

# **Threat to the Planet:\***

## **Implications for Energy Policy and Intergenerational Justice**

**Jim Hansen**

**November 27, 2008**

**Climate Conference, Rotterdam, Netherlands**

**\*Any statements relating to policy are personal opinion**

## **Global Warming Status**

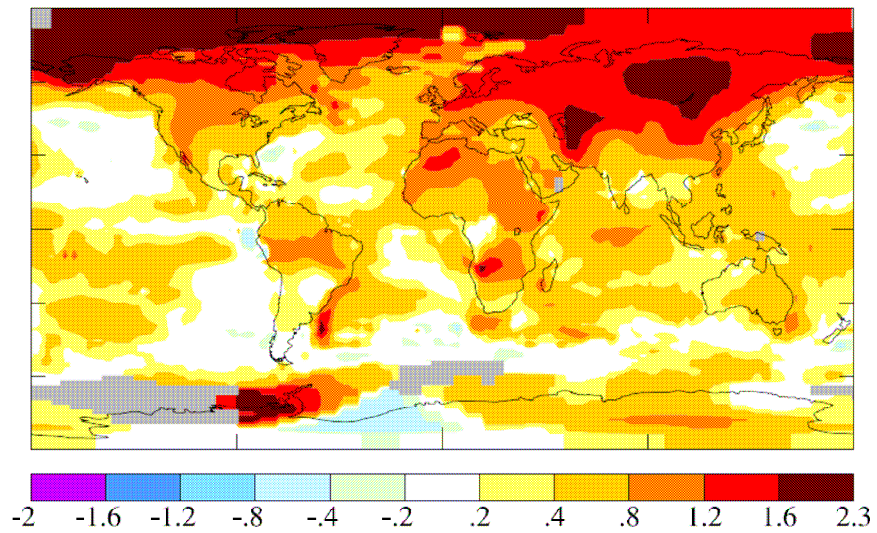
- 1. Knowledge Gap Between**
  - What is Understood (science)
  - What is Known (public/policymakers)
- 2. Planetary Emergency**
  - Climate Inertia → Warming in Pipeline
  - **Tipping Points → Could Lose Control**
- 3. Good News & Bad News**
  - Safe Level of CO<sub>2</sub> < 350 ppm
  - Multiple Benefits of Solution

Jake - 11 months

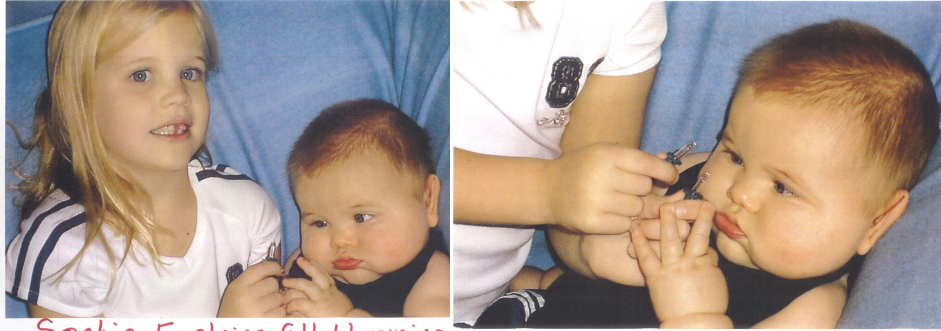


2001-2007 Mean Surface Temperature Anomaly ( $^{\circ}\text{C}$ )

Base Period = 1951-80, Global Mean = 0.54



Sophie explains 2 Watts of forcing to brother Connor



Sophie Explains GH Warming

Connor gets it: 2 Watts

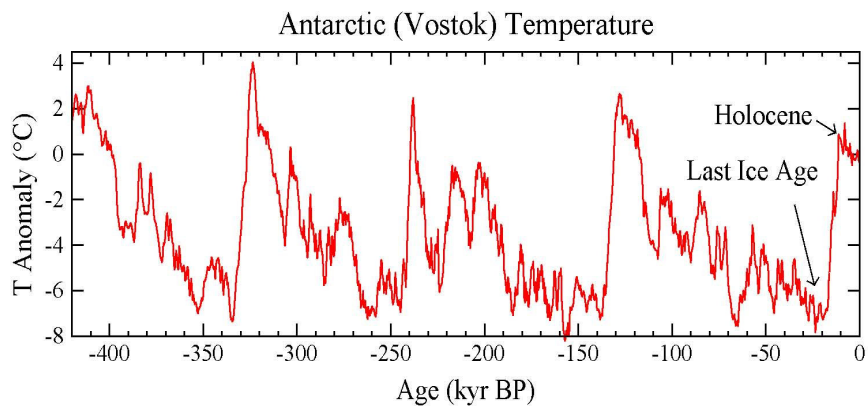
## Why be concerned about human-made climate change?

