

Climate Change workshop on **Energy costs**  
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- A. Cost of imported oil in US?
- B. Impact on environment if everyone uses energy at the US rate?
- C. Cost to decentralize US electricity with renewable energy?
- D. Availability of solar energy?

**A.** The USA uses 21 million barrels of crude oil per DAY, about half of it for gasoline. 60% of it is imported. A barrel of crude oil costs about \$80 in 2006.

**How much do we pay for imported gasoline?**

$$\frac{21}{2} \times 10^6 \frac{\text{barrels}}{\text{day}} \left( \frac{3}{5} \right) \$80 \sim$$

**Compare this to the cost of the current US war in Iraq**, estimated at \$1-2 billion dollars per WEEK:

**B. What will be the impact on the environment if everyone uses energy at the US rate?** The current burden, or amount of CO<sub>2</sub> in the atmosphere, is about 380 ppm (and the historical peak over the last 5 ice ages was 280 ppm).

World population ~ 6 billion people. US emissions ~ 5 tons of C per person per year.  
Global emissions now ~ 6 billion tons/year

If everyone used energy at the US rate, global emissions would be (in billion tons/year):

Steady state: Assume that the Burden = Flux \* Lifetime of CO<sub>2</sub> in atmosphere, and that the Lifetime of CO<sub>2</sub> in atmosphere = T ~ 100 years

Burden (in billions of tons or ppm) =

Consider the significance of this amount:

**C. What would be the cost to decentralize all US electricity generation with renewable energy?**

Number of people  $\sim 300 \times 10^6$

Number of homes  $\sim 10^6$

Estimate cost per home  $\sim$  \$20,000 to outfit with solar panels, etc.

Total cost  $\sim$

Compare this to the cost of war in Iraq:

**D. How much solar energy is available?** Compare to current electricity use.

The power received by the Earth from the Sun = intensity \* area =  $S * \pi R^2$  (about half the Earth absorbs at once, with an effective area equivalent to a disk), where the intensity of solar radiation received by the Earth is  $S = 1370 \text{ watts/m}^2$  and the radius of the Earth is  $R = 6.4 \times 10^6 \text{ m}$ .

Power received (W) =

If solar panels are about 10% efficient, then what fraction of the solar power incident on Earth would have to be harvested to meet our electricity needs?

Power<sub>available</sub>  $\sim$

Number of people on Earth  $\sim 6 \times 10^9$ . Assume each person needs 2 kW for a good standard of living. Then we need a total of

Power needed =

Fraction of solar power we must harvest:

$$\frac{\text{Power needed}}{\text{Power available}} \sim$$

Would this leave enough solar energy for growing plants and animals and keeping the biosphere happy?

Extra: How much area would it require in solar panels?