A Presentation Of

The North Texas Skeptics

Working to help people avoid dumb ass mistakes since 1987

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Anthropogenic Global Warming (AGW)
AGW Basics

- Earth maintains a temperature balance due to a number of factors.
- Solar energy flux (in)
- Nuclear decay (in)
- Tidal dissipation (in)
- Reflective radiation (out)
- Thermal radiation (out)
Thermal Balance Factors

• Solar flux varies over million-year cycles.
• Nuclear decay declines exponentially.
• Tidal dissipation declines.
• Reflective and radiated losses are affected by atmospheric absorption and can be impacted by human activity.
The Bad News

• Human activity supplements long-term changes in biosphere (air, water) temperatures.

• AGW produces temperature rises much more rapidly than would ordinarily occur.

• The Earth biosphere will not well tolerate a rapid rise in temperature.
The Real Bad News

• AGW can produce 3 C rise this century.
• Warming oceans will expand, raising sea level 3 feet.
• Melting land ice can raise sea level tens of feet.
• Regional climate changes (warmer, cooler, wetter, dryer) can disrupt economies
Worst Case

- Warmer temperatures $\rightarrow$ less snow
- Less snow $\rightarrow$ less reflection
- Less reflection $\rightarrow$ warmer temperatures
- Repeat (positive feedback—runaway warming)
- Can result in catastrophic melting of polar ice
Atmospheric Facts

• Atmosphere weighs at most $5.665 \times 10^{15}$ tons.

• Atmosphere is presently 0.0004 CO$_2$ by volume.

• 3348 billion tons of CO$_2$ in the atmosphere.

• One ton of carbon (coal) $\rightarrow$ 3.67 tons CO$_2$

• One ton petroleum $\rightarrow$ 3.32 tons CO$_2$

• 0.221 tons per automobile per year
Greenhouse Gases

- Water
- Carbon dioxide
- Methane
- Absorb long-wave infra red radiation
- Earth would be 33 C cooler without greenhouse gases.
Greenhouse Effect

Short Wave

Long Wave

Greenhouse Gas

Short Wave

Reflected

Long Wave
Black Body Equilibrium

Radiated Power Density
Planck Law

\[ S(\lambda) = \frac{2\pi c^2 h}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}} - 1} \]

Infrared

Power density (watts/m³)

Wavelength (nm)

373 K (100 C)

310 K (37 C)
The Greenhouse Effect

Solar Radiation absorbed by Earth: 235 W/m²

Thermal radiation into space: 195

Directly radiated from surface: 40

Heat and energy in the atmosphere: 324

Greenhouse gas absorption: 350

The Greenhouse Effect

Earth's land and ocean surface warmed to an average of 14°C
The Greenhouse Effect

Absorbed Radiation from the sun: 235 W/m²

168 absorbed by the surface

67 absorbed by the atmosphere
The Greenhouse Effect

195 radiated from the atmosphere into space

40 radiated from the surface into space

Total 235 radiated into space
The Greenhouse Effect

324 total absorbed by the surface

Greenhouse recirculation

452 total absorbed by the atmosphere

492 radiated toward space
Carbon dioxide is a greenhouse gas, transparent to incoming visible light from the sun but absorbing outgoing infrared radiation from the ground at its two infrared-active vibrational frequencies (see Structure and bonding above). Like all gases, the absorbed energy can be redistributed by molecular collisions which heat the atmosphere.

Relative Forcing

Radiative Forcing Components

- Greenhouse Gases: CO₂, CH₄, NO₂
- Stratospheric: Stratospheric water vapour
- Tropospheric: Black carbon on snow, Land use
- Aerosols: Direct effect, Cloud albedo effect, Linear contrails
- Solar irradiance
- Net Anthropogenic Component

Radiative forcing (W/m²)
# Greenhouse Gases

<table>
<thead>
<tr>
<th>Compound</th>
<th>Formula</th>
<th>Contribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water vapor and clouds</td>
<td>H_2O</td>
<td>36–72%</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>CO_2</td>
<td>9–26%</td>
</tr>
<tr>
<td>Methane</td>
<td>CH_4</td>
<td>4–9%</td>
</tr>
<tr>
<td>Ozone</td>
<td>O_3</td>
<td>3–7%</td>
</tr>
</tbody>
</table>
## Life Of Greenhouse Gases

Atmospheric lifetime and **GWP** relative to CO₂ at different time horizon for various greenhouse gases.