**There have been huge climate changes during Earth's history!**

It is arrogant to think that humans can control climate or that we know enough to say that today's climate is the best one for the planet.

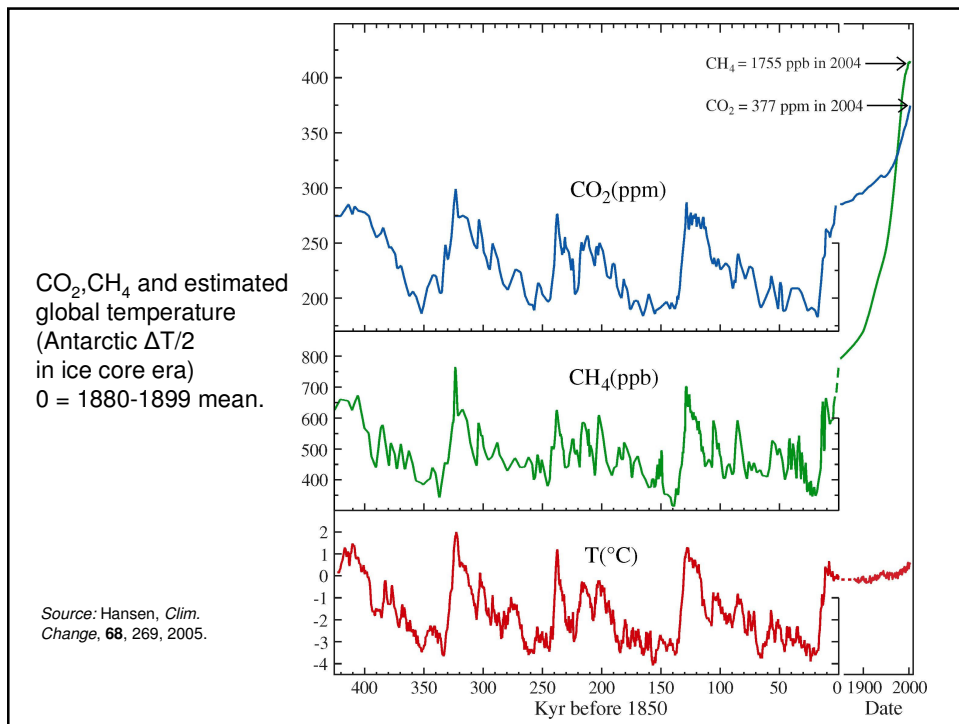
# Basis of Understanding

1. Earth's Paleoclimate History
2. On-Going Climate Changes
3. Climate Models

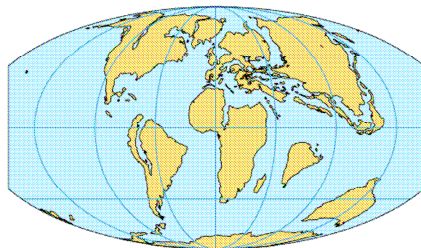


**Earth's history provides important information on global warming.  
Recorded human history occurs within the Holocene warm period.**

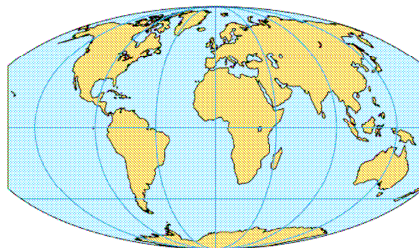




## Cenozoic Era



End of Cretaceous (65 My BP)



