Physics and Mathematics of Sustainable Energy
Homework Three
Due April 15, 2011

1. What power would you expect would be delivered by a wind turbine with 5 meter blades installed in a location where the average winds are 10 miles per hour? Do you think your answer is an over- or under-estimate? Why?

2. Estimate how much land area would be required for a wind farm that would provide the U.S. with all of its residential electricity. State any approximations and assumptions that you make, and cite any sources. Interpret the resulting area.

3. Suppose a house switched from incandescent to compact flourscent light bulbs. Assume that a flourscent light bulb uses roughly 25% of the energy that an equivalent incandescent light bulb would use.[1] Estimate how much energy this would save in a year. How far could you drive for this amount of energy? Explain any assumptions and approximations you make.

4. In order to get her daughter Ella to go to sleep, Lena sometimes puts her in her car seat and drives until she is asleep. Another option is to put Ella in her car seat on top of the electric dryer, turn the dryer on, and wait until Ella is asleep. Assume that both techniques are equally effective. Which uses more energy? Which costs more? Explain any assumptions that you make.

5. You need to travel from Bar Harbor to New York City. What is the energy cost per person if:

   (a) You drive alone?

   (b) You drive with four people total in your car?

   (c) You take a train? (assume such a train exists.)

   (d) You fly?

   Clearly state any assumptions and approximations you make.

[1] http://en.wikipedia.org/wiki/Compact_fluorescent_lamp#Energy_efficiency