Problem Set 6

Intro to Sustainable Energy 2.650/10.291/22.081
&
Sustainable Energy 1.818/2.65/10.391/11.371/22.811/ESD.166

For each of the problems you work out provide a list of sources for any data you used, as well as your assumptions. Be sure to mark which course number you are registered for on your solution. You can turn in the homework online (via Stellar) or in class.

Intro to SE Students: Pick any 2 of the 4 problems to solve.

1. It's a common misconception that non-nuclear sources of energy do not release radiation. However, the presence of uranium and other radioactive materials within the Earth's crust means that burning of coal releases some radiation into the biosphere.
    a. Find the mass of uranium liberated from the earth's crust via the production of 1 GWye from coal.
    b. Find the activity (decay constant multiplied by number of atoms) corresponding to this mass of uranium. Recall that natural uranium consists of multiple isotopes.
    c. Find a reliable source on how much activity is produced (not necessarily released) during production of 1 GWye from nuclear power.
    d. In 2008, a spill of coal ash in East Tennessee constituted the largest ever release of radiation to the public by the U.S. electric power industry, and yet this event received less media attention than minor events at nuclear power stations in the same year. Comment briefly on how perceived risk affects public opinion of these technologies.

2. Compare and contrast the regulations pertaining to siting of landfills for household and hazardous waste and for spent nuclear fuel. Discuss the differences and similarities between the hazards presented by each, particularly as a function of time.

3. Experts on anthropogenic greenhouse gases often say that CO_2 is an inventory problem rather than a production rate problem. Find a resource on the global rate of carbon fixation. In a few pages, discuss to what extent the Obama energy platform discussed in Prof. Moniz's lecture will succeed in reducing CO_2 production rate and inventory in the atmosphere. You should support your answer numerically.

4. **"US versus Japan"** American drivers are often criticized for not being as conservative as Japanese drivers. But let's take a closer look. The most popular car in the US is a Japanese car - the Toyota Camry - and it's very likely that the Japanese drive as many Toyotas as we do, but they might be smaller cars. How would the US compare to Japan if we somehow scaled the amount of driving done in each country according to the size of the country? Are the results that you calculate different? Roughly speaking Japan is the size of California with 128 million people. You should explicitly state all your assumptions and cite all sources of data. Please include several paragraphs explaining differences in your calculations, if any, in the amount of driving done in each country. Also, please identify uncertainties in both your analysis and conclusions.

Attribute	World	US	Japan	India
Population m	6,378	297	128	1,081
Area (10^6)km^2	148	9.37	0.378	3.29
% arable	10.8%	19%	12%	54%
Urban pop %	49.2%	80.8%	65.7%	28.7%
GDP $bn	41,300	11,712	4,623	691
Pop <15 %	28.2%	20.8%	14.0%	32.1%
Pop >60 %	10.4%	16.7%	26.3%	7.9%
Energy mTOE				
Total output	10,672	1,631	85	453
Total consumption	10,544	2,281	517	553
Net Imports as % consumption	-1%	28%	84%	18%

Statistics from "Pocket World in Figures, 2007 Edition, *The Economist*, Profile Books, London.

Average Daily Temperatures (^oF) in Selected Cities

	January		April		July		October	
Location	High	Low	High	Low	High	Low	High	Low
Tokyo	48	31	64	48	84	71	70	56
Bombay	83	67	89	76	85	77	89	76
New York	32 avg.		53 avg.		77 avg.		57 avg.	
Los Angeles	57 avg.		61 avg.		69 avg.		67 avg.	

From http://www.infoplease.com/ipa/A0004587.html

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Introduction to Sustainable Energy

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