

PS#4, Due Tuesday, February 11

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?
2. Actions of Climate Change:
 - a) What does "radiative forcing mean?"
 - b) Sunlight provides about 1000 W/m^2 when the sun is shining, and averaged over the whole planet is $\sim 250 \text{ W/m}^2$. What is the approximate *magnitude* of all the radiative forcing from all the GHG.
 - c) Describe what are greenhouse *feedback* mechanisms?
 - Describe a *positive* feedback
 - Describe a *negative* feedback
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.
4. **How much electricity do you use at home?**
 - a) Please find the Excel spreadsheet on the HW spot of the class website. Check all your electricity demands and estimate the amount of time you spend on these things, or your "duty cycle".
 - b) Reflect on your electricity use. Based on what you see above, is your personal electricity use a considerable portion of your carbon emissions?

5. **What will kill you?:** Please see Meera Subramanian's Nature article *Global health: Deadly dinners* and the statistics on deaths from electricity production.
- If you were born in an area where people use the 3-stone fires, what is the probability that it will cost you your life?
 - How many people have been killed due to nuclear mistakes? What is the probability of an earthling dying from a nuclear disaster?
 - How does this compare with the probability of being killed in a car accident in the USA?
 - Given the amount of electricity the USA will use over your lifetime, what is the probability that it would cost you your life if this electricity was from coal-fired generation? From nuclear generation?
 - How many people have been killed recently in wars? What's the probability of an earthling dying in a war?
 - How many people have been killed in the past decade as a result of terrorist attacks? What's the probability of an American being killed by a terrorist?
6. Nuclear safety, costs, etc. Nuclear power has the promise of wide spread, low carbon electricity for everyone. However, it's not widely adopted.
- Discuss your take on challenges to widespread nuclear adoption.
 - Do you think that the challenges to nuclear acceptance is more real or more imaginary?
 - Compared to last week, are you more pro-nuke or anti-nuke? Why do you think?
7. What is the cost of solar? What is the present cost of solar now?
- Please shop around for a 100 W solar panel. Can you find a very inexpensive one? What is the lowest cost?
 - How much electrical energy can you realistically generate from this panel in San Luis Obispo over its 30-year life time?
 - What is the cost of electricity from this panel in \$/kWh?
 - Please consider the decreasing rate of cost of solar panels in \$/W. You can find some information on my research webpage: <http://sharedcurriculum.peteschwartz.net/direct-dc-solar-research/>. What is the cause of the moderate decrease between 1975 and 2008? What is the cause in the more extreme decrease more recently? The most recent data point is taken from an Alibaba site where one can purchase imported wares in large quantities. This is certainly well below the retail purchase price you found in a), but is also likely more expensive than the manufacturing cost that is otherwise represented in the graph. Given the trends you see, please estimate the cost of purchasing a 100 W solar panel in the future.
 - Presently, people in Africa purchase their electricity in AA batteries. How much electrical energy is stored in these batteries? How much do they cost? What is the cost of electricity from these batteries in \$/kWh.
 - In California, we pay approximately \$0.15/kWh from the grid. Estimate when you think people in Africa will have solar electricity at \$0.15/kWh, \$0.05/kWh, and \$0.01/kWh.