APES Chapter 19 – Global Change

Intro: Walking On Thin Ice

Problems in the North (Arctic Region)

I. Global Change (defined):
(see fig. 19.1))

Global Climate Change:

Global Warming:

II. Warming the Planet

A. The Sun-Earth Heating System

B. Greenhouse Effect (fig. 19.2)

Greenhouse Gases (GHG's):

Greenhouse Warming Potential

III. Sources of GHG's

A. Natural Sources:

Volcanoes (CO_2 has a long-term warming effect)

Other volcanic gases (and ash) have short-term cooling effect (SO_2 for ex)

Methane (CH_4)

Nitrous Oxide (N_2O)

Water Vapor (H_2O)

B. Anthropogenic Sources (fig. 19.6)

1. Fossil Fuels - CO_2 Production from Coal:

Oil:

Natural Gas:

Particulates – dual role:

2. Agricultural Practices – Contribution of Nitrogen Oxides

3. Deforestation – CO_2 from decomposition

- reduced CO_2 sequestration

4. Landfills – production of methane (CH_4) during decomposition

5. Industrial Production

IV. The CO_2 – Global Temperature Link

The IPCC (Intergovernmental Panel on Climate Change)

A. CO_2 Concentrations 1958 to Present (fig. 19.7)

B. CO_2 Emissions from Developed and Developing Countries (fig. 19.8)

C. Global Temperatures since1880 (fig. 19.9)

D. Global Temperatures last 400,000 years (fig. 19.13 and 19.15)

E. Trends in 3 GHG's (fig. 19.14)

F. Northern Hemisphere Temp. Changes – 2000 years (fig. 19.18)
(fig. 19.10)

G. Climate Models: Depend on future CO_2 Increases (fig. 19.17)

V. Feedback Loops and Climate Change

A. Positive Feedback:

B. Negative Feedback:

C. Limitations on Feedback Mechanisms:

VI. Consequences of Global Warming

A. For the Environment

1. Ice Caps

2. Ocean Currents

B. For Organisms

1. Plants / Animals

2. Humans

C. Controversy:

1. Scientific Consensus –

2. The Uncertainty –

3. Addressed by IPCC (table 19.2)

VI. Action Steps

A. International

1. The Kyoto Protocols (1997)

a. The Precautionary Principle

b. Carbon Sequestration – need to scale up

2. The Copenhagen Conference (2009)

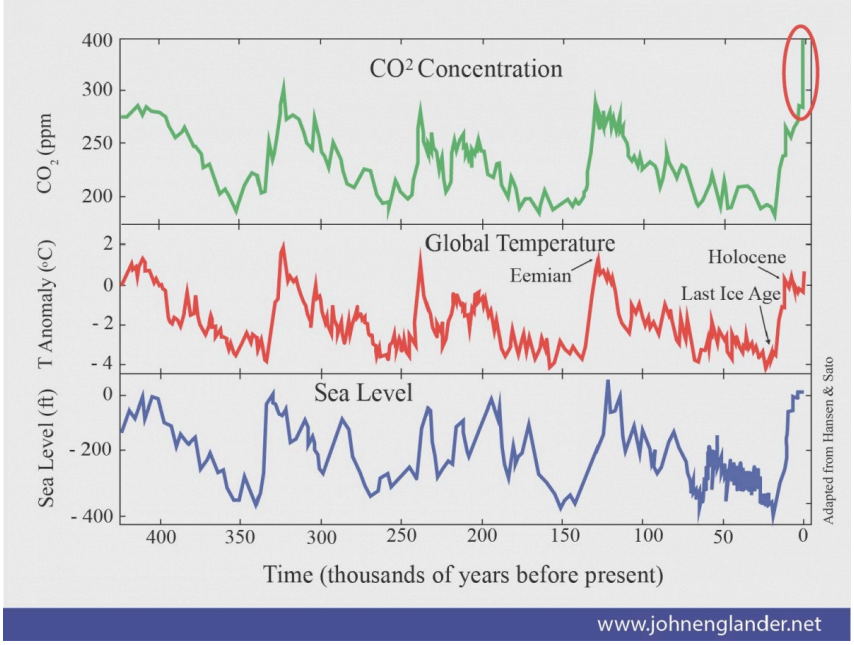
B. US Efforts – Regulating CO_2 Emissions

