ECE 4833 Devices for Renewable Energy

Homework 1

1) Global Warming Calculations

Given the total Mass of the Atmosphere: $5.1352 \pm 0.0003 \times 10^{18}$ kg
Value from Kevin E. Trenberth and Lesley Smith, "The Mass of the Atmosphere: A Constraint on Global Analyses", Journal of Climate, Volume 18, Issue 6, March 2005, pp. 864–875. National Center for Atmospheric Research, Boulder, Colorado

and the heat Capacity of Air (Sea Level value taken to simplify the math but real calculation would require integration): $\boldsymbol{C_p}$ **=** 1.0035 **J/(g·K)**

a) Assuming a steady state energy balance existed before man "interfered" with the atmosphere (as much energy is radiated as is absorbed), what is the total extra "man-made" energy needed to raise the temperature of the atmosphere by 1 degree average?
You may use the equation: Q (energy) = $C_p\, m\Delta T$

b) If the total power usage globally is 15 TW, how long would it take to raise the atmosphere temperature by 1 degree? How does this compare to the IPCC 2007 projections on temperature rise?

c) If the total power consumption is 85 % fossil fuels, how many square meters of 15% efficient solar cell modules will be needed to rid us of fossil fuels ONLY using photovoltaics. Compare this area to a relevant US state size.
(Fossil fuel usage from "Statistical Review of World Energy 2009", British Petroleum).

d) Comment on the realism of this "back of the envelope" estimate and any effects that may amplify mans influence.

2) After having read (I do not expect you to read everything but certainly scan the files) the web page reading assignments, write a 1 page single spaced typed position paper on your opinion about Anthropogenic Climate Change. There are no "correct" answers here – only your opinion.