<table>
<thead>
<tr>
<th>Gas name</th>
<th>Chemical formula</th>
<th>Lifetime (years)</th>
<th>Global warming potential (GWP) for given time horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20-yr</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>CO₂</td>
<td>See above</td>
<td>1</td>
</tr>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td>12</td>
<td>72</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>N₂O</td>
<td>114</td>
<td>289</td>
</tr>
<tr>
<td>CFC-12</td>
<td>CCl₂F₂</td>
<td>100</td>
<td>11 000</td>
</tr>
<tr>
<td>HCFC-22</td>
<td>CHCl₂F₂</td>
<td>12</td>
<td>5 160</td>
</tr>
<tr>
<td>Tetrafluoromethane</td>
<td>CF₄</td>
<td>50 000</td>
<td>5 210</td>
</tr>
<tr>
<td>Hexafluoroethane</td>
<td>C₂F₆</td>
<td>10 000</td>
<td>8 630</td>
</tr>
<tr>
<td>Sulfur hexafluoride</td>
<td>SF₆</td>
<td>3 200</td>
<td>16 300</td>
</tr>
<tr>
<td>Nitrogen trifluoride</td>
<td>NF₃</td>
<td>740</td>
<td>12 300</td>
</tr>
</tbody>
</table>
## Concentration

<table>
<thead>
<tr>
<th>Gas</th>
<th>Pre-1750 tropospheric concentration[^43]</th>
<th>Recent tropospheric concentration[^44]</th>
<th>Absolute increase since 1750</th>
<th>Percentage increase since 1750</th>
<th>Increased radiative forcing (W/m²)[^45]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide (CO₂)</td>
<td>280 ppm[^46]</td>
<td>395.4 ppm[^47]</td>
<td>115.4 ppm</td>
<td>41.2%</td>
<td>1.88</td>
</tr>
<tr>
<td>Methane (CH₄)</td>
<td>700 ppb[^48]</td>
<td>1893 ppb /[^49] 1762 ppb[^49]</td>
<td>1193 ppb / 1062 ppb</td>
<td>170.4% / 151.7%</td>
<td>0.49</td>
</tr>
<tr>
<td>Nitrous oxide (N₂O)</td>
<td>270 ppb[^45][^50]</td>
<td>326 ppb /[^49] 324 ppb[^49]</td>
<td>56 ppb / 54 ppb</td>
<td>20.7% / 20.0%</td>
<td>0.17</td>
</tr>
<tr>
<td>Tropospheric ozone (O₃)</td>
<td>237 ppb[^43]</td>
<td>337 ppb[^43]</td>
<td>100 ppb</td>
<td>42%</td>
<td>0.4[^51]</td>
</tr>
</tbody>
</table>
This diagram of the fast carbon cycle shows the movement of carbon between land, atmosphere, and oceans in billions of tons of carbon per year. Yellow numbers are natural fluxes, red are human contributions in billions of tons of carbon per year. White numbers indicate stored carbon.
The Evidence

Global Land-Ocean Temperature Index

Temperature Anomaly (°C)

1880 1900 1920 1940 1960 1980 2000

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Evidence Of Warming

For 650,000 years, atmospheric CO₂ has never been above this line ... until now.
Evidence Of Warming

Atmospheric Carbon Dioxide
Measured at Mauna Loa, Hawaii

Carbon dioxide concentration (ppmv)

