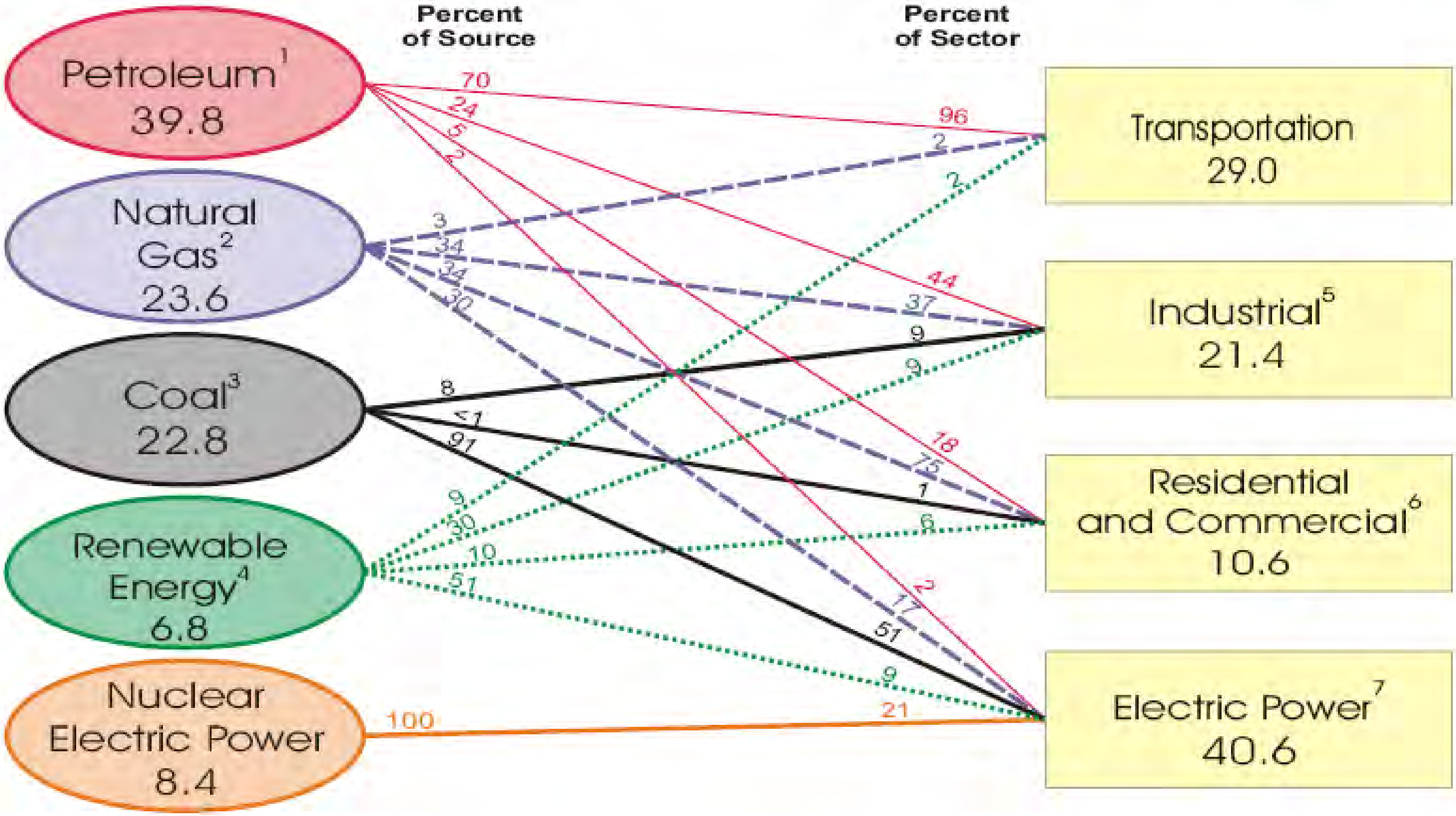
The Richard Hill Presentation

U.S. Primary Energy Consumption by Source and Sector, 2007

(Quadrillion Btu)



