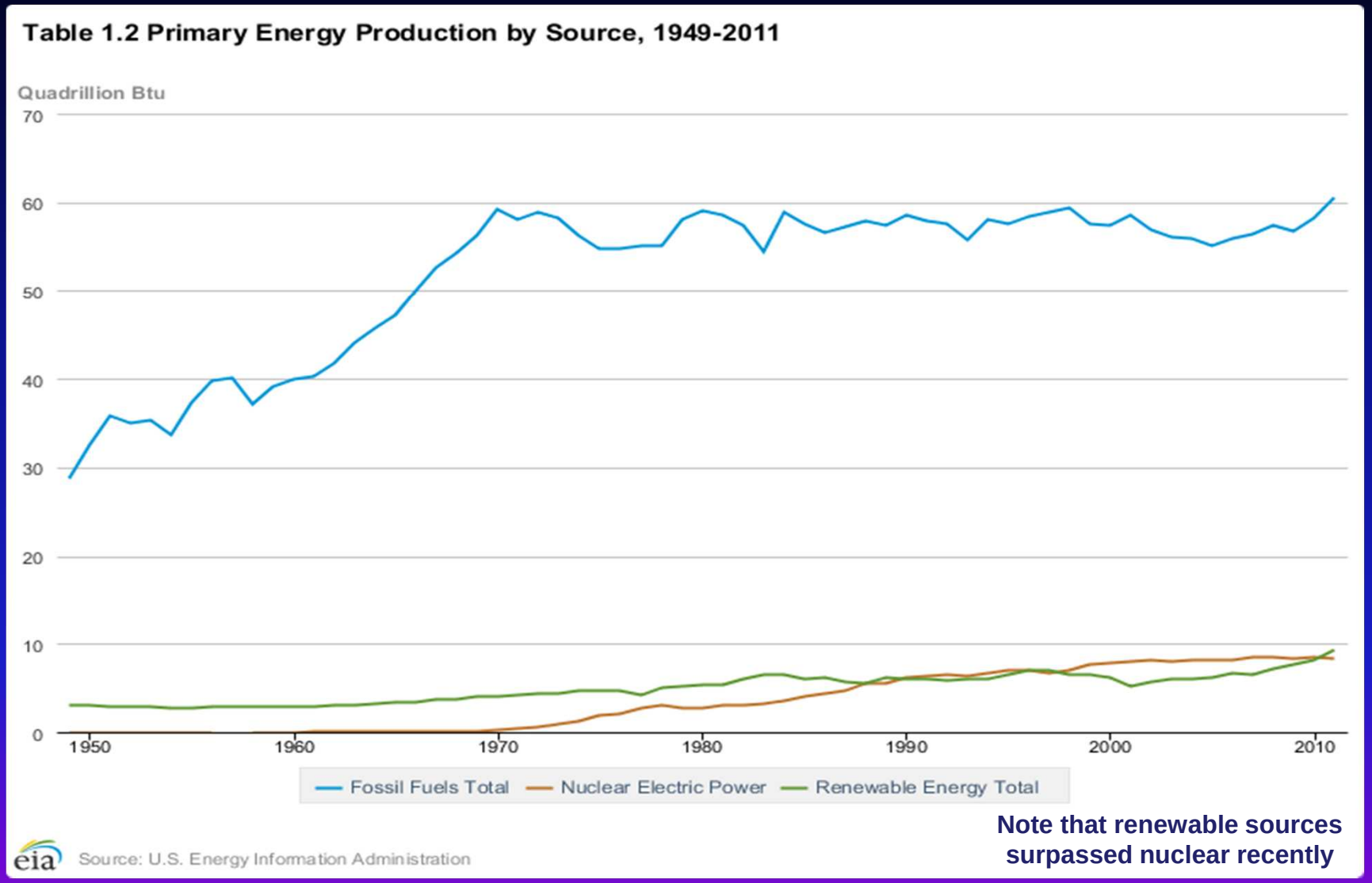
Drew Nelson; edf.org

U.S. Energy Consumption



http://www.tclabz.com/2011/03/11/steo-eia-short-term-energy-outlook-highlights/

U.S. Energy Consumption



Note that renewable sources surpassed nuclear recently

http://en.wikipedia.org/wiki/Fossil-fuel_phase-out

At issue

Resolving our energy future and climate issues involves:

- **Economic issues**
- **Reducing emissions**
  - **But also mitigation (Biochar/BECCS)**
- **Educating ourselves**
  - **About energy**
  - **About climate**
- **Building trust**
- **Dialogue**

At issue

…the low priority given by the public

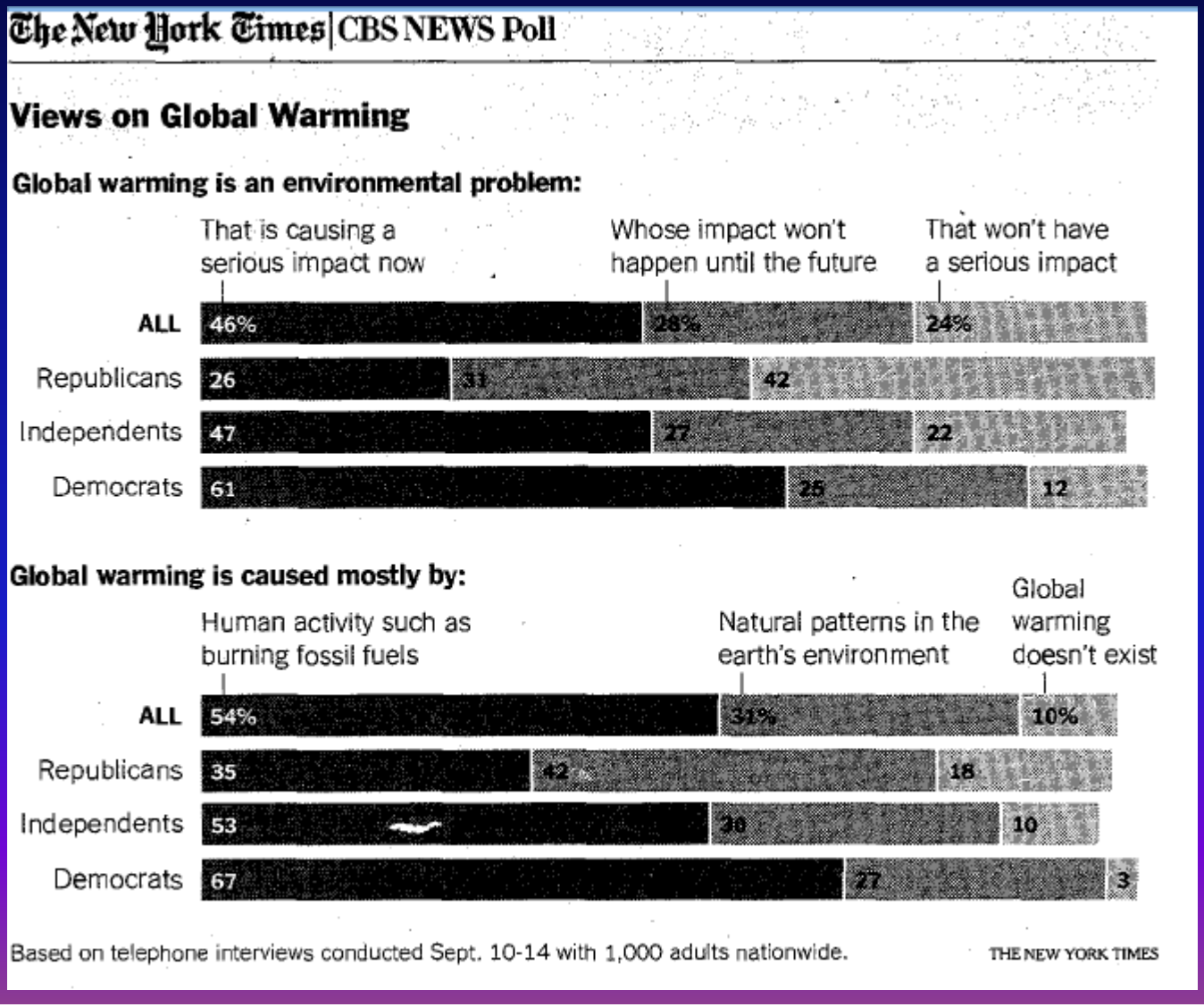
March 2014 Gallup poll – hard pressed to make changes when climate change not of great concern

	Great deal	Fair amount	A little/ not at all
	%	%	%
The economy	59	29	11
Federal spending and the budget deficit	58	22	20
The availability and affordability of healthcare	57	20	23
Unemployment	49	28	23
The size and power of the federal government	48	20	31
The Social Security system	46	29	24
Hunger and homelessness	43	33	23
Crime and violence	39	31	29
The possibility of future terrorist attacks in the U.S.	39	24	37
The availability and affordability of energy	37	30	33
Drug use	34	29	37
Illegal immigration	33	24	42
The quality of the environment	31	35	34
Climate change	24	25	51
Race relations	17	26	56

Question asked of a half sample
March 6-9, 2014

GALLUP

Views on Global warming by whether you're a Republican, Democrat or Independent



THANK YOU

With that our speakers:

John Harpole

Harv Teitelbaum

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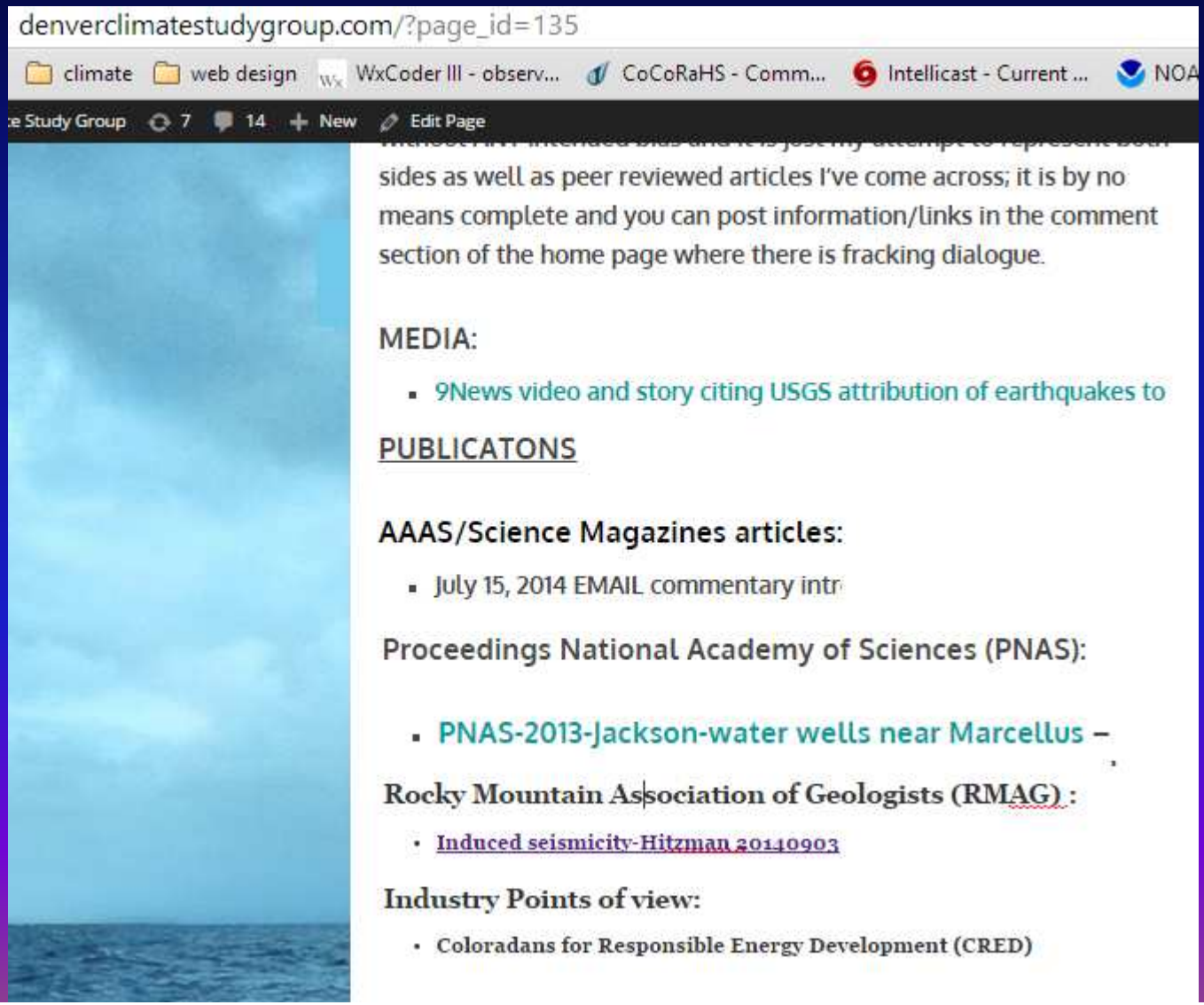
http://denverclimatestudygroup.com/ - fracking tab