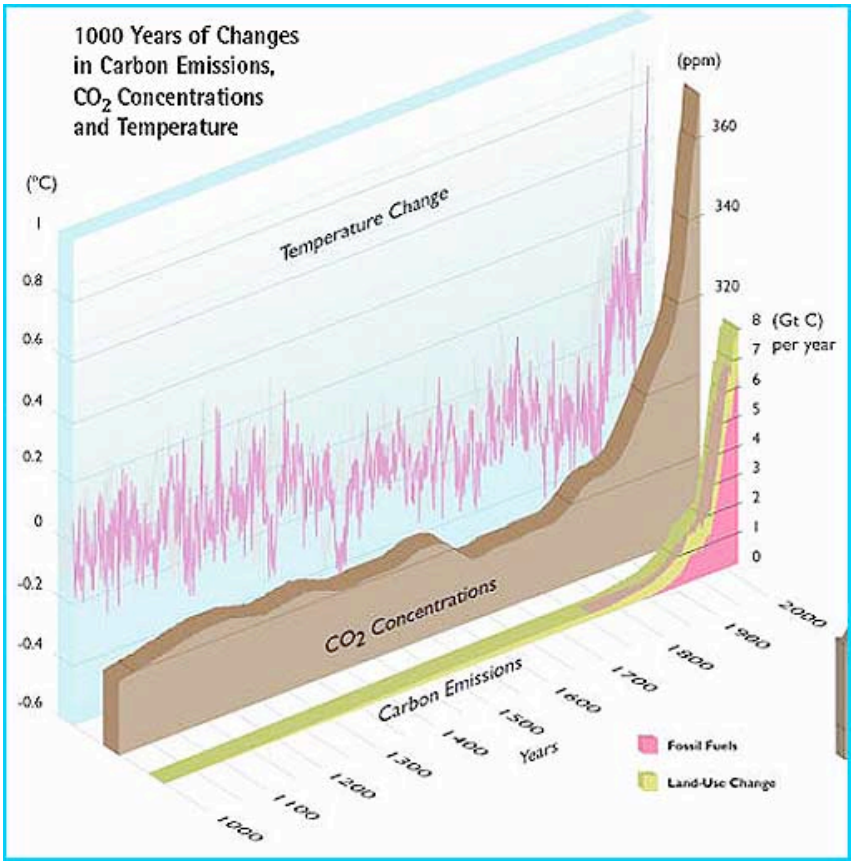
2007 – EPA rules under the Clean Air Act….according to Supreme Court