Per-Person Use of Energy

$$100 \times 10^{15} \frac{\text{Btu}}{\text{US-year}} \times \frac{1}{3 \times 10^{8}} \frac{\text{US}}{\text{Person}} \times \frac{1}{3 \times 10^{3}} \frac{\text{kW hr}}{\text{Btu}} \times \frac{1}{10^{4}} \frac{\text{yr}}{\text{hr}} =$$

$$10 \ \frac{\text{kW}}{\text{Person}}$$

Energy to Electricity

$4 \ \frac{\text{Kw}}{\text{Person}}$ Electricity

4000×10^9 Kwh/year

10^4 hours/year

3×10^8 US Population

per person use: $1.3 \ \frac{\text{Kw}}{\text{Person}}$

The Maine Forest

$$0.69 \frac{\text{ton}}{\text{acre yr}} \times 2000 \frac{\text{pounds}}{\text{ton}} \times 8000 \frac{\text{Btu}}{\text{pound}} = 10 \times 10^{6} \frac{\text{Btu}}{\text{acre yr}}$$

$$10 \times 10^{6} \times \frac{1}{10^{4}} \times \frac{1}{3000} = 0.3 \frac{\text{kW}}{\text{acre}}$$

$$0.3 \times 17 \times 10^{6} = 5 \times 10^{6} \frac{\text{kW}}{\text{Maine forest}}$$

$$5 \times 10^{6} \times \frac{1}{1.3 \times 10^{6}} = 4 \frac{\text{kW}}{\text{person}}$$

$$2000 \times 10^{9} \quad \text{kW hr from Coal}$$

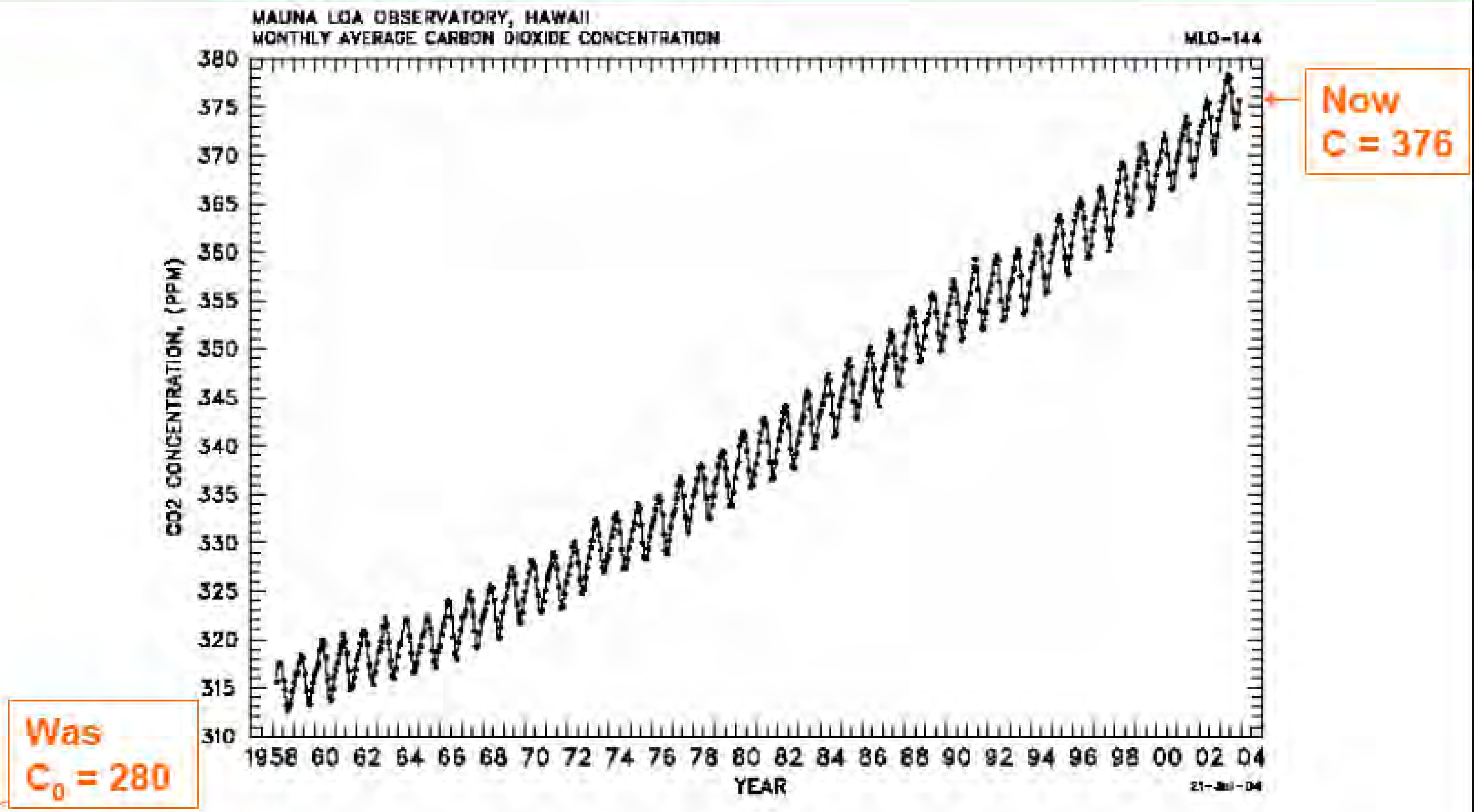
$$4000 \times 10^{9} \quad \text{lb } CO_2$$

