

### Talk Outline

1. Past climate changes and human evolution
2. The present climate mess
3. The future climate crisis
4. ...and what to do about it.

### Talk Outline

1. Past climate changes and human evolution
  - A. Upright woodland apes
  - B. Live without trees, out of Africa
  - C. Creative Explosion very recent
  - D. Abrupt climate changes
2. The present climate mess
3. The future climate crisis
4. ..and what to do about it.



### The Evolution and Devolution of Homo sap

From New Scientist 2004

Common ancestor 7,000,000 years ago

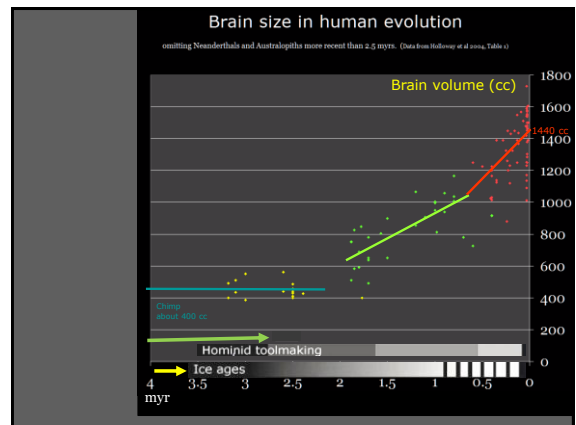
Bipedal woodland apes 6,000,000 years ago

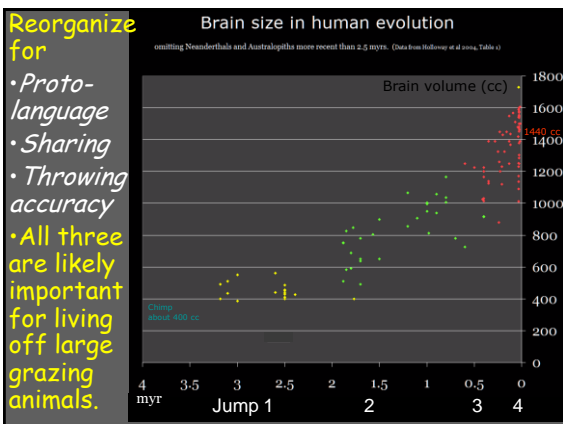
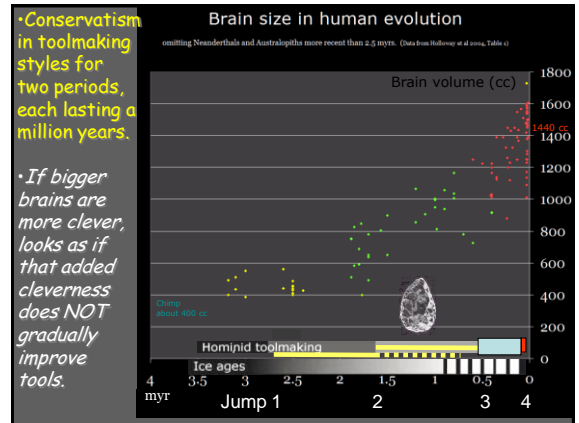
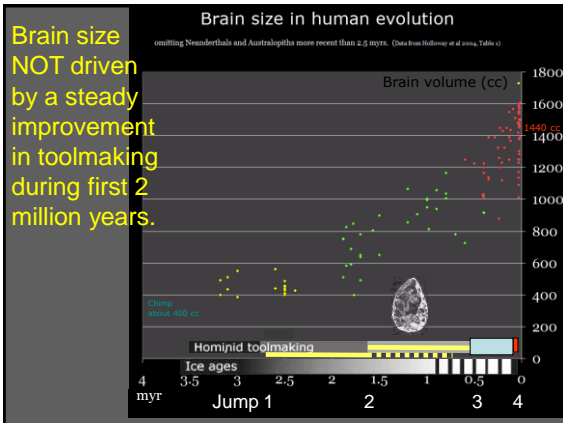
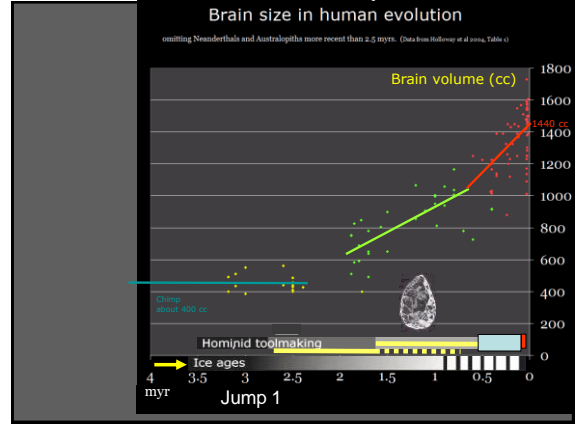
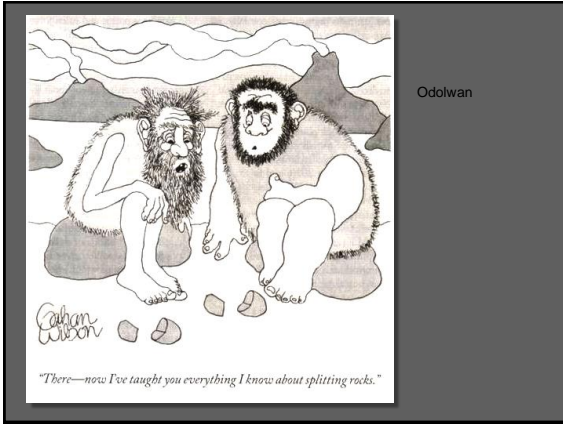
Savanna Homo erectus 1,800,000 years ago