http://denverclimatestudygroup.com/

Click on Fracking – excerpts displayed below



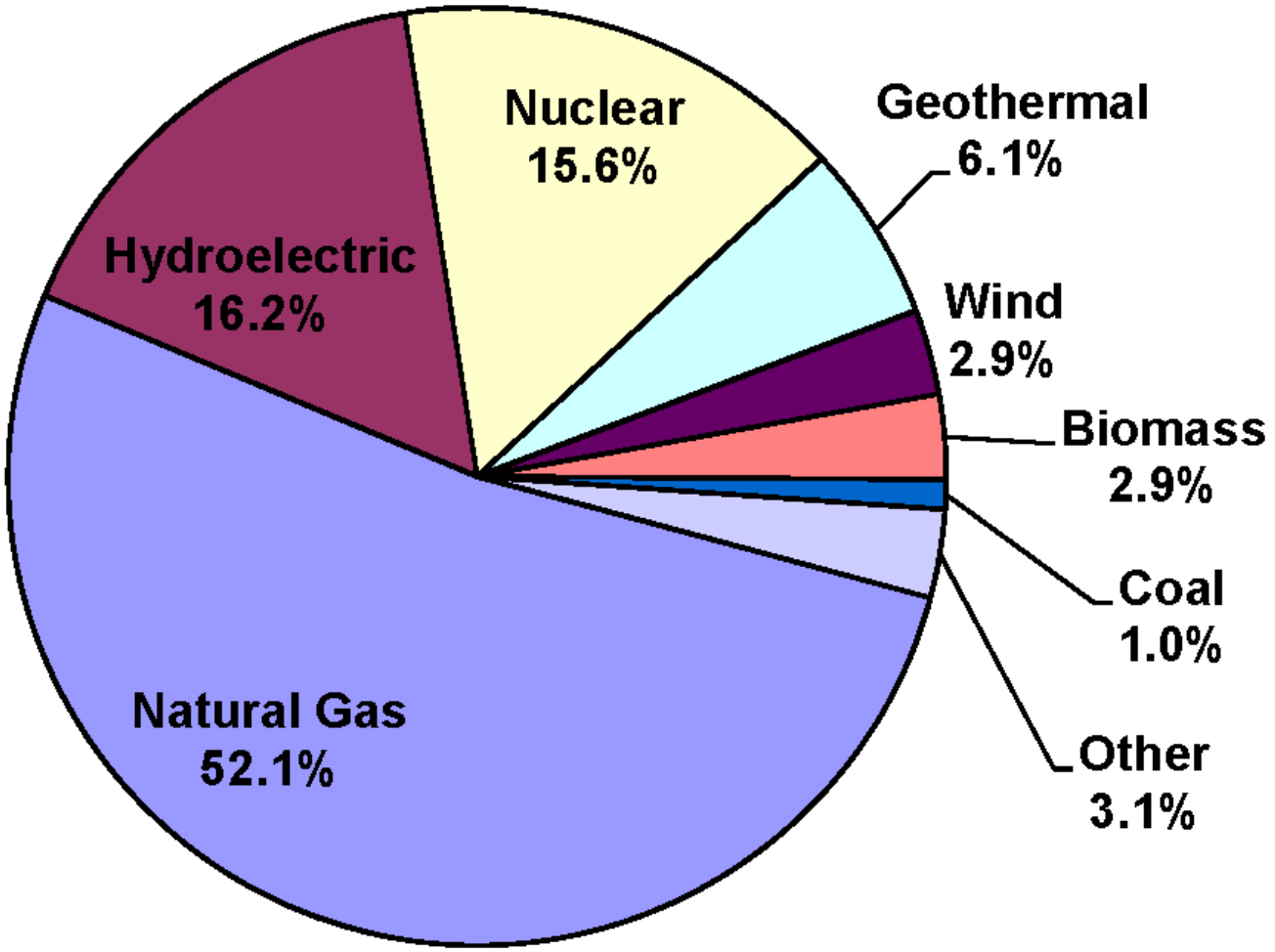
EXTRAS #1

For your information as well as for answering questions from the audience

Fossil-fuel phase-out:

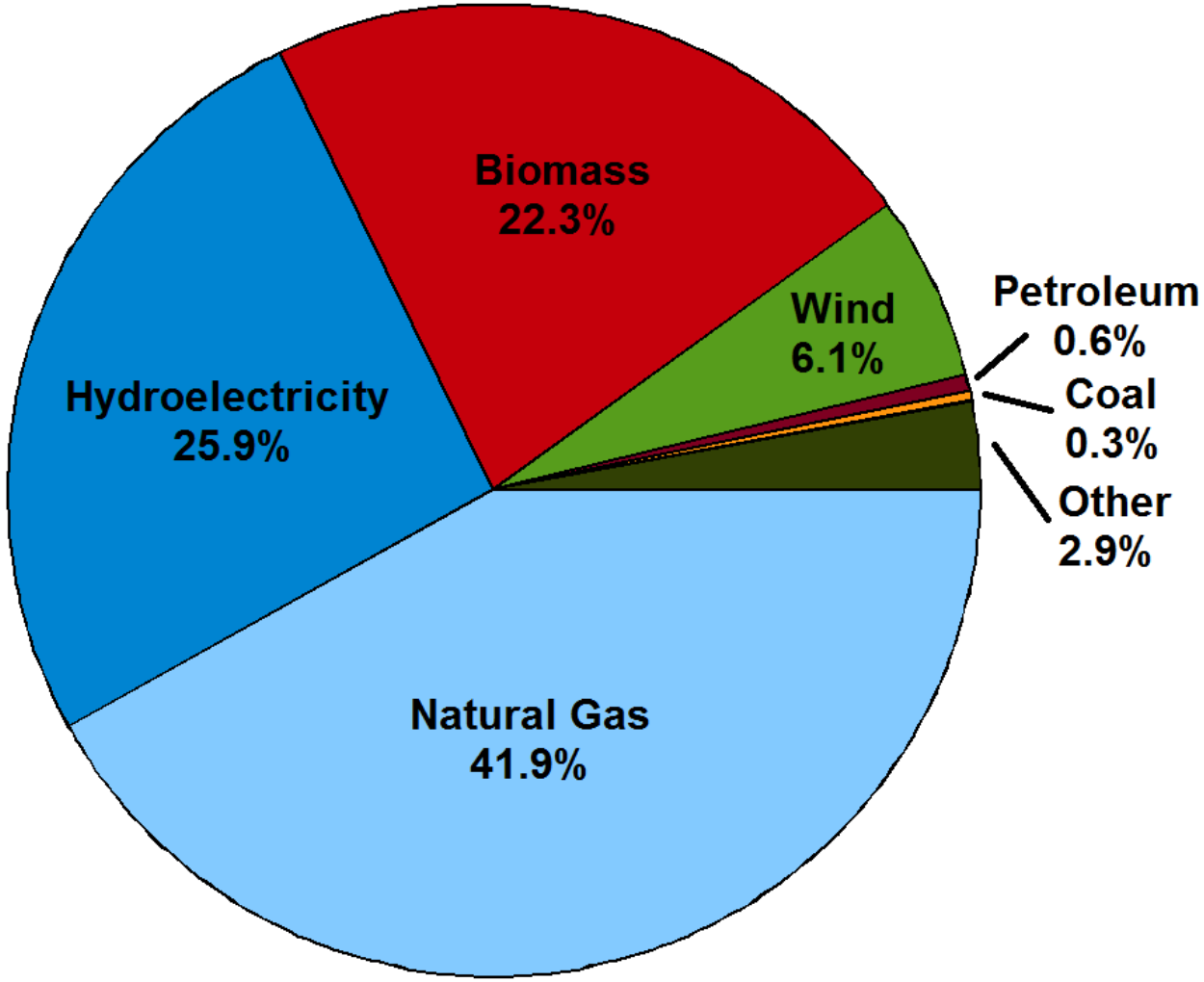
http://en.wikipedia.org/wiki/Fossil-fuel_phase-out

California Electrical Generation



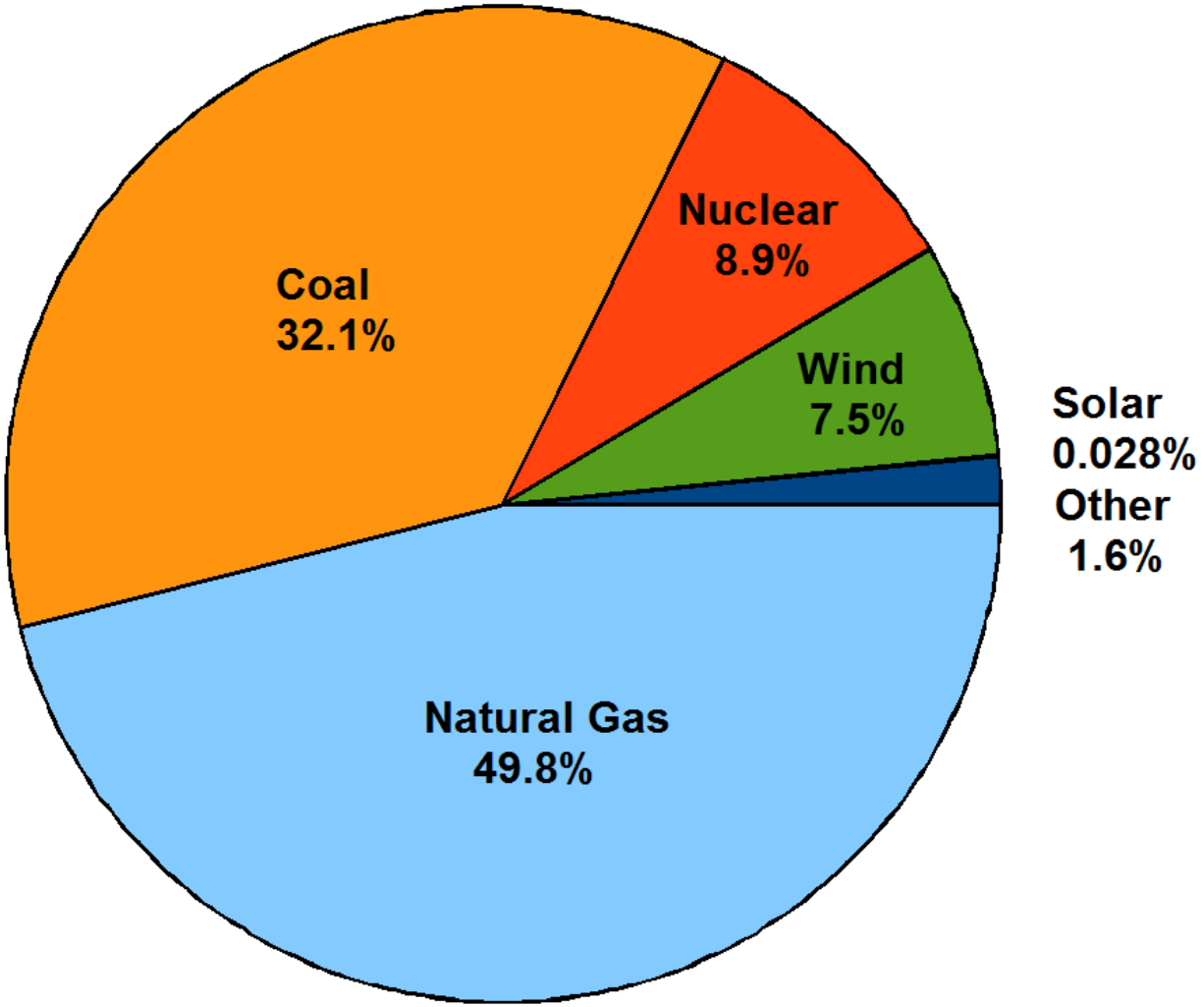
http://en.wikipedia.org/wiki/Fossil-fuel_phase-out