$$80 \times 10^{9} \quad ft^{3}\, CO_2$$

$$20 \times 10^{6} \frac{\text{Bbl}}{\text{Day oil}} \times 5 \frac{ft^{3}}{\text{Bbl}} \times 400 \frac{\text{day}}{\text{yr}}$$

$$40 \times 10^{9} \quad \frac{ft^{3}}{\text{yr}}$$

Anthropogenic increase of atmospheric CO_2



- 1 ppm = 8 Gt CO2 = 2.2Gt C

Annual carbon flows in Giga tons (GtC)

- Plant growth and decay: 60
- Dissolved and emitted from ocean: 90

Carbon storage in biosphere GtC

- Atmosphere 750
- Ocean 700

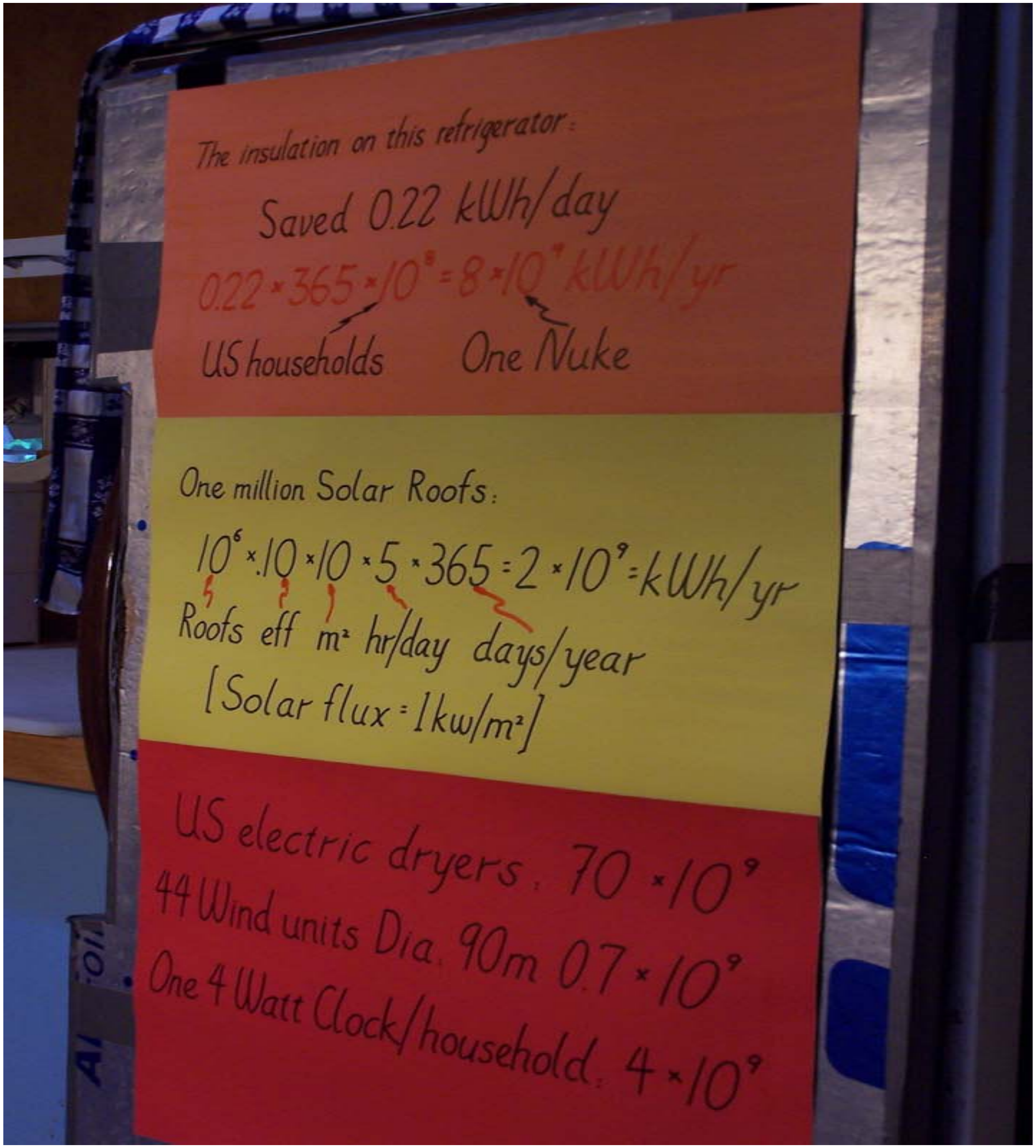
Each year burning fossil fuel adds 6 GtC
and it stays there!!