Big brain Homo sapiens 200,000 years ago

Creative Homo sapiens sapiens 50,000 years ago

The last century





### Abrupt Changes in Climate

[on time scale of a drought but widespread]

- Nuclear Winter
- North Atlantic Current decline rearranges winds and rains worldwide.
- El Niño has done two limited versions already.

GEORGE ORWELL: PROBLEMS OF GLOBALISM / FICTION BY DOBBIE ANN MASON

The Atlantic Monthly

The Great Climate Flip-flop

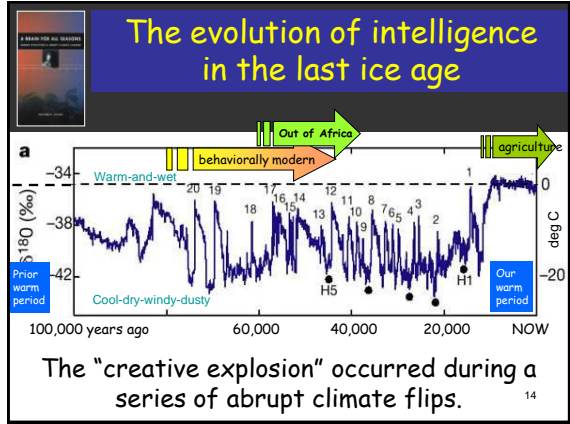
Global warming could, paradoxically, cause a sudden and catastrophic cooling

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by WILLIAM H. CALVIN

The people who study the abrupt climate shifts of the past have an aphorism:

Climate is like a drunk:  
*Left alone, it sits.*  
*Forced to move, it staggers.*



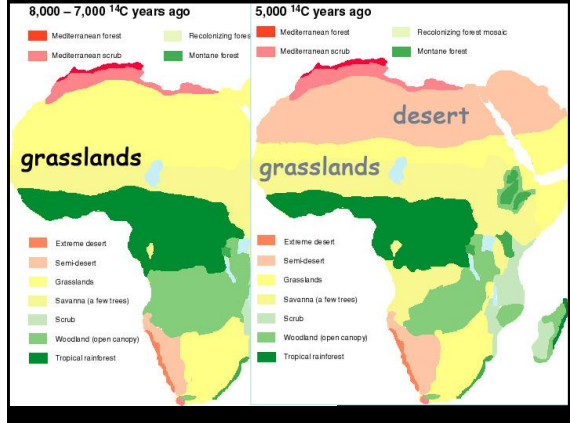
### What it takes to finally settle down.

**Table 2** Four agricultural societies developed independently

Location	Species	Development
Levant	Wheat, barley, chickpeas, flax, sheep, goats	~ 9,000 ybp
China	Rice, millet, pigs, silkworms	by 9,500 ybp
Mesoamerica	Corn, beans, squash, turkey	by 5,500 ybp
Andes and Amazonia	Potato, manioc, guinea pig, llama	by 5,500 ybp

Springer

Joan Feynman · Alexander Ruzmaikin  
 "Climate stability and the development of agricultural societies."  
*Climatic Change* (2007) 84:295–311 DOI 10.1007/s10584-007-9248-1



About 5,200 years ago, the Sahara lost monsoon rainfall and, over several centuries, lost its grass and grazing animals.