Maine Electricity Generation



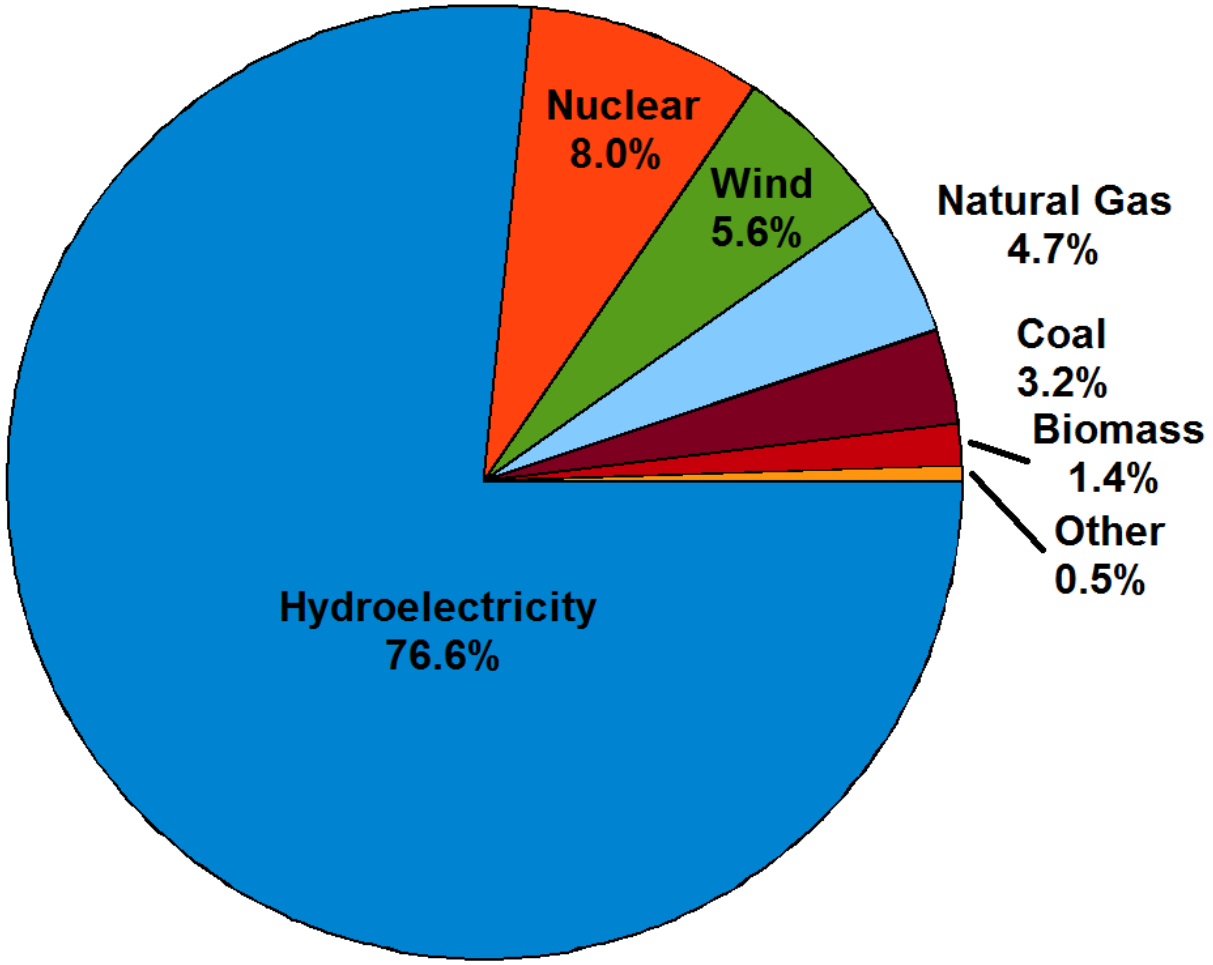
http://en.wikipedia.org/wiki/Fossil-fuel_phase-out