Present Day

### Global Climate Forcings

External (solar irradiance): +1 W/m<sup>2</sup>

Surface (continent locations): ~1 W/m<sup>2</sup>

Atmosphere (CO<sub>2</sub> changes): > 10 W/m<sup>2</sup>

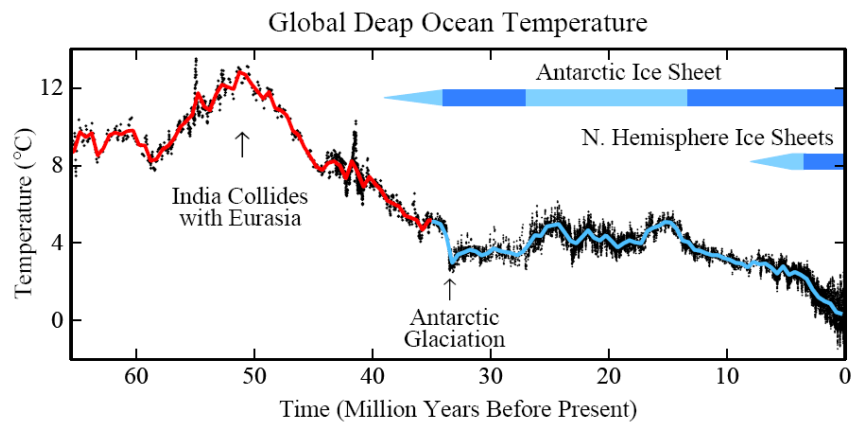


Fig. 1

## Summary: Cenozoic Era

### 1. Dominant Forcing: Natural $\Delta\text{CO}_2$

- Rate  $\sim 100$  ppm/My ( $0.0001$  ppm/year)
- Human-made rate today:  $\sim 2$  ppm/year

Humans Overwhelm Slow Geologic Changes

### 2. Climate Sensitivity High

- Antarctic ice forms if  $\text{CO}_2 < \sim 450$  ppm
- Ice sheet formation reversible

Humans Could Produce “A Different Planet”

## United Nations Framework Convention on Climate Change

*Aim is to stabilize greenhouse gas emissions...*

*“...at a level that would prevent  
dangerous anthropogenic interference  
with the climate system.”*

## Metrics for “Dangerous” Change

### Extermination of Animal & Plant Species

1. Extinction of Polar and Alpine Species
2. Unsustainable Migration Rates

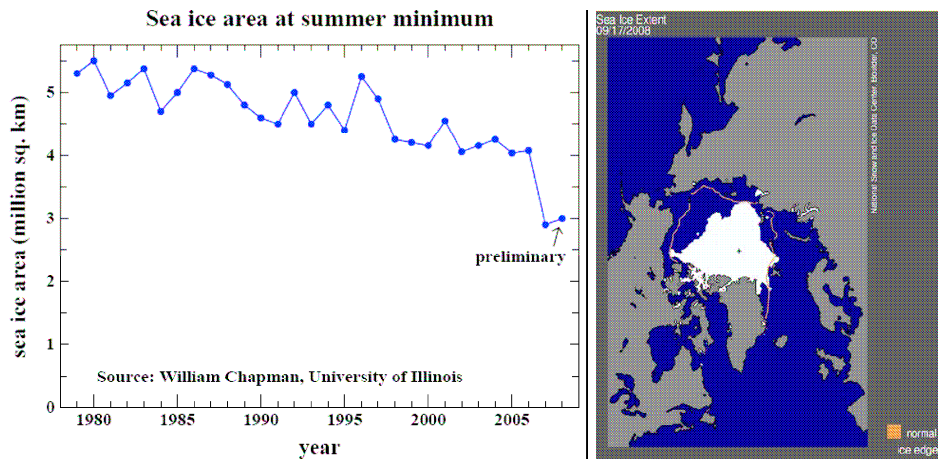
### Ice Sheet Disintegration: Global Sea Level