This was the stimulus for the great irrigation civilizations and the need for tax accountants. (That's how *writing* began, 3200 BCE).

### Are we "Just out of beta"?

- If higher intellectual functions are only about 50,000 years old, there hasn't been much time for natural selection to fix the biological bugs.
- Cultural evolution sometimes succeeds, as when we teach "critical thinking" to students.
- But in many areas, the tragedy of the commons keeps us from collectively acting quickly enough to prevent harm.

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1. Past climate changes and human evolution
2. The present climate mess
  - A. 10x more fires and floods since 1950.
  - B. Jumps in drought in 1983, 1998
  - C. Heat waves, thaw of Arctic
3. The future climate crisis
4. ..and what to do about it.

If wind speed increases 20%, from 50 mph to 60 mph, the damage goes up not 20% but 500%.

### Nonlinearity



[6X insurance claims]

Something blown loose from one building may hit another building if it doesn't hit the ground first, giving a cascade of damage.

### Heavy Weather



The heavens opened  
(US government photo)

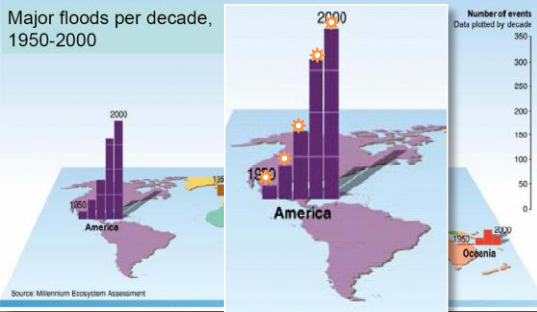
### Logged hillside collapse

Chehalis WA flood 2007



So it is a global climate change, not merely local trouble that moves around.

Major floods per decade, 1950-2000



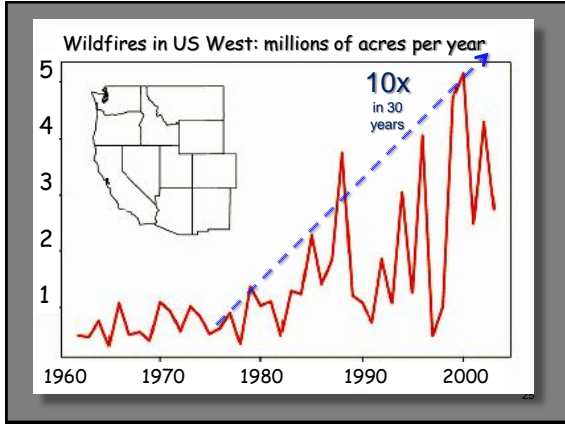
Floods have been increasing for 50 years.

### Fire managers predict bad year for blazes

Sat. May 10, 2008 2:37pm EDT



David S. Roberts, San Diego County 2007



**Climate Briefings**

How hot is it?

*The Little Ansonist*

William H. Calvin  
University of Washington  
Global-Fever.org

The 2003 heat wave in Europe killed 35,000 people.

Salvador Dalí *The Persistence of Memory*, 1931

Heat waves are already killing coral.

Coral Reefs


**Caribbean 2005 coral disaster**

reef loss -70 m

Nighttime infrared satellite measures of sea surface temperature, plotted as excess degree weeks.

GREEN areas bleaching only  
YELLOW-VIOLET areas have increasing mortality


Since NOAA's last report in 2005, the Caribbean region has lost at least **50 percent of its corals**, largely because **sea temperatures have risen**, said Timothy Keeney, NOAA's deputy assistant secretary for oceans and atmosphere, and **25 percent of all marine species need coral reefs** to live and grow, while **40 percent of the fish caught commercially** use reefs to breed.



(NOAA press release, July 2008)

### Arctic sea ice

1970-1999 average



The Arctic floating sea ice that remained in September 2007


No sea level rise.



REFLECTS most sunlight

ABSORBS most sunlight

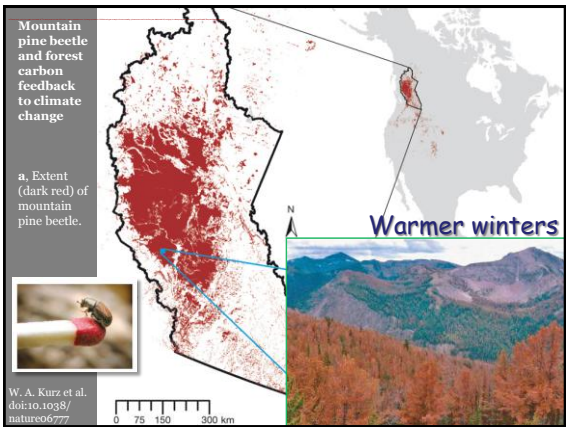
Photo courtesy of John H. Weller  
National Geographic



Permafrost researcher *Katy Walter* igniting methane trapped beneath the surface of a frozen pond.