Texas Electricity Generation

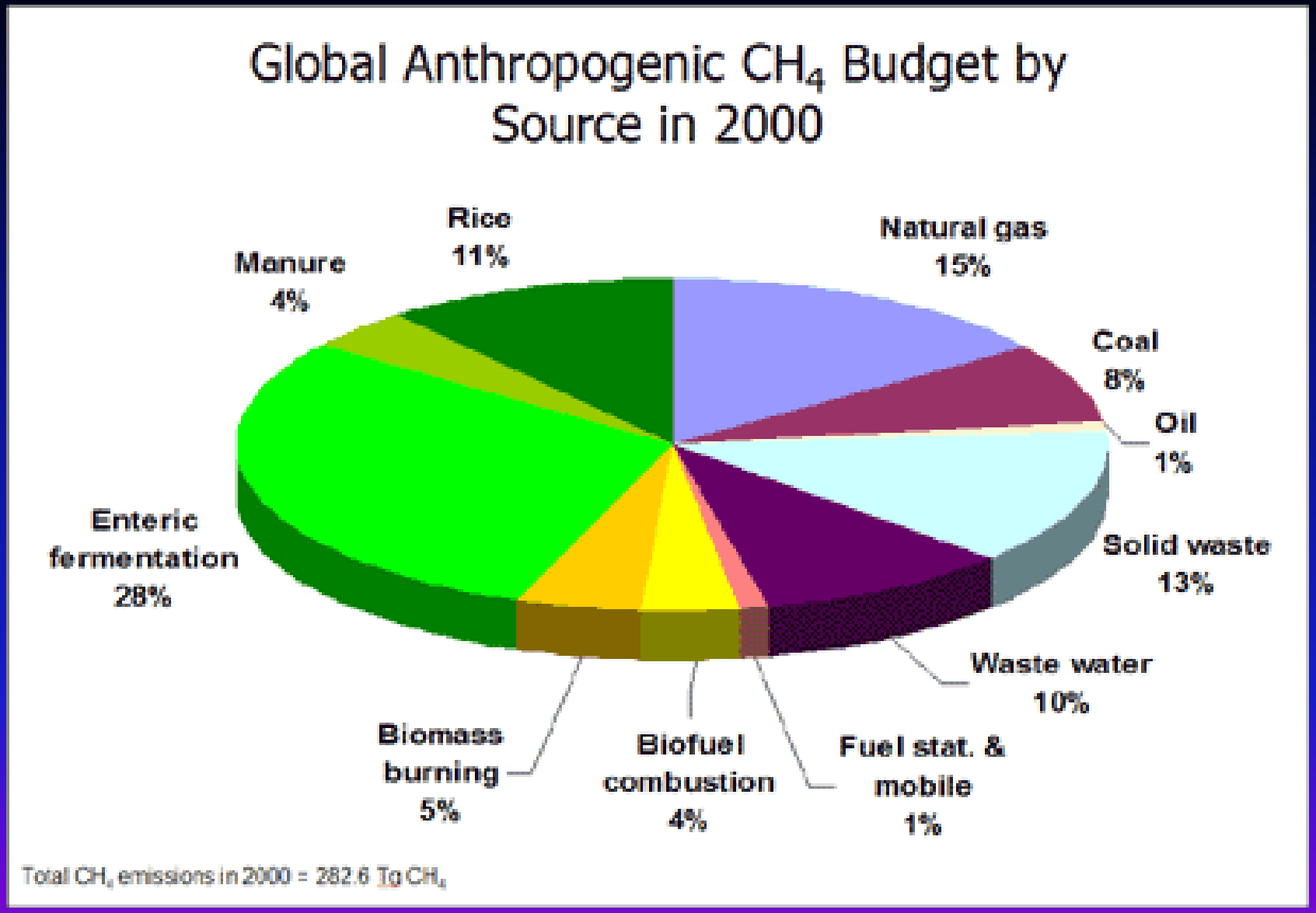


http://en.wikipedia.org/wiki/Fossil-fuel_phase-out

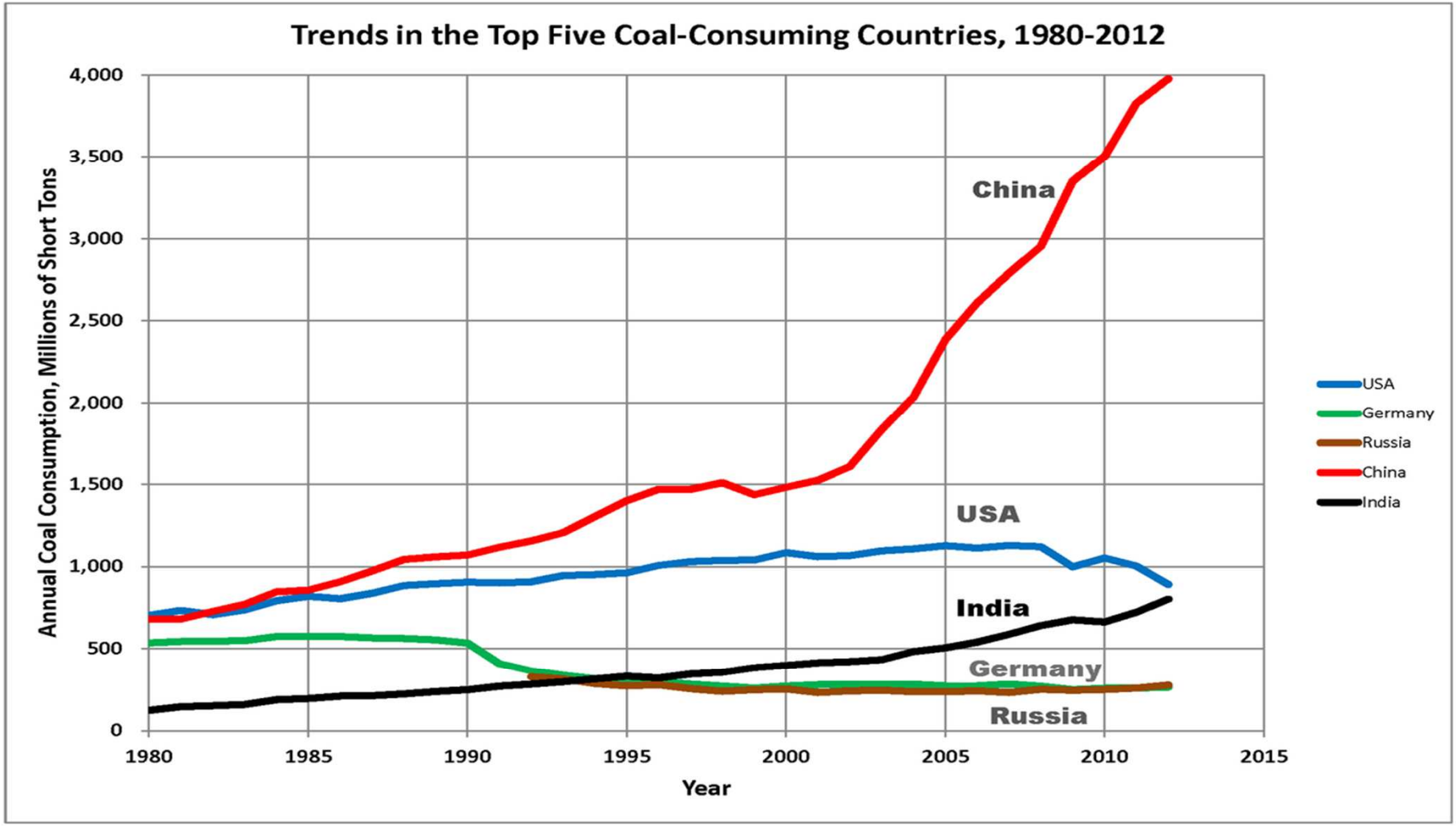
Washington Electricity Generation



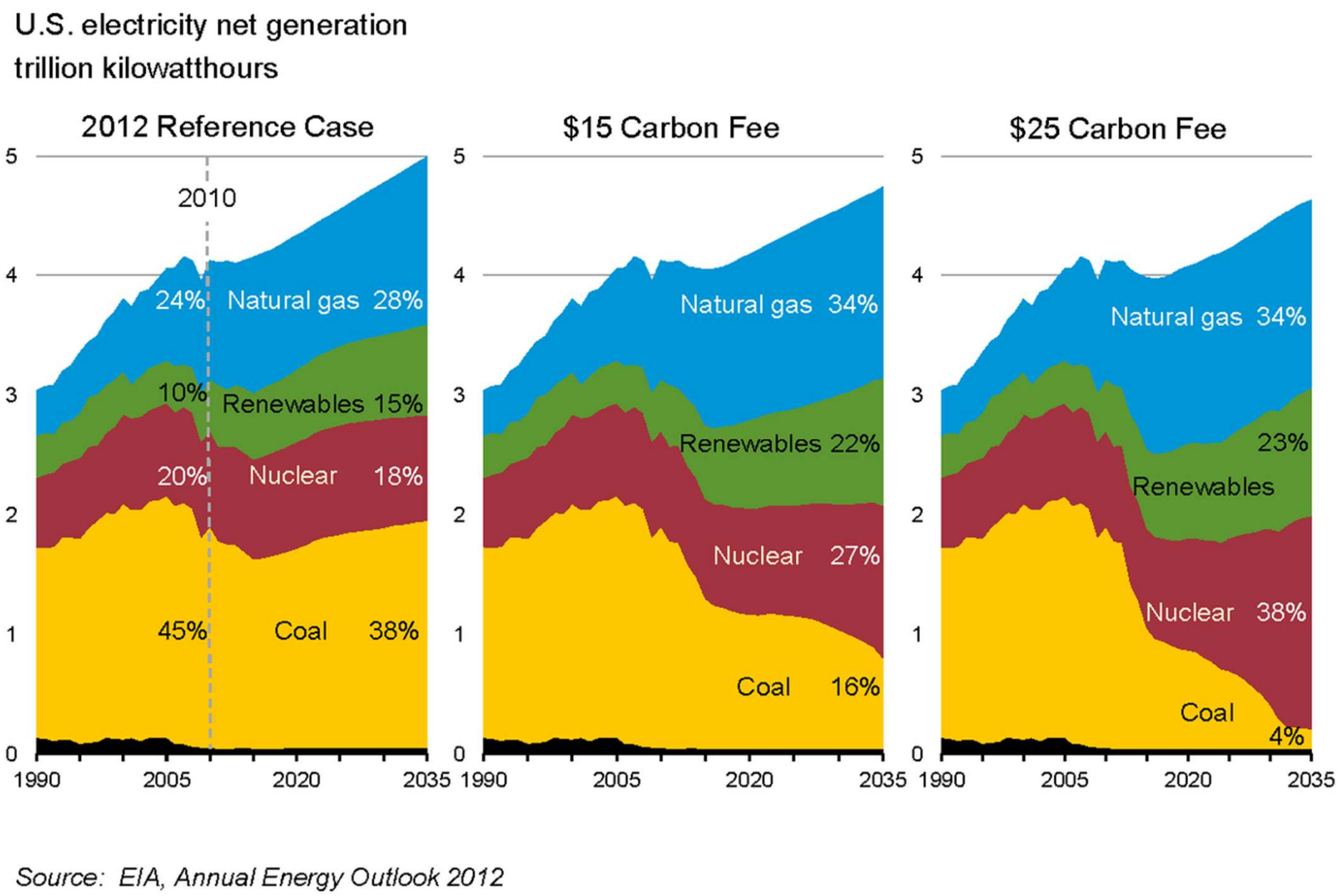
http://en.wikipedia.org/wiki/Fossil-fuel_phase-out



http://oceanlink.island.net/ONews/ONews7/methane.html



http://en.wikipedia.org/wiki/Fossil-fuel_phase-out



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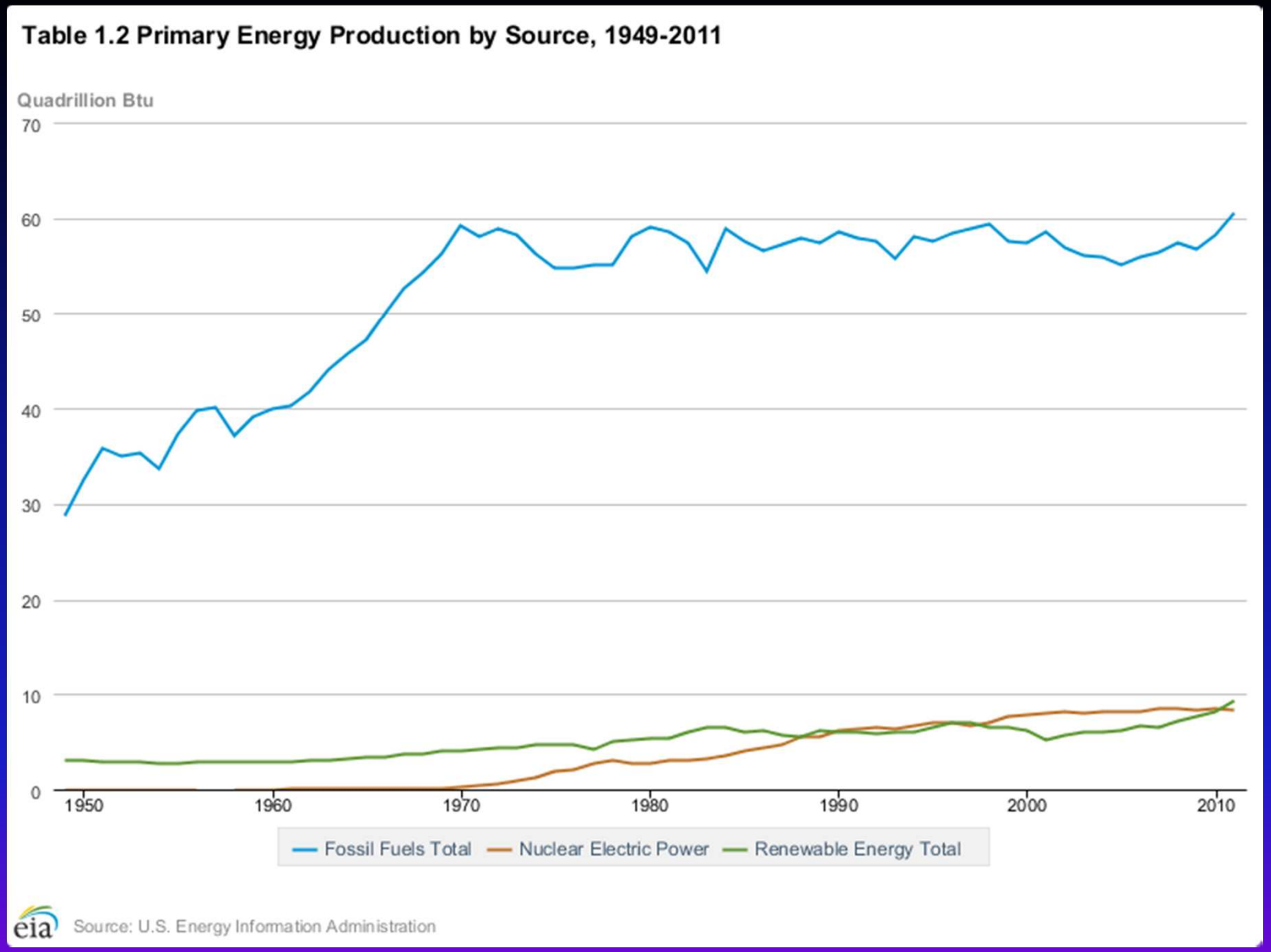
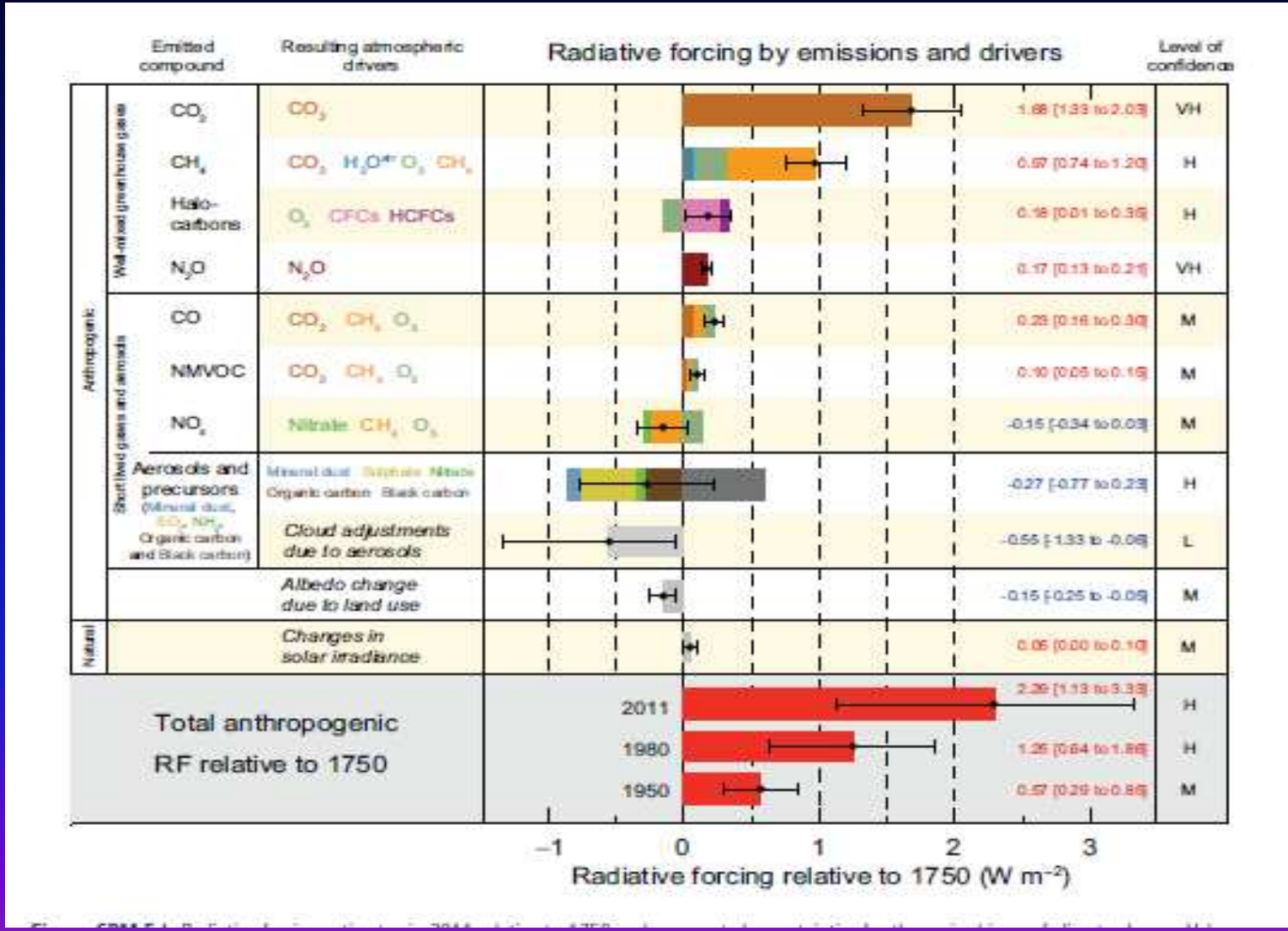


