Homework Seven

Physics & Mathematics of Sustainable Energy

College of the Atlantic

Due Tuesday, May 13, 2016

Please print out this cover sheet and attach it to your problem solutions. Completed assignments should go in my mailbox or be handed in during class. Please don't hand them to me other times, as I might end up losing them and that would make us both sad.

Your Name: _____

Please list all the students you collaborated with on this assignment:

_____ _____

_____ _____

_____ _____

Did you get help from Aura or Morgan?

Did you consult any resources other than our textbook or class notes? (If yes, please include citations in your solutions.)

Were you able to get enough help so you could complete this assignment to your satisfaction?

Approximately how many hours did you spend on this assignment?

Anything else of note about this assignment? (It was too hard, too easy, lots of fun, too repetitious...)

The work I am turning in for this assignment is an accurate reflection of my own understanding of the material.

Signature: _____ Date: _____

Assignment is on the next page....

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For some of these problems you might want to consult the lists of "useful data" that I've assembled in Appendix C of the textbook.

1. Suppose you buy some solar panels that will generate 6500 kWh of electricity per year.

   (a) If the electricity you generate displaces electricity generated in a coal power plant, how much carbon dioxide have you prevented from going into the atmosphere in one year?

   (b) If the electricity you generate displaces electricity generated in a natural gas plant, how much carbon dioxide have you prevented from going into the atmosphere in one year?

   Express your answers in tonnes of CO_2. How you answers compare to the average annual emissions for someone from the US?

2. Suppose you add some insulation to your attic and as a result use 600 less gallons of oil every year to heat your house. How much carbon dioxide have you prevented from going into the atmosphere as a result? Express your answer in tonnes of CO_2. How you answers compare to the average annual emissions for someone from the US?

3. This problem concerns a *Guardian* article[1] about the African Renewable Energy Initiative (AREI).

   (a) The article states that the average annual per person consumption of electricity is around 600 kWh. Convert this to kWh per person per day.

   (b) The article also states that the worldwide average per capita electricity use is around 3000 kWh per year. Convert this to kWh per person per day.

   (c) The per capita yearly electricity use in the US is around 13000 kWh.[2] Convert this to kWh per person per day.

   (d) The *Guardian* article states that AREI has a goal of adding 300 GW[3] of renewable electricity generation by 2030. How much eletricity is this in kWh per person per day? The population of Sub-Saharan Africa is, very roughly, 1 billion.

   (e) If these 300 GW of power were entirely from solar PV, how much land would this be? Express your answer in an understandable way; perhaps find the size of a square that has this area, or express the area as a fraction of one of the countries in Sub-Saharan Africa.

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[1] `http://www.theguardian.com/global-development/2015/dec/07/africa-plans-renewable-energy-initiative-solar-hydro-`

[2] `http://www.iea.org/statistics/statisticssearch/report/?year=2013&country=USA&product=Indicators`

[3] It's not quite clear to me if this is nameplate or actual power, but I think it's the latter. So let's assume that this is 300 GW of actual power.