Human Contribution

Human activity since the Industrial Revolution has increased the amount of greenhouse gases in the atmosphere, leading to increased radiative forcing from CO$_2$, methane, tropospheric ozone, CFCs and nitrous oxide. According to work published in 2007, the concentrations of CO$_2$ and methane have increased by 36% and 148% respectively since 1750. These levels are much higher than at any time during the last 800,000 years, the period for which reliable data has been extracted from ice cores. Less direct geological evidence indicates that CO$_2$ values higher than this were last seen about 20 million years ago. Fossil fuel burning has produced about three-quarters of the increase in CO$_2$ from human activity over the past 20 years. The rest of this increase is caused mostly by changes in land-use, particularly deforestation. Estimates of global CO$_2$ emissions in 2011 from fossil fuel combustion, including cement production and gas flaring, was 34.8 billion tonnes (9.5 ± 0.5 PgC), an increase of 54% above emissions in 1990. Coal burning was responsible for 43% of the total emissions, oil 34%, gas 18%, cement 4.9% and gas flaring 0.7% In May 2013, it was reported that readings for CO$_2$ taken at the world's primary benchmark site in Mauna Loa surpassed 400 ppm. According to professor Brian Hoskins, this is likely the first time CO$_2$ levels have been this high for about 4.5 million years.

Consequences

• Sea level rise is the worst. A rise of just a few feet will encroach on countries like Bangladesh and the Maldives. The Mississippi Delta is at sea level. New York City and Washington D.C are just above.

• Effects on crops

• More energy in the air → stormy weather

• Less rain | more rain?
The Opposition

- Heartland Institute
- American Legislative Exchange Council
- Petroleum industry
- Coal industry
- Political fuddy-duddies
- Glenn Beck
- Senator James Inhofe
Wei-Hock (Willie) Soon

But newly released documents show the extent to which Dr. Soon’s work has been tied to funding he received from corporate interests. He has accepted more than $1.2 million in money from the fossil-fuel industry over the last decade while failing to disclose that conflict of interest in most of his scientific papers. At least 11 papers he has published since 2008 omitted such a disclosure, and in at least eight of those cases, he appears to have violated ethical guidelines of the journals that published his work.

The documents show that Dr. Soon, in correspondence with his corporate funders, described many of his scientific papers as “deliverables” that he completed in exchange for their money. He used the same term to describe testimony he prepared for Congress.
The Real Villains

- Not the oil companies
- Not the coal companies
- The real villains are us (we).
- If we stopped purchasing these products the companies would stop drilling and mining.
The Solution

• Stop using fossil fuel.
• Cannot stop pumping oil.
• If the oil pumps stopped today, within a year in the order of 1 billion people would starve to death.
• There is no hybrid jet liner.
• Produce carbon-based fuel from atmospheric CO$_2$. 

Bad Solutions

• Ethanol
  – Not carbon neutral
  – Competes for vital resources

• Hydro power
  – Limited resource
  – Does not scale well
  – Ecological and geological disruption
Good Solutions

• Solar power
  – 1000 Watts per square meter
  – Only works when the sun shines
  – Becoming competitive

• Wind power
  – Only works when the wind blows
  – Currently competitive

• Nuclear power (hydrogen?)
  – No hydrogen solution in sight
  – Finite uranium source
A Basic Fact

Human well being, health, longevity, satisfaction of life—all are proportional to individual energy consumption.
The Hydrocarbon Solution

• Hydrocarbons are the ideal energy storage medium.
• Ethanol is not a hydrocarbon.
• Source from natural vegetation
• Source from atmospheric CO$_2$
• Low down-channel impact
• Technology is lacking.
Fuel From Plants

- Plants are harvested for the carbon.
- Removing the plants also removes plant nutrients from the growing area.
- For sustainable production the nutrients need to be returned to the growing area.
Arguments Against AGW

• Human contribution is insignificant compared to natural variations.
• AGW is a liberal conspiracy to promote overbearing government regulation.
• AGW research is driven by greed for grant money.
Contact Us

If you disagree with any portion of this presentation, you are invited engage us in a public dialog.

Contact John Blanton jf_blanton@yahoo.com

This presentation is on-line at ntskeptics.org.