http://en.wikipedia.org/wiki/Fossil-fuel_phase-out

EXTRAS #2

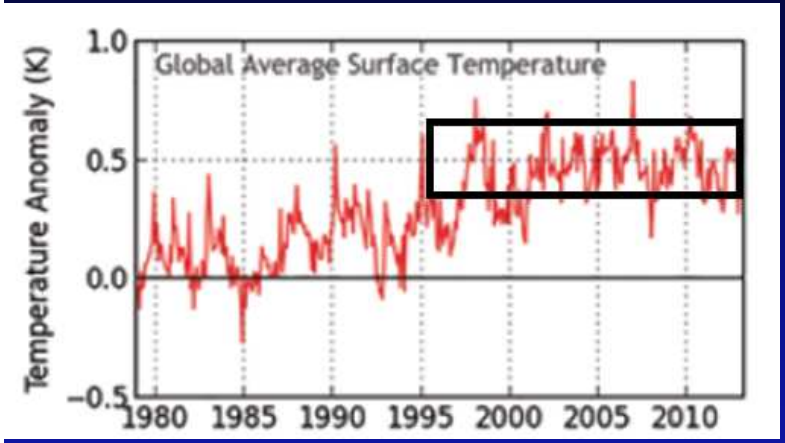
Variously related slides

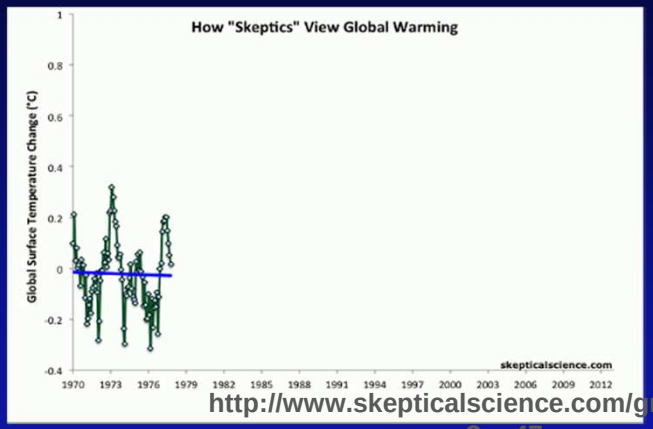
Drivers: aka forcings, i.e. causes



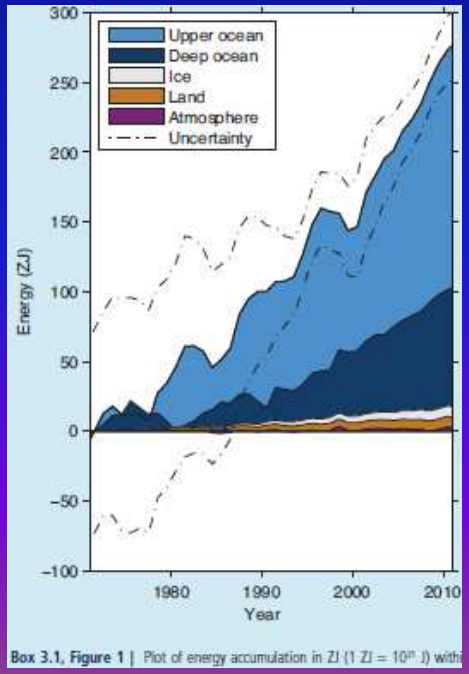
http://www.ipcc.ch/report/ar5/wg1/

Where's the heat going?
Answer – the ocean

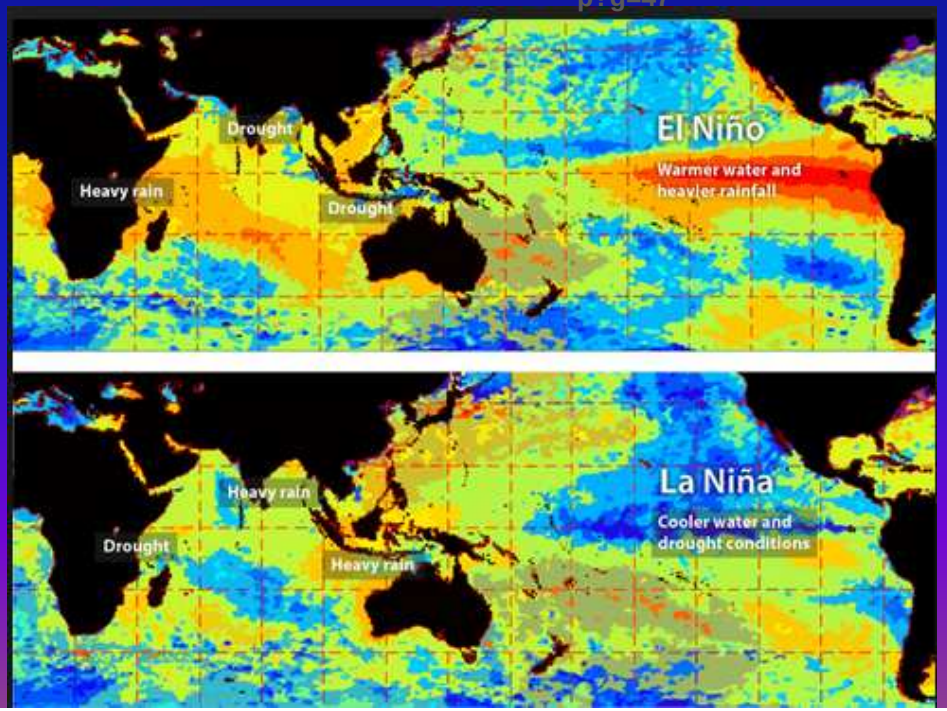




http://www.skepticalscience.com/graphics.php?g=47

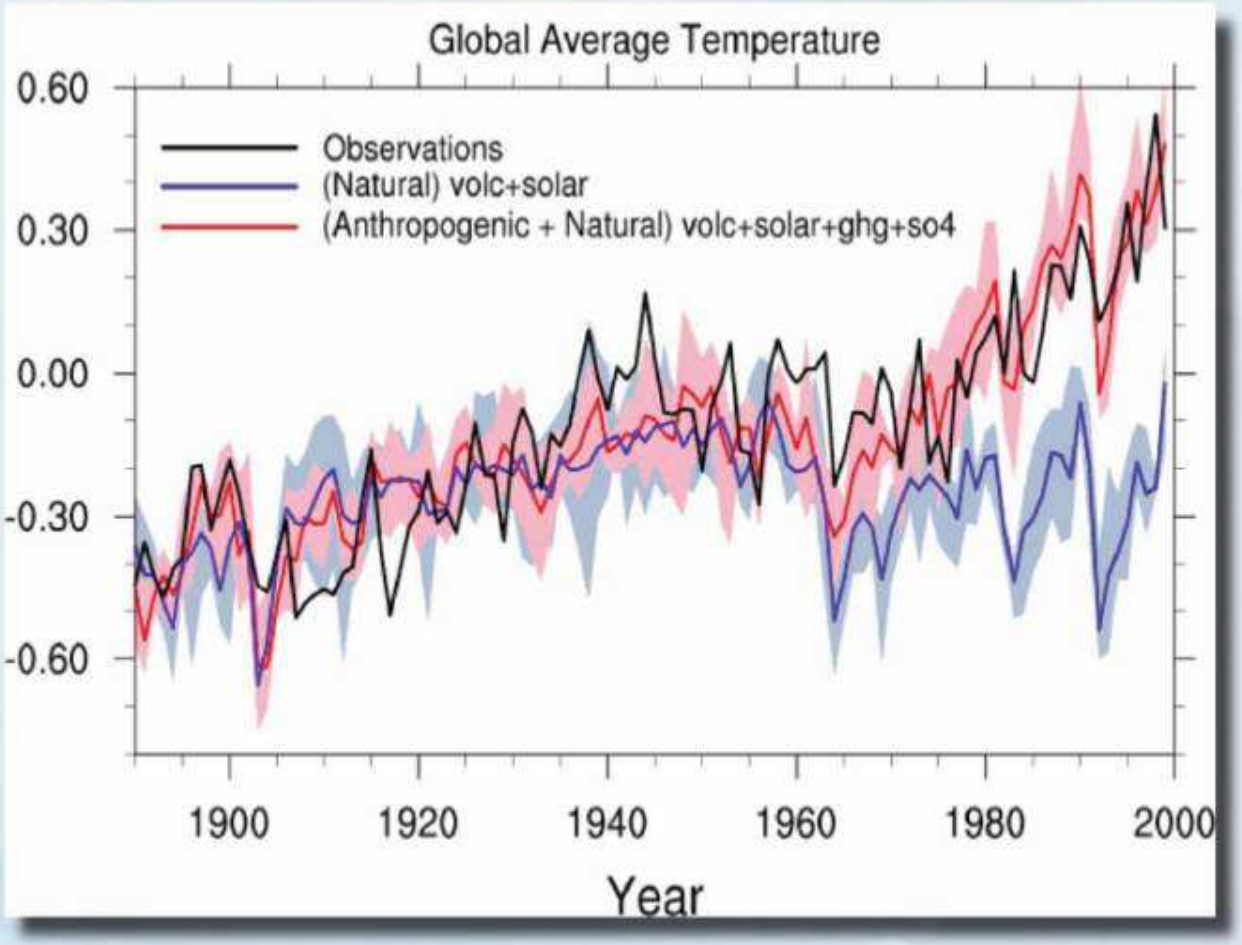


Box 3.1, Figure 1 | Plot of energy accumulation in ZJ (1 ZJ = 10^{21} J) with



Simulations of the 20th century: Time

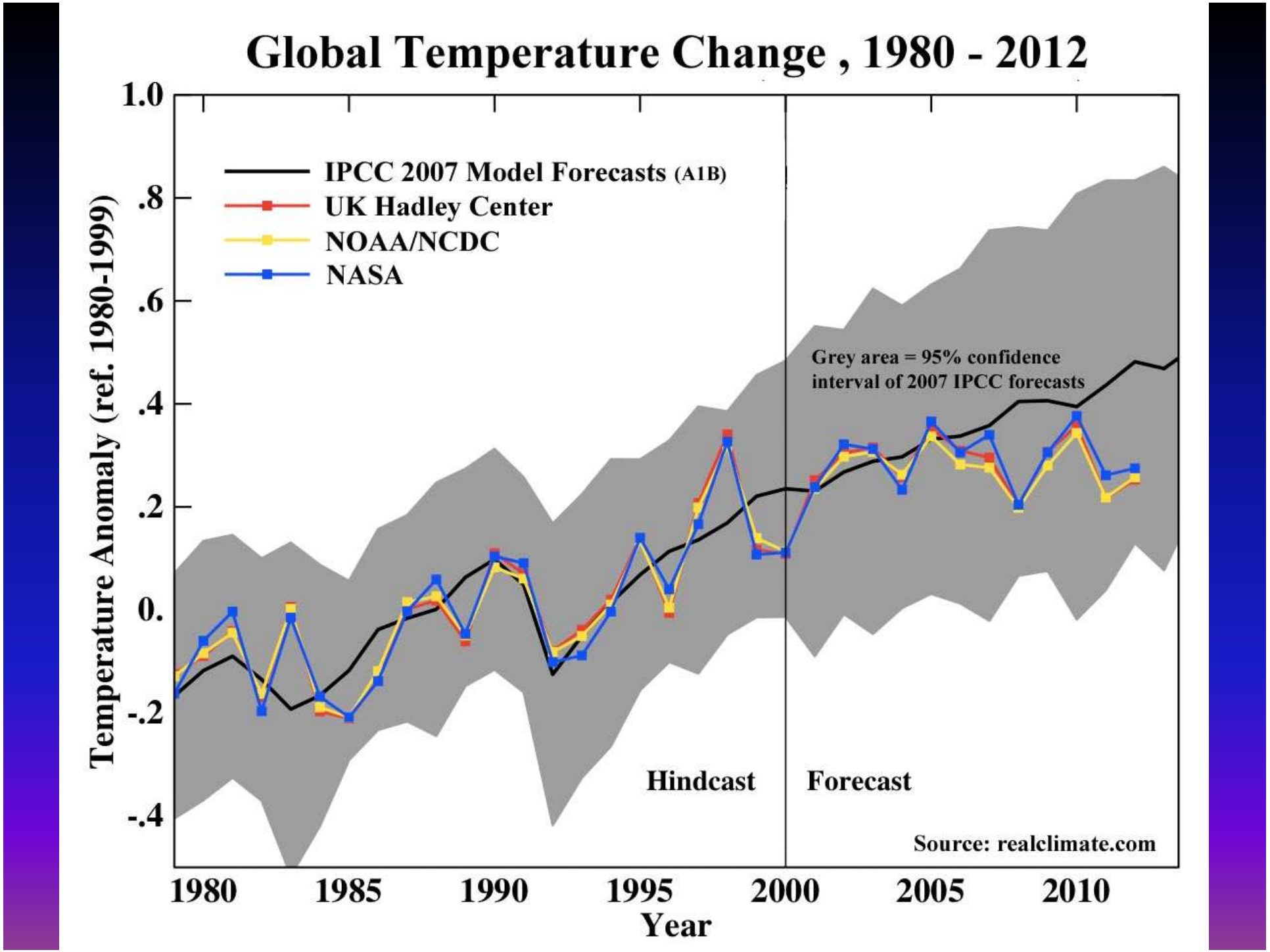
NCAR



All forcings

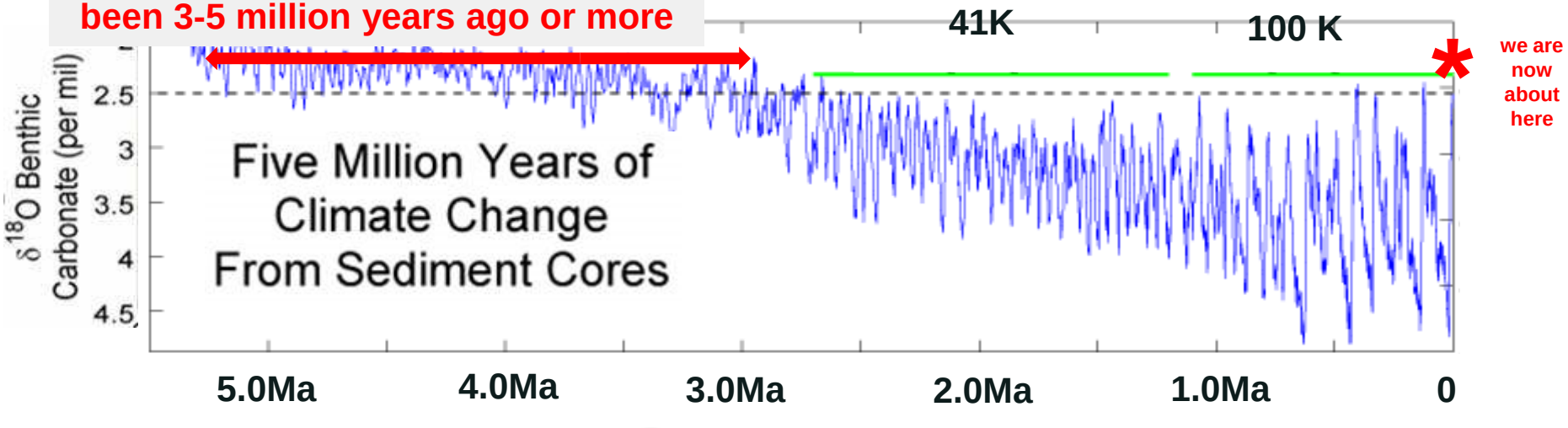
Natural only

Meehl et al. 2004


Global Temperature Change , 1980 - 2012
1.0
.8
.6
.4
.2
0.
-.2
-.4