1. Long-Term Change from Paleoclimate Data
2. Ice Sheet Response Time

### Regional Climate Disruptions

1. Increase of Extreme Events
2. Shifting Zones/Freshwater Shortages

## Arctic sea ice area at summer minimum.



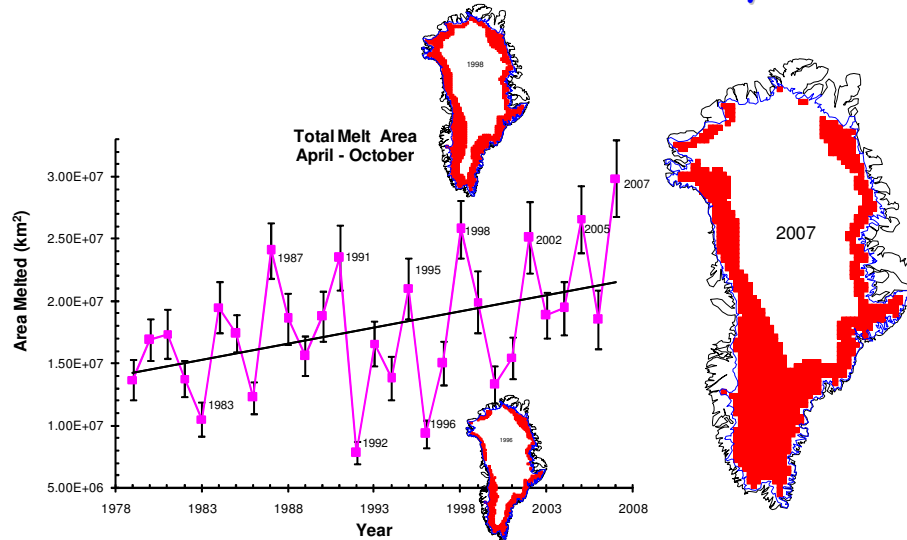
## Arctic Sea Ice Criterion\*

- 1. Restore Planetary Energy Balance**  
→ CO<sub>2</sub>: 385 ppm → 325-355 ppm
- 2. Restore Sea Ice: Aim for -0.5 W/m<sup>2</sup>**  
CO<sub>2</sub>: 385 ppm → 300-325 ppm

Range based on uncertainty in present planetary energy imbalance (between 0.5 and 1 W/m<sup>2</sup>)

\* Assuming near-balance among non-CO<sub>2</sub> forcings

## Greenland Total Melt Area - 2007 value exceeds last maximum by 10%



Konrad Steffen and Russell Huff, CIRES, University of Colorado at Boulder

## Surface Melt on Greenland

Melt descending into a moulin, a vertical shaft carrying water to ice sheet base.



Source: Roger Braithwaite,  
University of Manchester (UK)

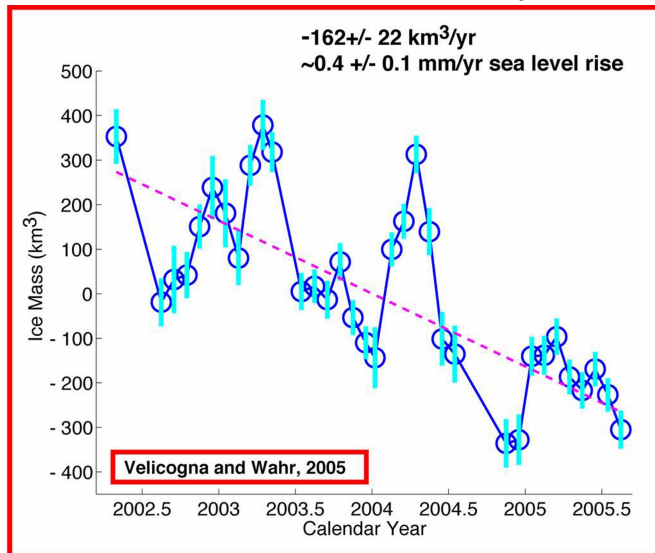
## Jakobshavn Ice Stream in Greenland

Discharge from major Greenland ice streams is accelerating markedly.