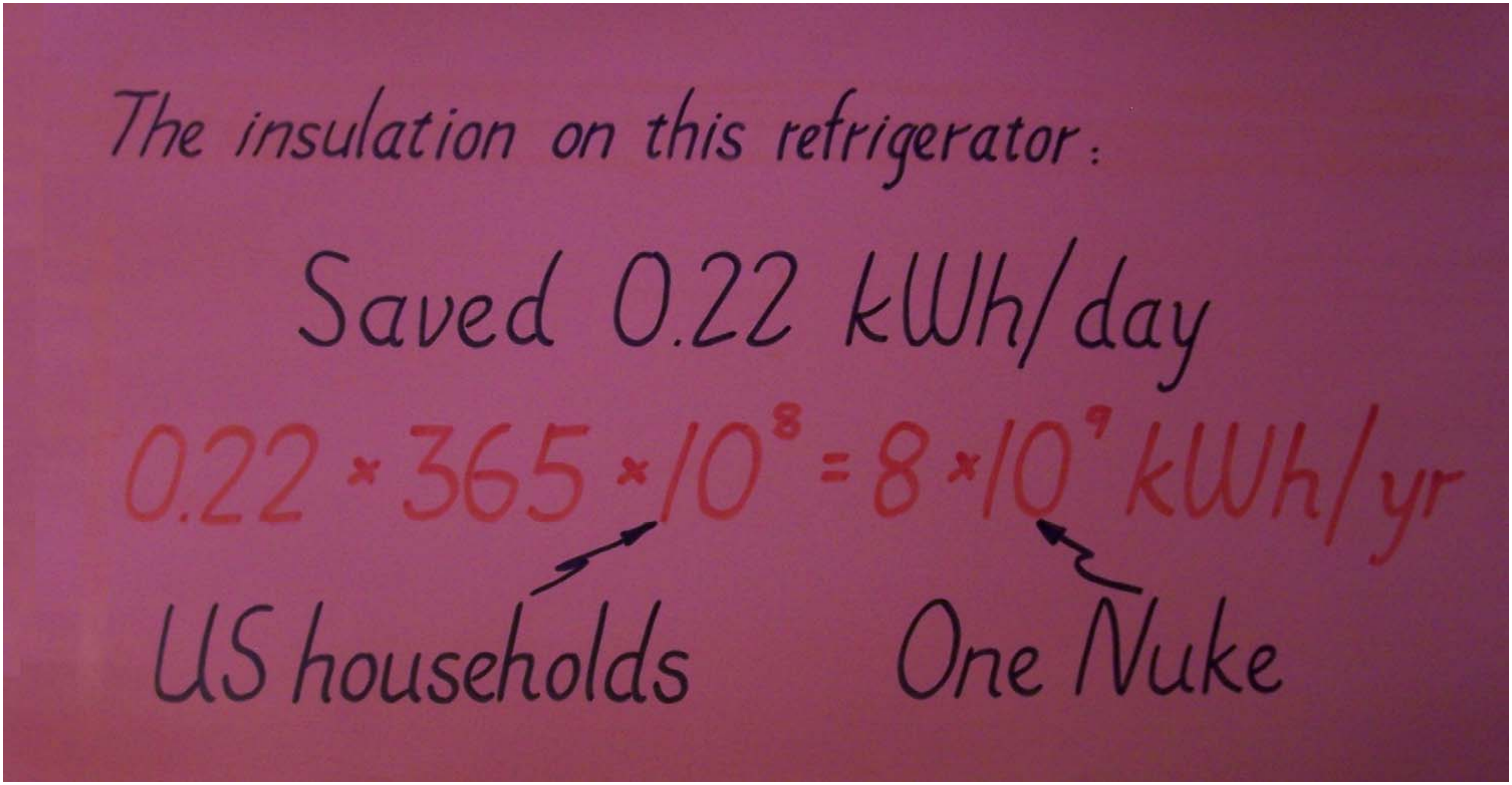
But—Lookout!!

6000 GtC of carbon are still in the earth in the form of oil, coal and natural gas

How to save one giga ton of carbon each year

- Double the efficiency of 2 billion cars: 30mpg to 60 mpg
- Double the nuclear plants from 200 to 400
- 40,000 square kilometers of solar array or 4 million windmills to produce hydrogen for fuel cell powered autos.
- 2 million windmills
- Plant 1/6 of earth cropland with biomass plantations for ethanol production


The insulation on this refrigerator:
Saved 0.22 kWh/day
0.22 × 365 × 10^8 = 8 × 10^9 kWh/yr
US households
One Nuke
One million Solar Roofs:
10^6 × .10 × 10 × 5 × 365 = 2 × 10^9 = kWh/yr
Roofs eff m² hr/day days/year
[Solar flux = 1kw/m²]
US electric dryers: 70 × 10^9
44 Wind units Dia. 90m 0.7 × 10^9
One 4 Watt Clock/household: 4 × 10^9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One million Solar Roofs:

$$10^6 \times .10 \times 10 \times 5 \times 365 = 2 \times 10^9 = kWh/$$

Roofs eff m^2 hr/day days/year

[Solar flux = $1 kw/m^2$]