Temperature Anomaly (ref. 1980-1999)
IPCC 2007 Model Forecasts (A1B)
UK Hadley Center
NOAA/NCDC
NASA
Grey area = 95% confidence
interval of 2007 IPCC forecasts
Hindcast
Forecast
Source: realclimate.com
1980
1985
1990
1995
2000
2005
2010
Year

Climate Changes from Ocean Sediment Cores, since 5 Ma. Milankovitch Cycles

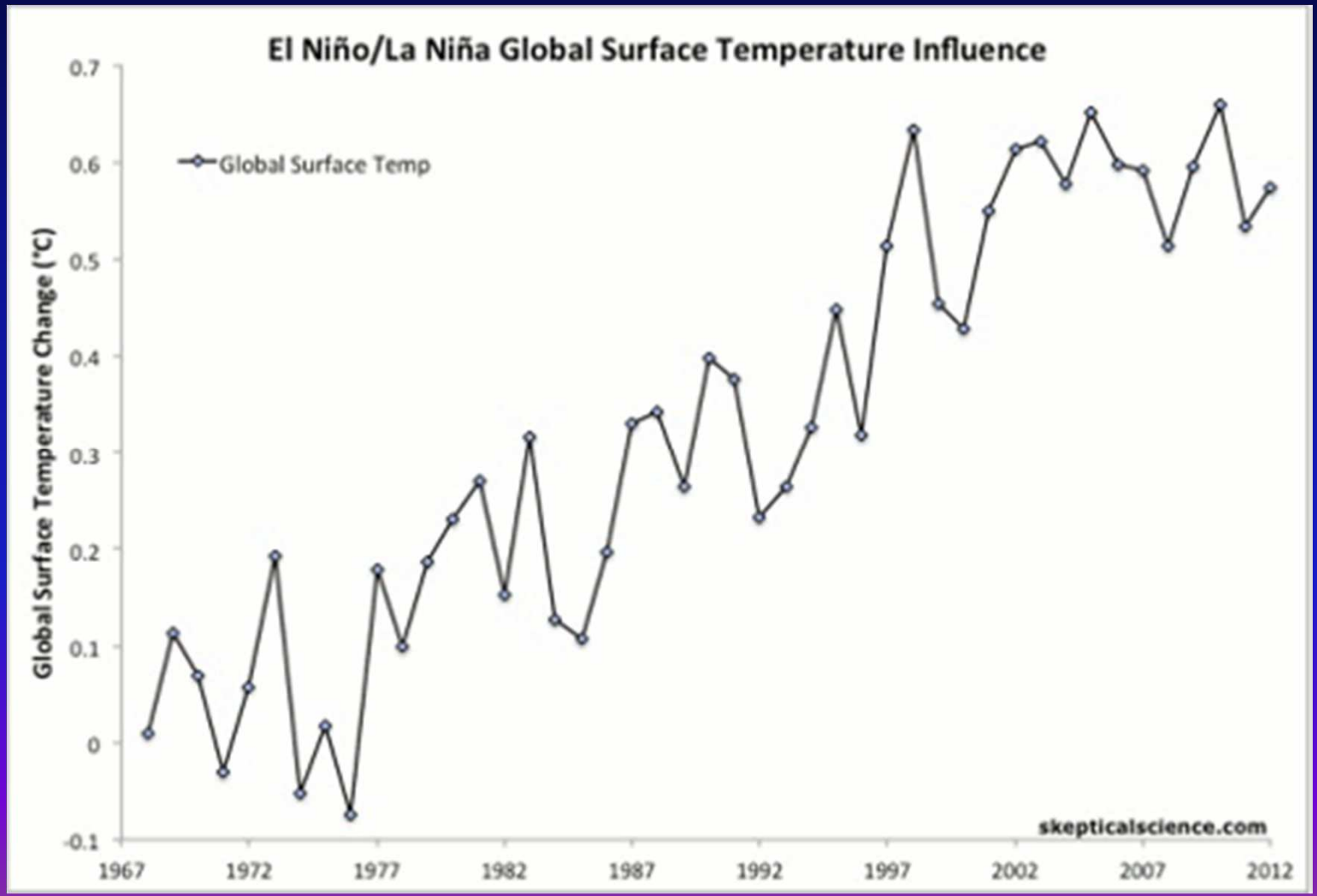
the last time inferred temperatures will have been this high – once equilibrium is reached, will have been 3-5 million years ago or more



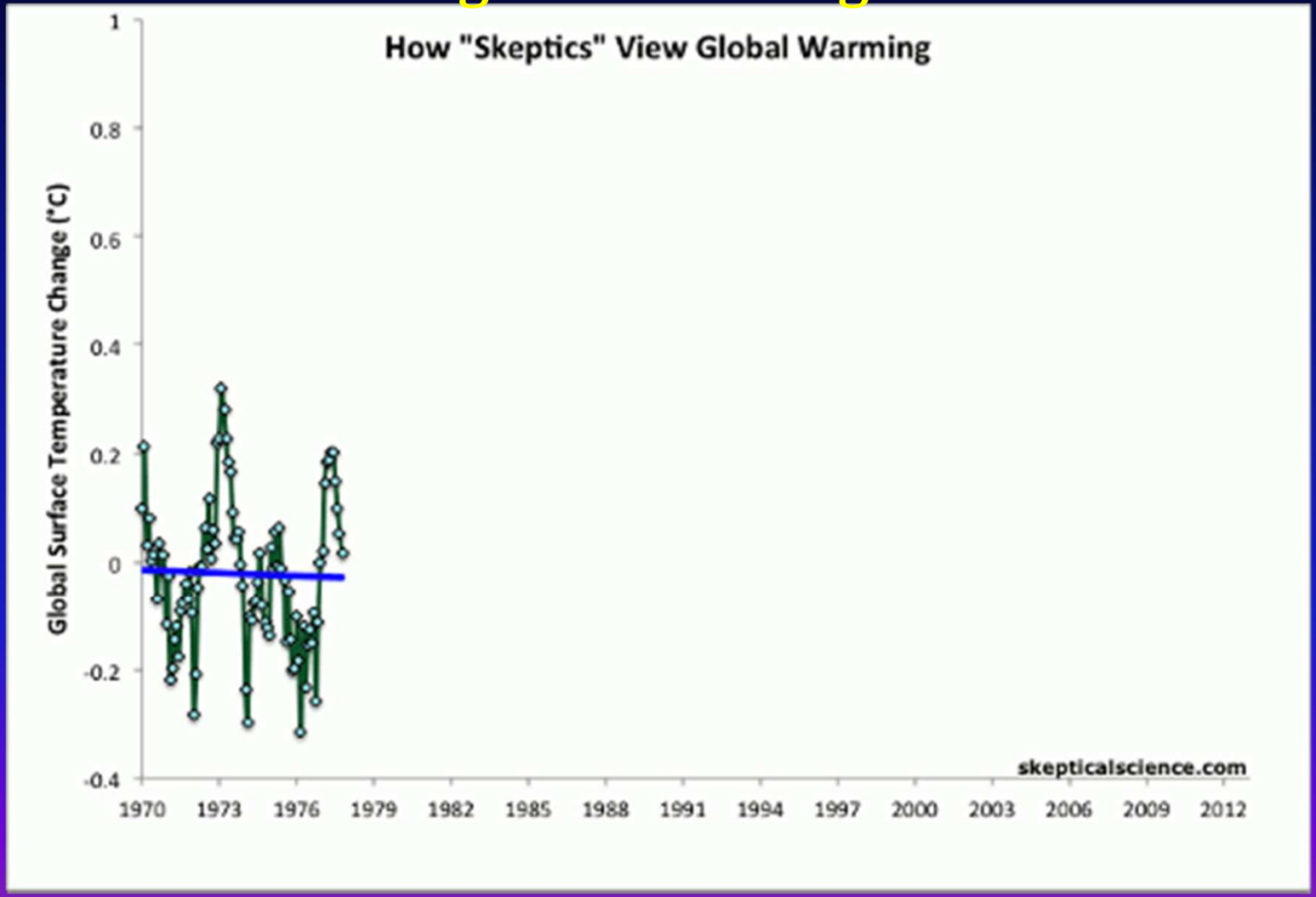
When CO_2 levels get below ~400-600 ppm Orbital parameters become more important than CO_2

Correcting for El Niño and La Niña Influences

Shows the Global Warming Trend More Clearly



How to Abuse Statistics: Choose a Short Time Interval and Ignore the Long-Term Trend



