

PS#4, Due Tuesday, February 7

1. You're at an environmental demonstration and someone starts talking about how the ozone hole causes climate change. Please gently help them distinguish between climate change and increased exposure to UV.
 - a) What are the sources of each problem?
 - b) What are the physical mechanism and effect of each problem?
 - c) What are the environmental/biological effects of each problem?
 - d) What are the solutions for each problem?

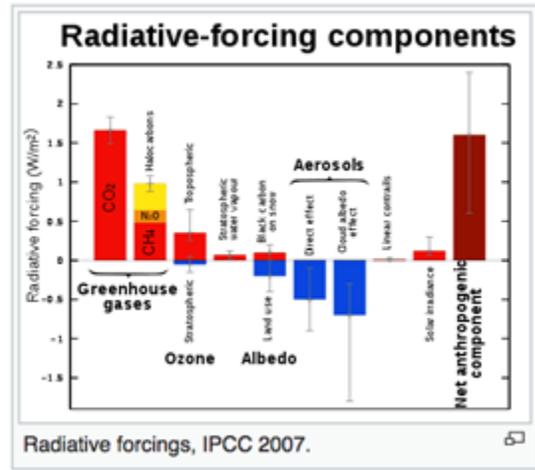
1. a. Greenhouse effect the source of CC is <u>energy</u> ✓
<u>conversion and industrial agriculture</u> . the source of the ozone hole is aerosol propellants and refrigerants. ✓
b. physical mechanism of C.C. is the atmosphere is absorbing more of earth's radiation. the effect is that the earth gets warmer. physical mechanism of the ozone hole is CFC's are destroying stratospheric ozone (O ₃). the effect is that sun's UV rays penetrate more. ✓
c. C.C. is causing shifts in weather patterns, extinctions, changes in migration and sea level. ozone hole is causing "global sunburn" ✓
d. to solve C.C., need to change lifestyle, po control population size and use alternative technologies. to solve ozone hole, need to use different chemicals. ✓

2. Actions of Climate Change:

- a) What does "radiative forcing mean?" If you look up Radiative-forcing on Wikipedia, it says the difference between incoming and outgoing radiation. However, if we consult the IPCC we see something different... it's the difference in insulation provided by the atmosphere now and in 1750 (the dawn of the industrial revolution). We hopefully learned that the earth's atmosphere has always provided the "greenhouse effect" of keeping the earth warmer. Global warming (climate change, and climate crisis) is due to the INCREASE of insulation that the atmosphere is providing.

The Intergovernmental Panel on Climate Change (IPCC) AR4 report defines radiative forcings as:^[4]

"Radiative forcing is a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism. In this report radiative forcing values are for changes relative to preindustrial conditions defined at 1750 and are expressed in Watts per square meter (W/m^2)."



- b) Sunlight provides about $1000 W/m^2$ when the sun is shining, and averaged over the whole planet is $\sim 250 W/m^2$. What is the approximate *magnitude* of all the radiative forcing from all the GHG. We see it's a little over $1.6 W/m^2$
- c) Describe what are greenhouse *feedback* mechanisms?
 - Describe a *positive* feedback Melting of arctic ice, increased water vapor methane being emitted... and now deforestation due to forest fires.
 - Describe a *negative* feedback Increased Cloud Cover.
3. Climate Change and You: Chris Jones, at Berkeley has created a spreadsheet-based tool for individuals to estimate all direct and indirect emissions of GHGs in CO₂ equivalent units resulting from their primary energy related choices: transportation, food, housing (including energy use), goods and services, and waste. Go to Chris' website: <https://coolclimate.berkeley.edu/calculator> and
 - a) spend some time learning the basic logic of what the site. There are five separate sectors: Transport, Housing, Food, Goods, and Services.
 - b) Fill out the carbon calculator with your individual information for each sector. Please be as honest as possible. I won't post your results.
 - c) Go to the Summary tab and save your answers.
 - d) What is the ratio of the highest category (e.g. housing, food, etc.) of your emissions to the lowest?
 - e) What is the ratio of your total emissions to the national average of 16 tons CO₂ per person per year? What is the ratio of your total emissions to the global average of 4.5 tons CO₂ per person per year?
 - f) What do you find most surprising about your results? Please explain in a short paragraph. c)
 - g) **Most Important!** What lifestyle changes would you have to make in order to emit no more than the global per capita average of 4.5 tons of CO₂? To do this, change the values you entered in the spreadsheet until your total emissions are below 4.5 tons CO₂. Try to make realistic choices.
 - h) What do the results say about how your lifestyle compares to the lifestyles of the majority of people on the planet? Could you live at or below the global average? Please explain in one short paragraph.

3. d. Travel: Goodr

• $18.12 / 5.53 = 3.29$

e. Total emissions - 55 tons CO₂e/yr

National avg ration $\rightarrow 55 / 16 = 3.44$ ~~to~~

global avg = $55 / 4.5 = 12.2$

Nice!

f. I find it most surprising how much CO₂ the air traveling I do expels into environment. While it makes sense considering how large a plane is and how much fuel it consumes, I feel like b/c so many people can fit on one as well as how much

technological advances there have been with air travel, I would expect the CO₂ emissions to be much lower

g. to lower my individual CO₂ consumption of 7.8 tons CO₂ below 4.5 tons, significant lifestyle changes would have to be made. One realistic thing I could do would be to switch to EV when my car dies. This would greatly lower CO₂ emissions. Additionally, reducing my air travel and cutting my dairy intake in half would allow my CO₂ emissions to drop below global avg.

h. My lifestyle uses about 2x as much ^{CO₂} as the global average. This is not very surprising to me - considering that many people in the world live in developing countries and many more live in poverty, I think it would be very difficult for me to live at or below the global average. This is because I am so accustomed to my current lifestyle and significant changes would have to be made to cut my CO₂ emissions in half.

4. What were the energy markets policies that allowed the Cal Energy crisis to happen? What fundamental economic rules did this violate? The policies provided a profound market distortion – that is it prevented the consumer from paying for the cost of their decision, so they were unable to make the most economically-intelligent decisions for society. How was this “free market” blocked? The utilities were not allowed to charge customers for the electricity they consumed. The other side was that the providers (electricity generating companies... IOU – independently Owned Utilities)... “colluded”... essentially forming a monopoly allowing them to raise the cost of production by taking turns having “maintenance outages”, requiring the use of expensive peaker plants so that all the utilities could charge that expensive price.
5. What is a smart grid? What are some practices that we have invoked or can invoke that constitute a “smart grid”? We can have “real time pricing”, which would allow us to restore a transparent free market economy so that consumers’ choices would reflect the cost of the choices. Also, they could make contracts to have “dispatchable loads” so that the utilities could turn off loads that didn’t need immediate charging... such as heating water or charging cars. Both of these would facilitate variable renewable energy (electricity) to “feed into” the grid.