Source: Prof. Konrad Steffen,  
Univ. of Colorado



## Greenland Mass Loss – From Gravity Satellite





## Sea Level Criterion\*

### 1. Prior Interglacial Periods

→  $\text{CO}_2 < \sim 300 \text{ ppm}$

### 2. Cenozoic Era

→  $\text{CO}_2 < \sim 300 \text{ ppm}$

### 3. Ice Sheet Observations

→  $\text{CO}_2 < 385 \text{ ppm}$

\* Assuming near-balance among non- $\text{CO}_2$  forcings

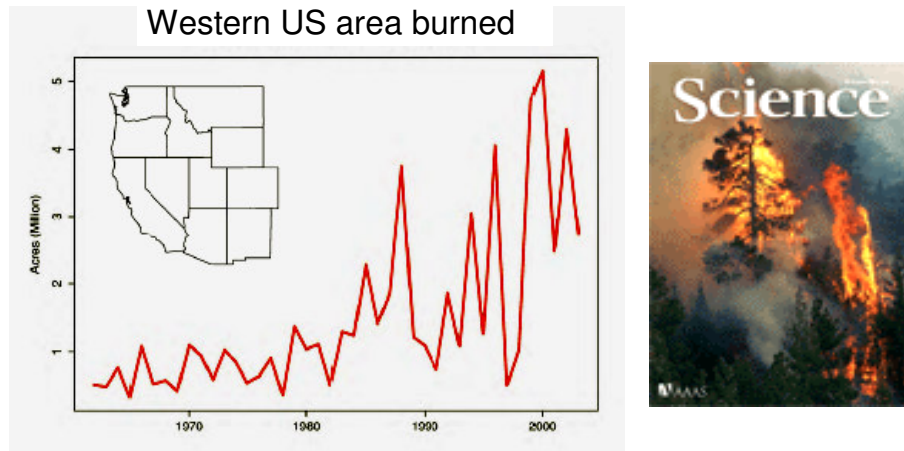
Pier on Lake Mead



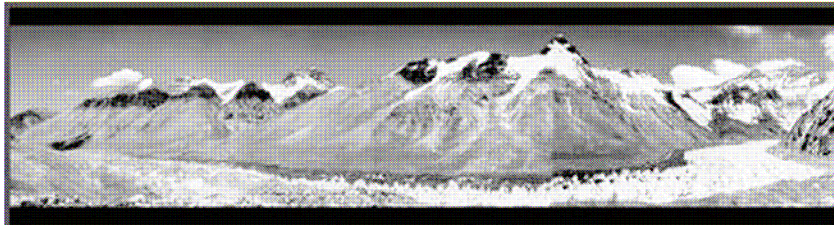
Subtropics expected to expand with global warming.  
Observations show 4 degrees of latitude expansion.

## Fires Are Increasing World-Wide

Wildfires in Western US have increased 4-fold in 30 years.



## Rongbuk Glacier



Rongbuk glacier in 1968 (top) and 2007. The largest glacier on Mount Everest's northern slopes feeds Rongbuk River.

## Stresses on Coral Reefs



Coral Reef off Fiji (Photo: Kevin Roland)

## Assessment of Target CO<sub>2</sub>

<u>Phenomenon</u>	<u>Target CO<sub>2</sub> (ppm)</u>
1. Arctic Sea Ice	300-325
2. Ice Sheets/Sea Level	300-350
3. Shifting Climatic Zones	300-350
4. Alpine Water Supplies	300-350
5. Avoid Ocean Acidification	300-350

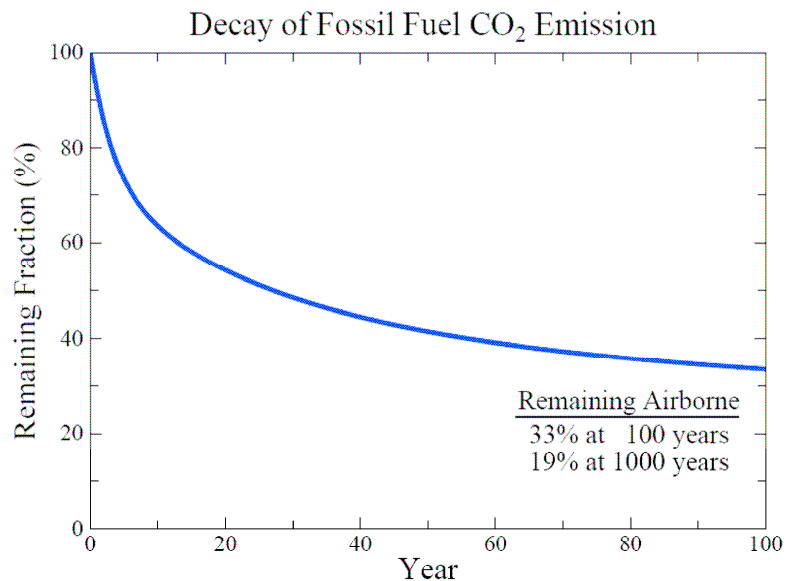
→ Initial Target CO<sub>2</sub> = 350\* ppm