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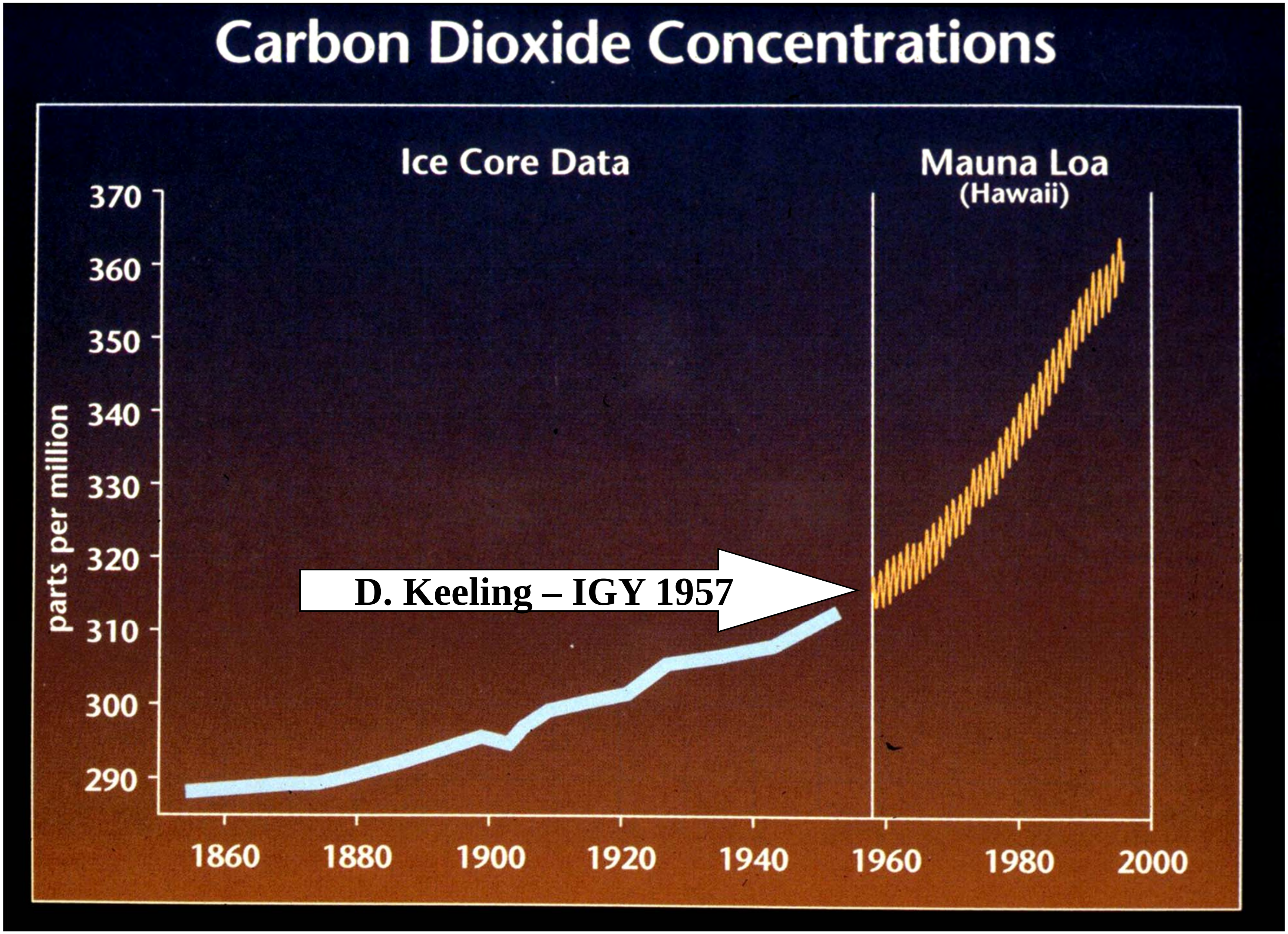

Carbon Dioxide Concentrations
Ice Core Data
Mauna Loa
(Hawaii)
parts per million
370
360
350
340
330
320
310
300
290
1860
1880
1900
1920
1940
1960
1980
2000
D. Keeling – IGY 1957

125 Billion kWh