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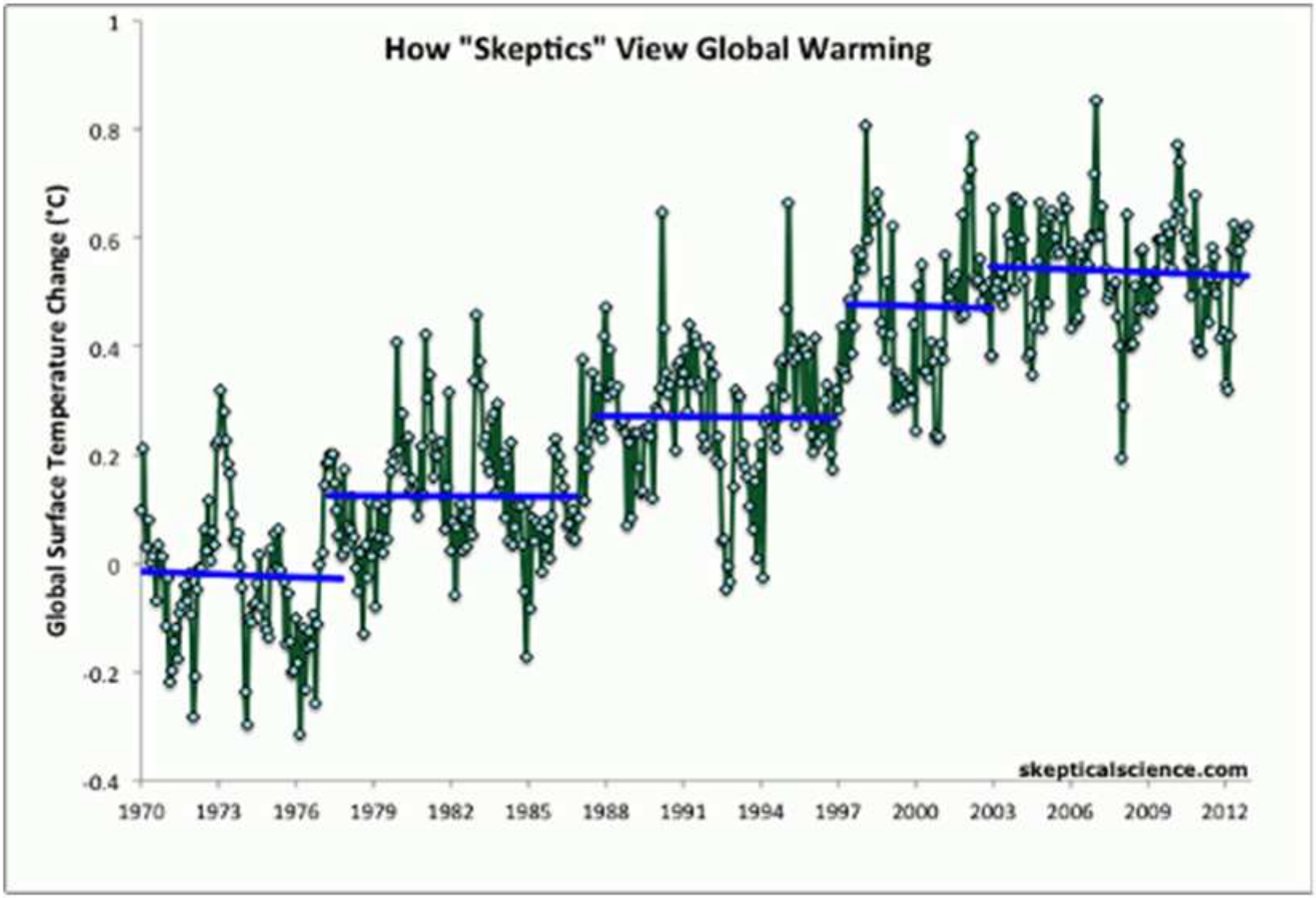

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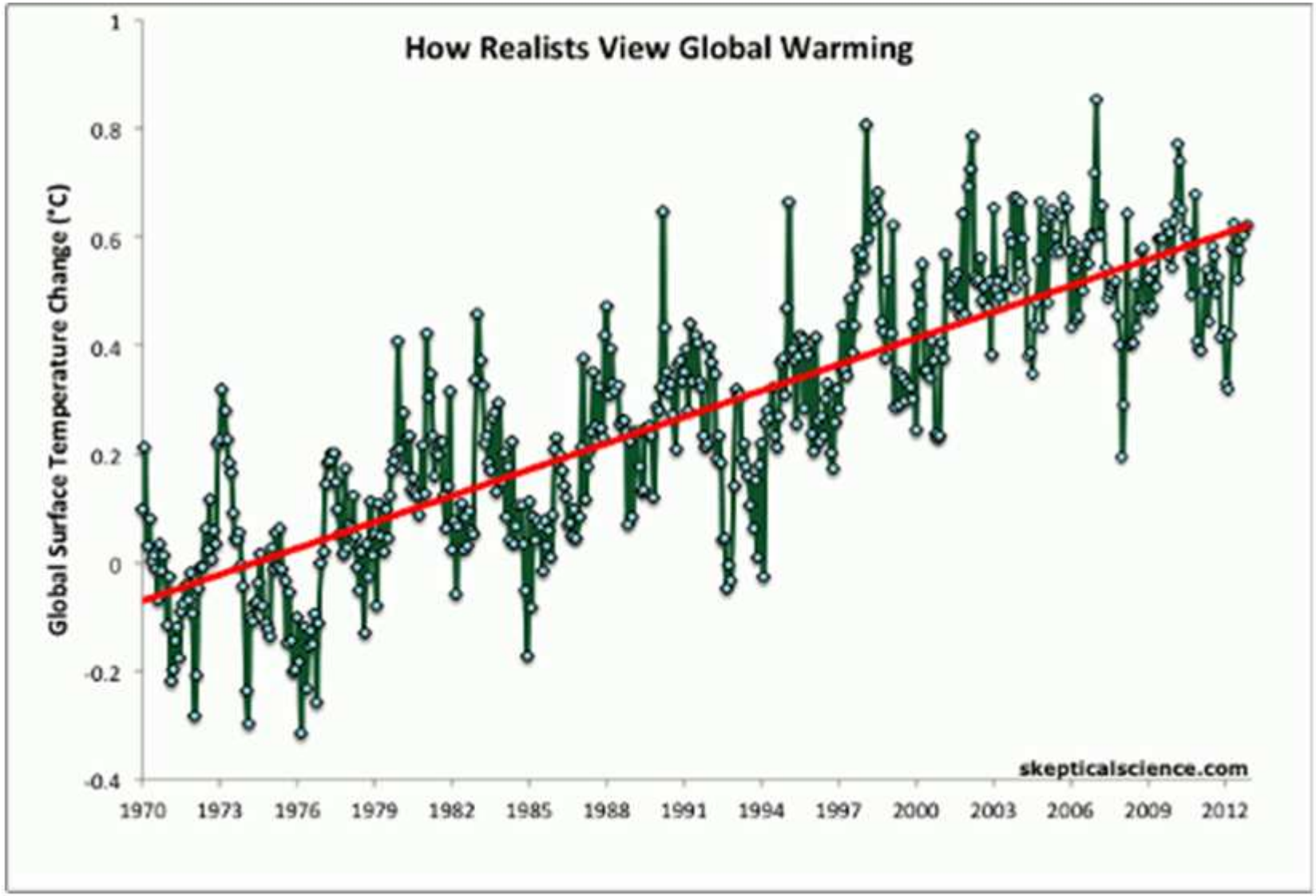
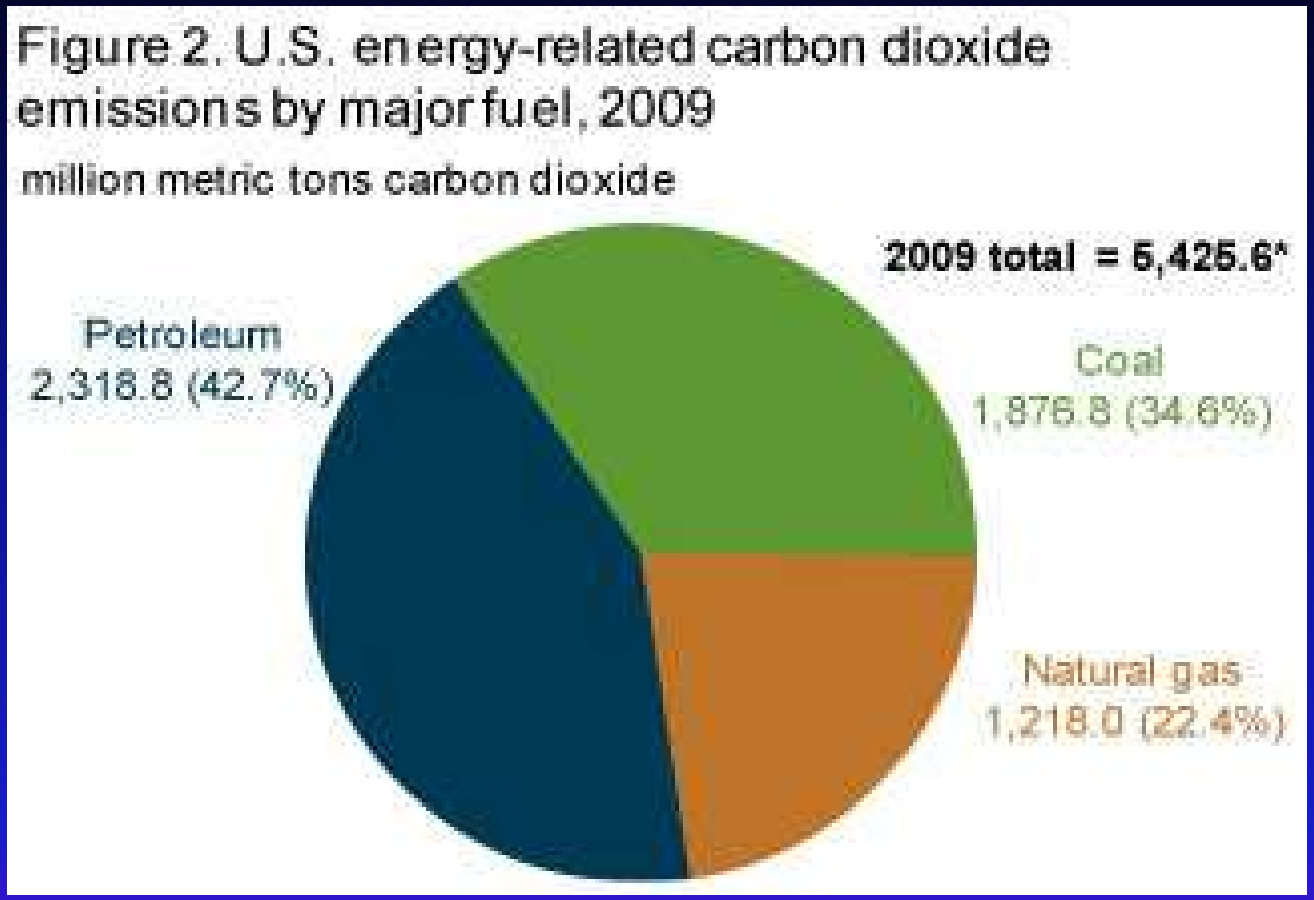




http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm

EXTRAS #3

From Drew Nelson: Natural gas symposium 9/25/2014

http://denverclimatestudygroup.com/wp-content/uploads/2014/07/Drew-Nelson-slides20140925.pdf

Widely Acknowledged The Oil and Gas Boom Has Clear Advantages…

- Economic development
- Increased energy security
- Less air pollution
- Fewer greenhouse gases (GHG) from combustion than coal.

… ***IF*** done the right way.

From Natural Gas conference 9/25/2014

Drew Nelson; edf.org

And Potential Risks:

- Ground and Surface water contamination
- Induced Earthquakes injecting waste water
- Increased GHG emissions
- Local impacts: noise, truck traffic, lights, etc.