23X as potent as CO<sub>2</sub>

### Mountain pine beetle and forest carbon feedback to climate change




a. Extent (dark red) of mountain pine beetle.

Warmer winters

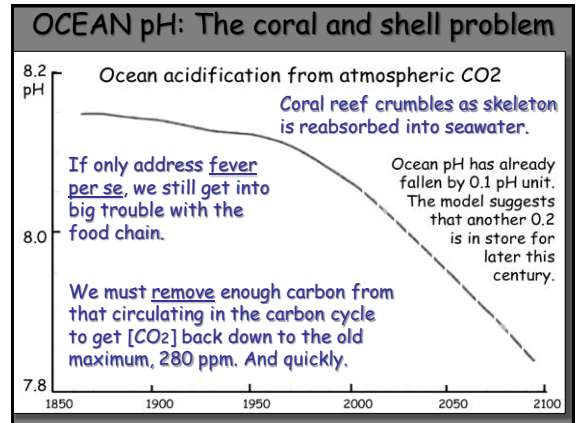
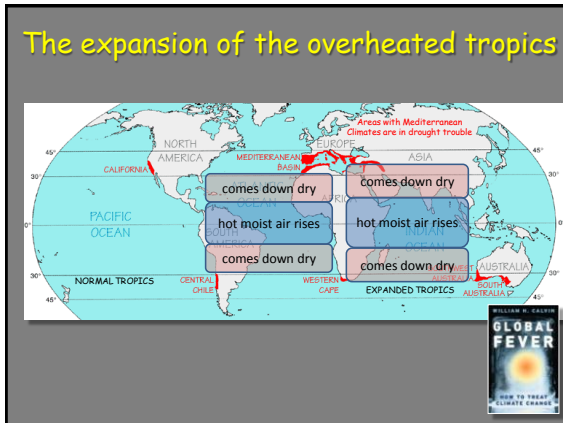
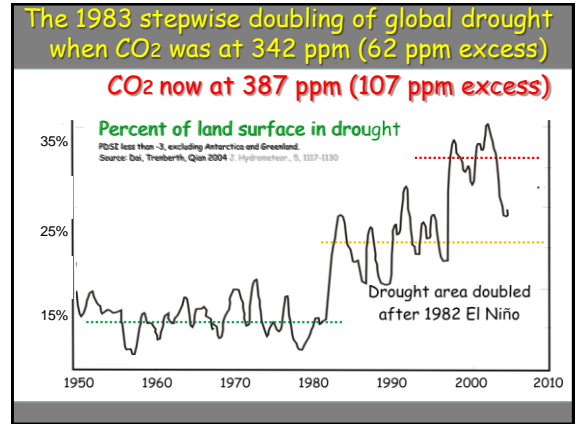
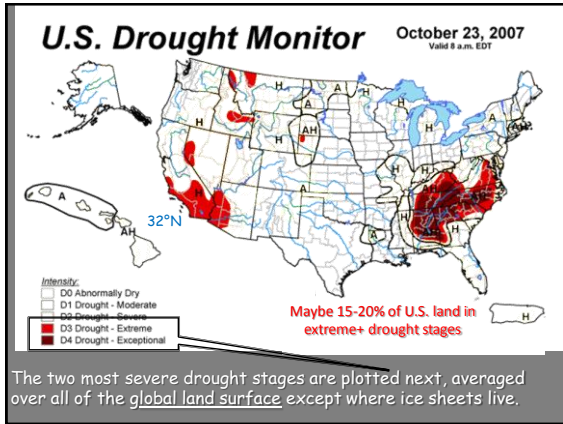
W. A. Kurz et al. doi:10.1038/nature06777

0 75 150 300 km

### Drought



Vincent van Gogh, Olive Trees with Yellow Sky and Sun, 1889



- ### Talk Outline
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  3. The future climate crisis
    - A. Extrapolate trends
    - B. IPCC modeling ignores abrupt possibilities
  4. ..and what to do about it.

Where are 100 million people going to flee?