\*assumes CH<sub>4</sub>, O<sub>3</sub>, Black Soot decrease

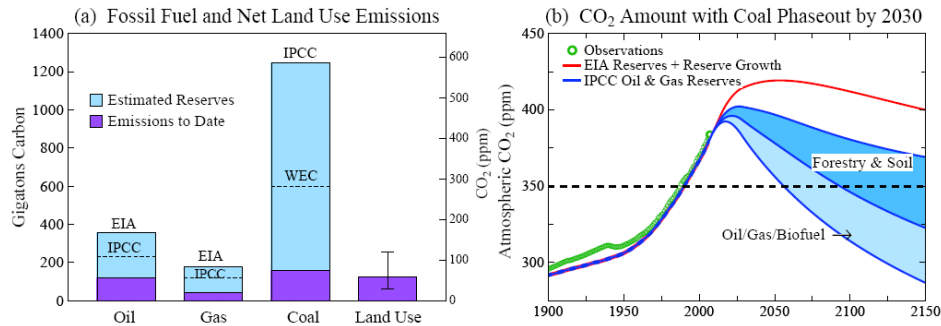
# Target CO<sub>2</sub>:

## < 350 ppm

To preserve creation, the planet  
on which civilization developed



The fraction of CO<sub>2</sub> remaining in the air, after emission by fossil fuel burning, declines rapidly at first, but 1/3 remains in the air after a century and 1/5 after a millennium (*Atmos. Chem. Phys.* **7**, 2287-2312, 2007).



**Coal phase-out by 2030 → peak CO<sub>2</sub> ~400-425 ppm, depending on oil/gas**  
**Faster return below 350 ppm requires additional actions**

## Initial Target CO<sub>2</sub>: 350 ppm

### Technically Feasible

(but not if business-as-usual continues)

### Quick Coal Phase-Out Critical

(long lifetime of atmospheric CO<sub>2</sub>)

(must halt construction of any new coal plants that do not capture & store CO<sub>2</sub>)

## **Basic Conflict**

**Fossil Fuel Special Interests**

**vs**

**Young People & Nature (Animals)**

**Fossil Interests:** God-given fact that all fossil fuels will be burned (**no free will**)

**Young People:** Hey! Not so fast!  
Nice planet you are leaving us!

## **What are the Odds?**

**Fossil Interests:** have influence in capitals world-wide

**Young People:** need to organize, enlist others (parents, e.g.), impact elections

**Animals:** not much help (don't vote, don't talk)



## **The Challenge**

**We can avoid destroying creation!  
(+cleaner planet, + good jobs!)**

**We have to figure out how to live  
without fossil fuels someday...**

**Why not now?**

## **What's the Solution?**

**(Not Carbon Cap or % Target!!!)**

- 1. Coal Emissions Phase-Out**  
**UK, US, Germany Should Lead**
- 2. Carbon Price & 100% Dividend**  
**For Fundamental Transformations**  
**Avoid Unconventional Fossil Fuels**

## **Carbon Tax & 100% Dividend**

- 1. Tax Grows (esp. when fuel costs fall)**
  - on oil/gas/coal at mine or port of entry
- 2. Entire Tax Returned in Equal Shares**
  - deposited monthly in bank accounts
- 3. Limited Government Role**
  - keep hands off money!
  - eliminate fossil subsidies
  - let marketplace choose winners

## **Priorities**

- 1. Energy Efficiency**
  - Standards & Carbon Tax Needed
- 2. Renewable Energies**
  - Solar, Wind, Geothermal, Biomass...
- 3. Electric Grid**
- 4. 4<sup>th</sup> Generation Nuclear Power**
  - Integral Fast Reactor
  - Liquid Fluoride Thermal Reactor
- 5. Carbon Capture & Sequestration**
  - Adds Cost, Problems Remain

## Intergenerational Conflict

**Intergenerational inequity** and injustice is the result, affecting the young and unborn.

**'Did not know' defense** of prior generations no longer viable.

**Ethical and legal liability** questions raised by actions that deceived the public.

**Continued failure** of political process (not even available to young and unborn) may cause increasing public protests.

### Climate Change Protest at Kingsnorth Power Station



Greenpeace activists on the painted chimney  
October 8 2008. Photograph: Will Rose/Greenpeace

## Kingsnorth Six: Not Guilty



Huw Williams, Kevin Drake, Ben Stewart, Tim Hewke, Emily Hall and Will Rose outside Maidstone Crown Court.