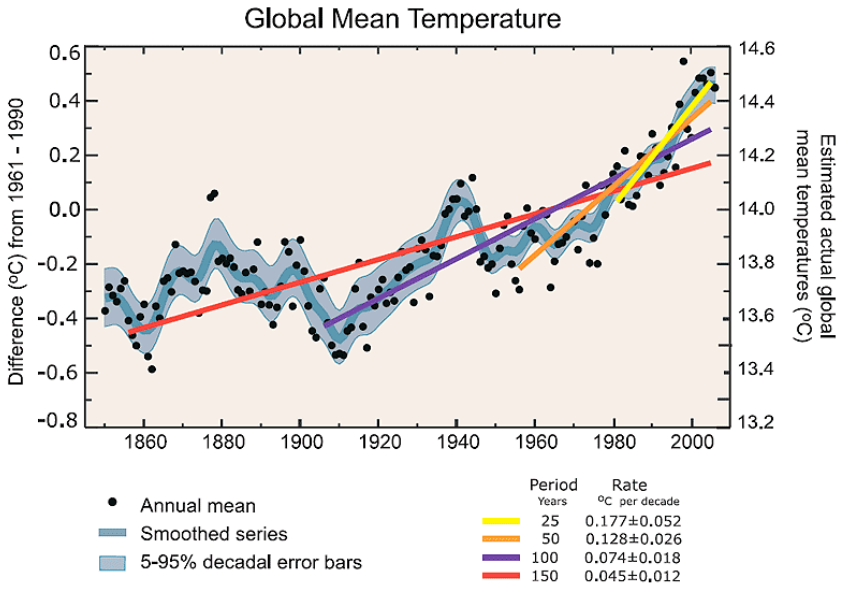
2009 – EPA regulate GHG's

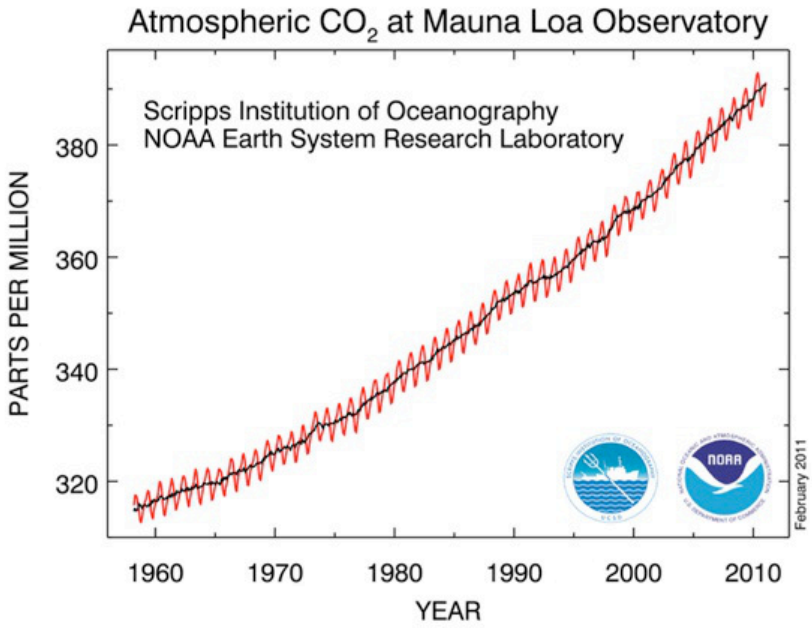
- increase vehicle fuel efficiency to reduce CO2 emissions

Working Toward Sustainability – Local Govts. / Businesses Lead the Way:


CO² Concentration
CO2 (ppm)
400
300
250
200
Global Temperature
T Anomaly (°C)
2
0
- 2
- 4
Eemian
Holocene
Last Ice Age
Sea Level
Sea Level (ft)
0
- 200
- 400
400
350
300
250
200
150
100
50
0
Time (thousands of years before present)
Adapted from Hansen & Sato
www.johnenglander.net


1000 Years of Changes
in Carbon Emissions,
CO2 Concentrations
and Temperature
(°C)
(ppm)
Temperature Change
CO2 Concentrations
Carbon Emissions
(Gt C)
per year
Years
Fossil Fuels
Land-Use Change


Global Mean Temperature
Difference (°C) from 1961 - 1990
Estimated actual global mean temperatures (°C)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
14.6
14.4
14.2
14.0
13.8
13.6
13.4
13.2
1860
1880
1900
1920
1940
1960
1980
2000
Annual mean
Smoothed series
5-95% decadal error bars
Period Years
Rate °C per decade
25 0.177±0.052
50 0.128±0.026
100 0.074±0.018
150 0.045±0.012


Atmospheric CO2 at Mauna Loa Observatory
Scripps Institution of Oceanography
NOAA Earth System Research Laboratory
PARTS PER MILLION
380
360
340
320
1960
1970
1980
1990
2000
2010
YEAR
NOAA
February 2011