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Any major downsizing usually involves

1. Famine
2. Pestilence
3. War
4. Genocide

Albrecht Dürer  
*The Revelation of St John: The Four Riders of the Apocalypse*, 1497-98, Woodcut, 39 x 28 cm, Staatliche Kunsthalle, Karlsruhe

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**Majority hits on minorities**

Anti-Immigrant Violence in Johannesburg

A mob of South Africans marching on Sunday through a squatter settlement near Johannesburg, from Zimbabwe, have been attacked.  
 by BARRY BEARAK  
 Published: May 19, 2008

This one merely about who gets jobs when unemployment at 25%.

Refugees from Zimbabwe are better educated than those from South Africa's educational system and so get hired first.

COUNTRIES WITH AREAS INSIDE THE AMAZON BASIN, "AMAZONIA": Brazil, Peru, Ecuador, Bolivia, Colombia, Venezuela, Guyana, French Guiana, and Suriname

The size of the continental United States relative to the size of the Amazon basin

The Amazon is drying & burning under the influence of deforestation & climate-change-induced drought

Fire and Flammability in Amazonia

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Just after 1998 El Niño Nepstad et al., *Forest Ecology & Management* 154, 2001

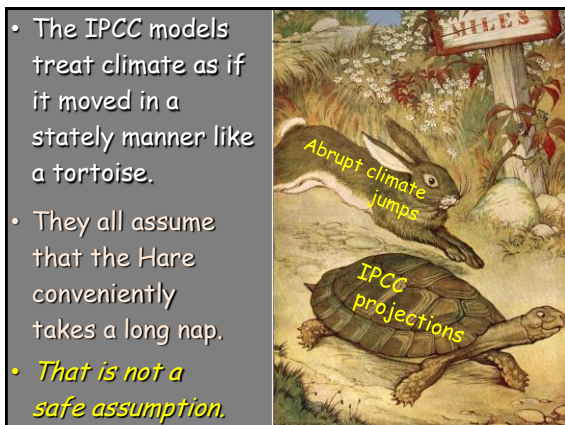
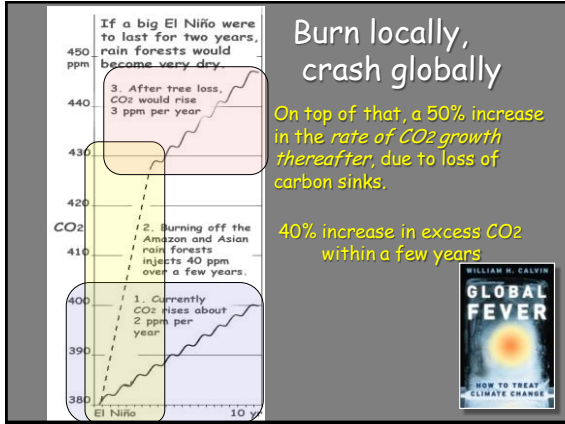
**How to rearrange atmospheric circulation in only a few months**  
 All it takes is a big El Niño.

El Niño (warm) 1982-83

La Niña (cool central Pacific Ocean)

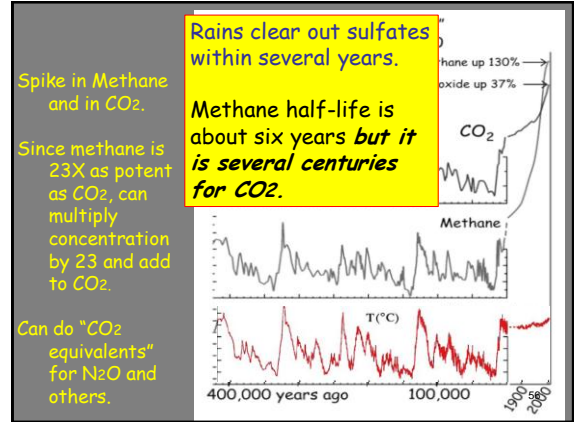
Double-duration and big ??

If a big one lasted two years instead of one....