Photograph: Jiri Rezac/Greenpeace

## Web Site

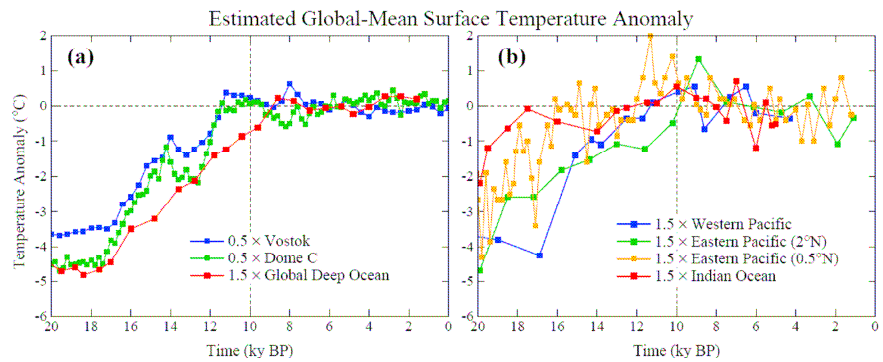
[www.columbia.edu/~jeh1](http://www.columbia.edu/~jeh1)

includes

**Target Atmospheric CO<sub>2</sub>: Where Should Humanity Aim?**

**Global Warming Twenty Years Later:  
Tipping Points Near**

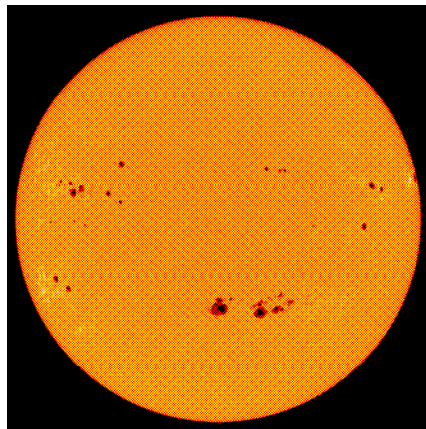
**In Defence of Kingsnorth Six**



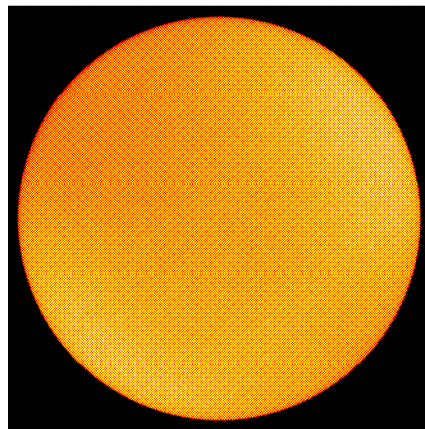
Estimates of global temperature change inferred from Antarctic ice cores and ocean sediment cores for a period allowing Holocene temperature to be apparent.