….if NOT done correctly

NEED to:

- Reduce risks
- Reduce emissions
- Rebuild public trust

It’s in everyone’s interest to minimize risks and emissons

Modified from Drew Nelson; edf.org

Climate Implications of Methane

POUND FOR POUND METHANE TRAPS

84X MORE HEAT OVER 20 YEARS

CO_2 CH_4

Drew Nelson; edf.org

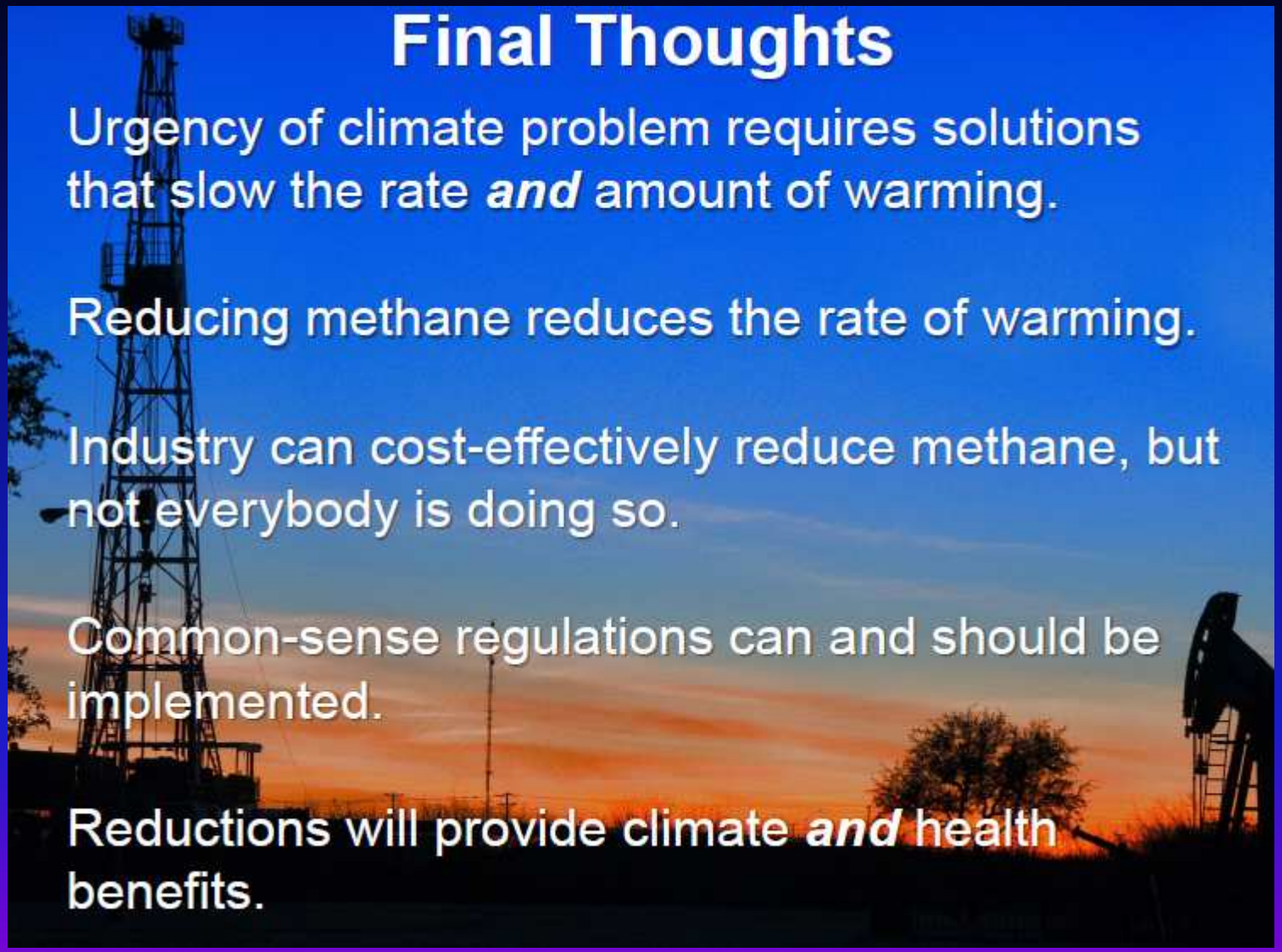
Even 1.3% Leakage is Too Much…

- Annual GHGs of:
  - 117 million cars *or*
  - 146 coal power plants

  of ~615 coal plants
- Gas carried by 127 LNG tankers.
- $1.7- $6.2 Billion of lost revenue

Comment: we've reduced the output of about 25% of our coal plants but offset that with about and equivalent increase or worse in equivalent GHG emissions

Drew Nelson; edf.org


Final Thoughts
Urgency of climate problem requires solutions that slow the rate *and* amount of warming.
Reducing methane reduces the rate of warming.
Industry can cost-effectively reduce methane, but not everybody is doing so.
Common-sense regulations can and should be implemented.
Reductions will provide climate *and* health benefits.

EXTRAS #4 - other

WG1; AR5 chapter 8

http://www.ipcc.ch/report/ar5/wg1/#.UuAsbxDn9hE

Table 8.7 | GWP and GTP with and without inclusion of climate–carbon feedbacks (cc fb) in response to emissions of the indicated non-CO2 gases (climate-carbon feedbacks in response to the reference gas CO2 are always included).

	Lifetime (years)		GWP_{20}	GWP_{100}	GTP_{20}	GTP_{100}
CH_4[b]	12.4[a]	No cc fb	84	28	67	4
		With cc fb	86	34	70	11
HFC-134a	13.4	No cc fb	3710	1300	3050	201
		With cc fb	3790	1550	3170	530
CFC-11	45.0	No cc fb	6900	4660	6890	2340
		With cc fb	7020	5350	7080	3490
N_2O	121.0[a]	No cc fb	264	265	277	234
		With cc fb	268	298	284	297
CF_4	50,000.0	No cc fb	4880	6630	5270	8040
		With cc fb	4950	7350	5400	9560

Table 8.7 | GWP and GTP with and without inclusion of climate–carbon feedbacks (cc fb) in response to emissions of the indicated non-CO2 gases (climate-carbon feedbacks in response to the reference gas CO2 are always included).

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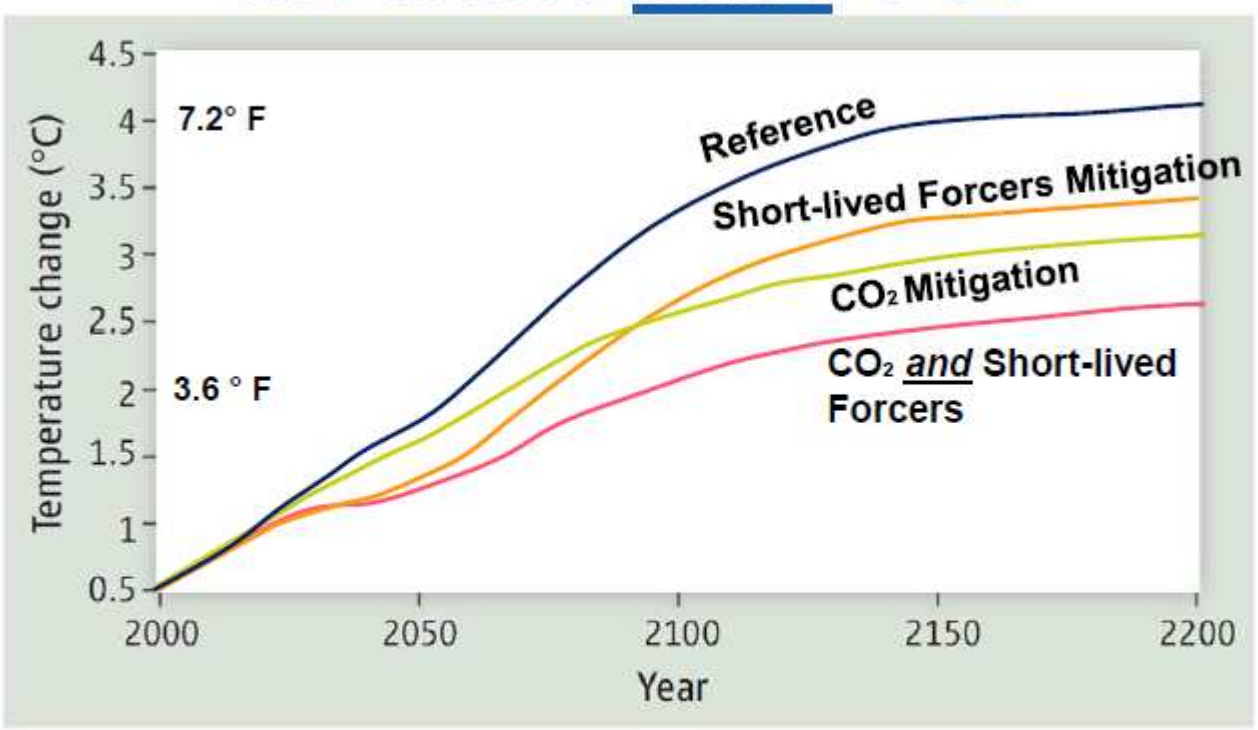
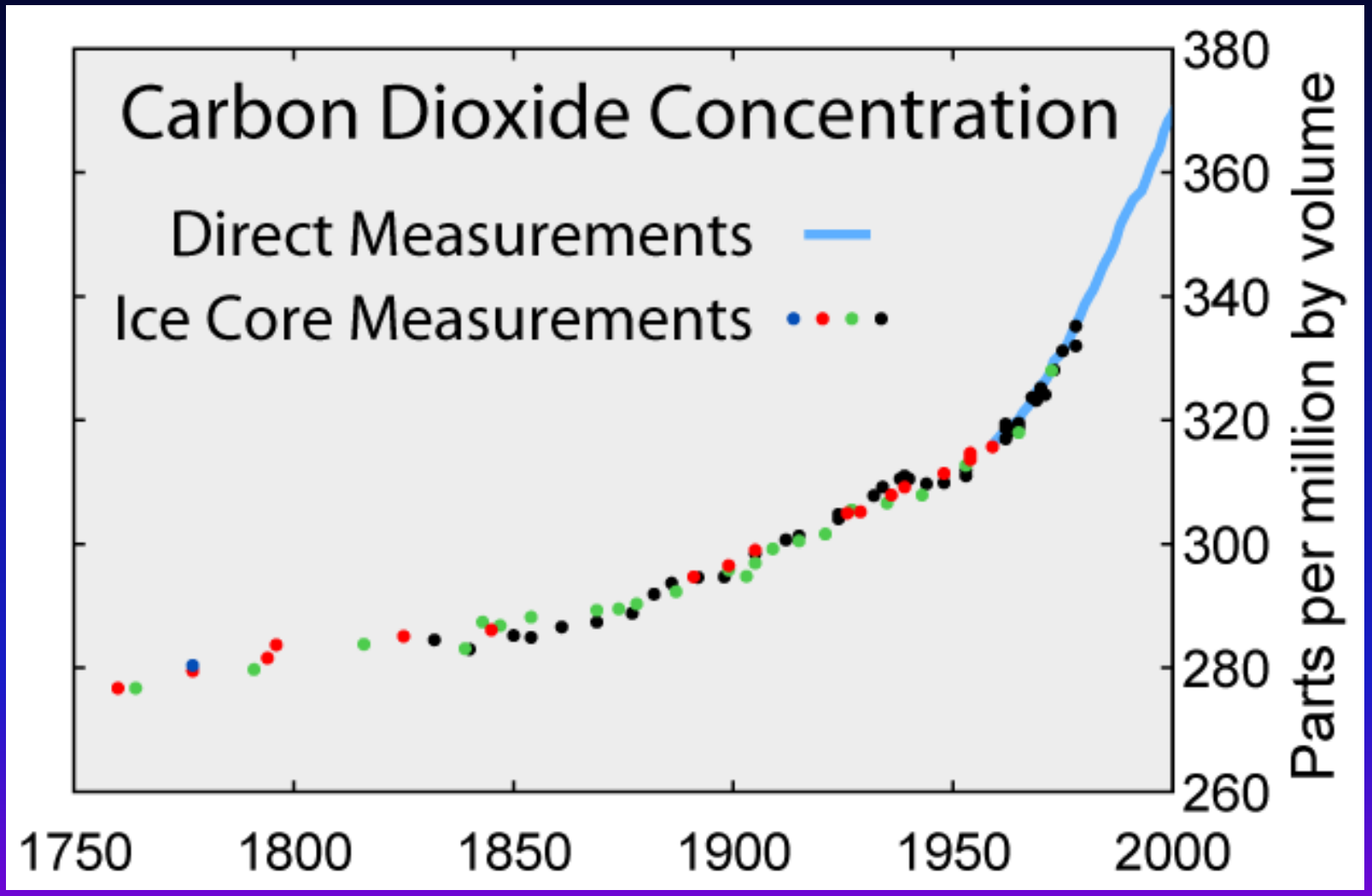
		7080	3490
N_2O	121.0[a]	277	234
		284	297
CF_4	50,000.0	5270	8040
		5400	9560

Methane AND CO_2



About **25 percent of the man-made warming** we are experiencing today is caused by methane.

J. K. Shoemaker, 1 D. P. Schrag, 1 * M. J. Molina, 2,V. Ramanathan 3, 4, Science 9/25/2014



http://www.windows2universe.org/earth/climate/greenhouse_effect_gases.html