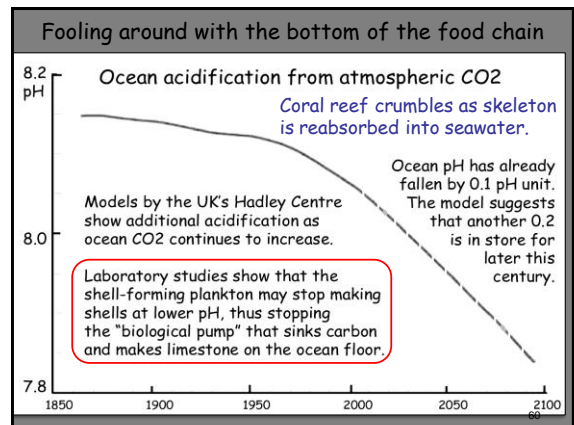
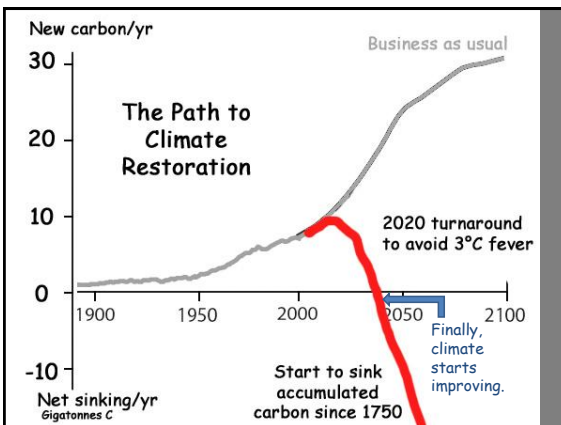
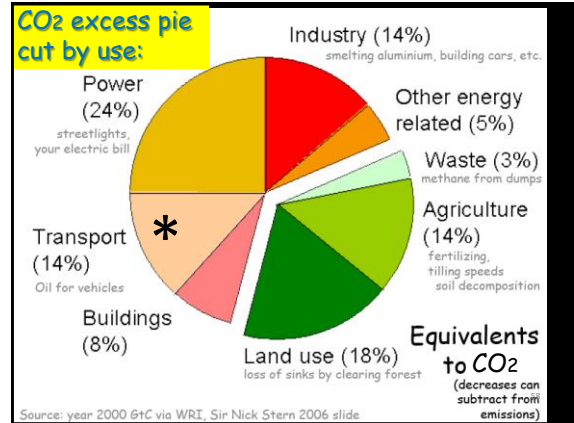
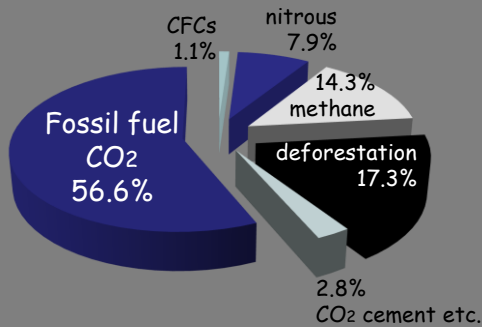


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  - A. Reduce emissions (and equivalents like deforestation)
  - B. Anthropogenic carbon sinks
  - C. Become a resilient civilization.

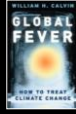


### CO2 and Equivalents: The Pie of Excess



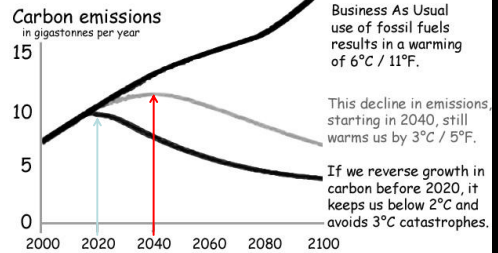
## Why the *Climate Fix* needs to be primarily *Technofix*

1. Need to bypass Tragedy of the Commons stalemates like Kyoto.
2. Need something that will prevent developing countries from repeating our mistakes. Some governments will prove incompetent so need cheap innovations.
3. Need big progress in next ten years.
  - Clone and give away existing solutions in exchange for banning fossil fuel extraction.



## Big effort up front because

1. Already in danger zone for jumps.
2. Need safety margin for later.
3. Will otherwise be on track for 3°C



## The Great Use-it-or-lose-it Intelligence Test

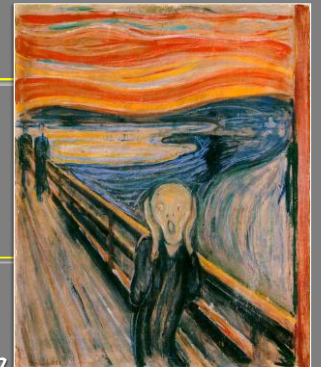
The public interest requires doing today those things that men of intelligence and goodwill would wish, five or ten years hence, had been done.

- Edmund Burke

## The End

My books and talks may be found at:

[WilliamCalvin.org](http://WilliamCalvin.org)



Edvard Munch, *The Scream*