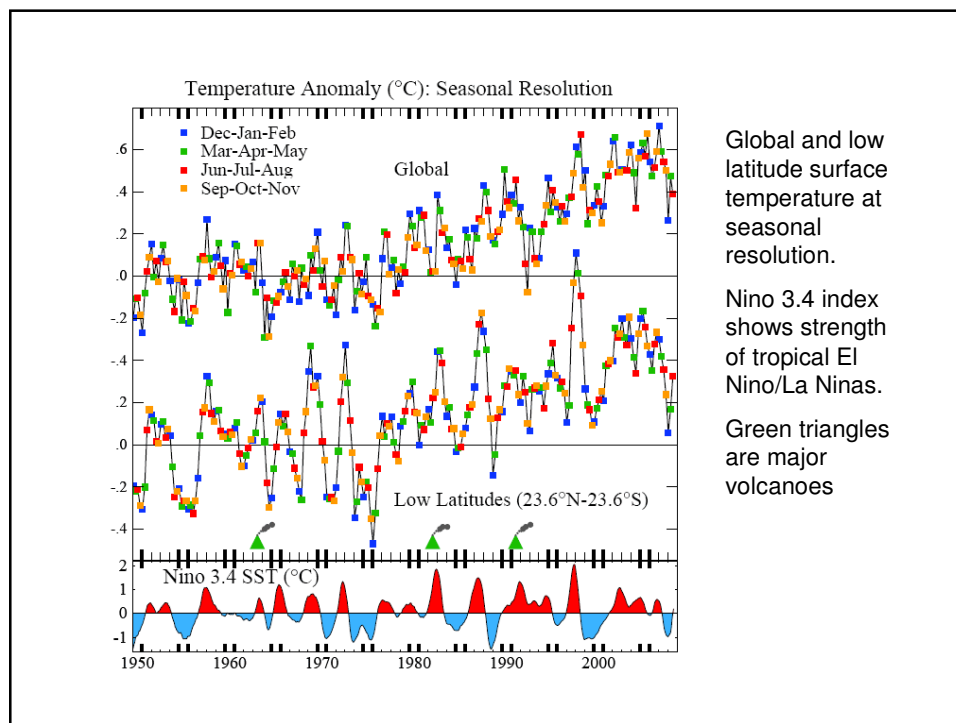
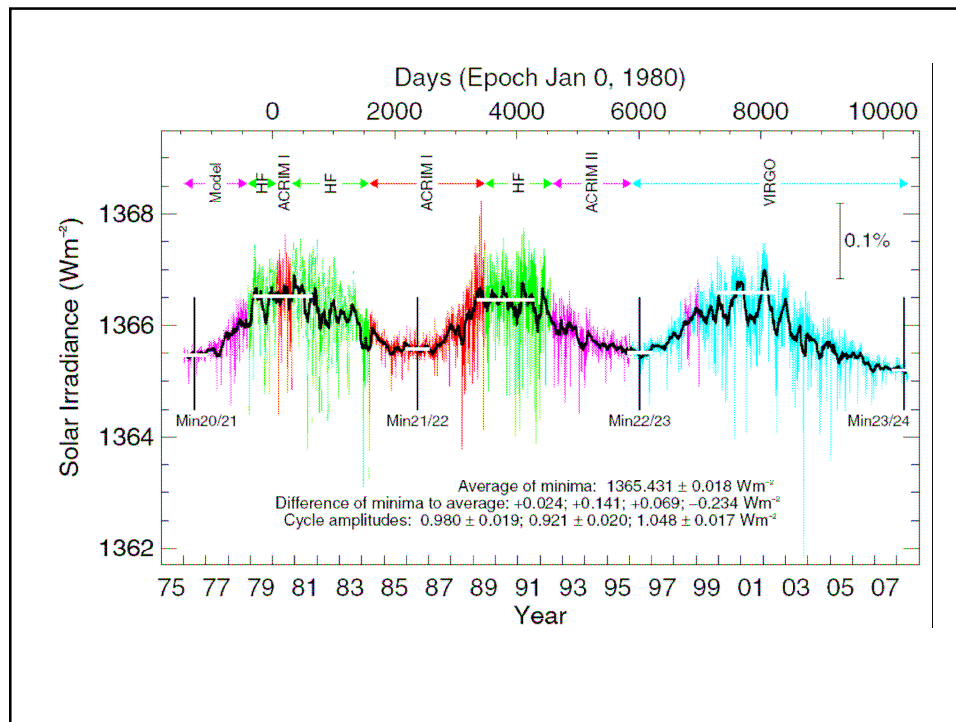
## Solar Activity

2001 (Solar Maximum)



2008 (Solar Minimum)







## Key Elements in Transformation

### Low-Loss Electric Grid

Clean Energy by 2020 (West) & 2030  
Allows Renewable Energy Ascendancy

### Carbon Tax and 100% Dividend

Tax at First Sale of Coal/Oil/Gas  
Tax Can Rise & Spur Transformations  
“100% or Fight! No Alligator-Shoes!”

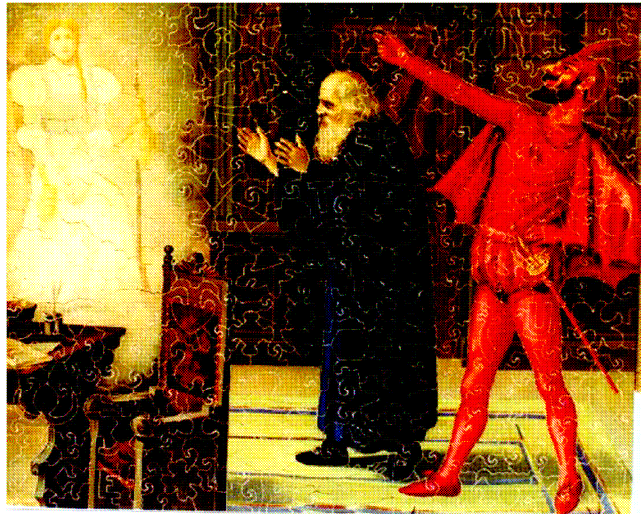


Figure 20. The Faustian bargain. Humans have enjoyed the fruits of the industrial revolution and avoided a large cost in climate change, as aerosol cooling has mitigated greenhouse warming. Payment comes due when humanity realizes that it cannot tolerate the further exponential growth of air pollution that would be needed for continued mitigation of global warming.