Physics and Mathematics of Sustainable Energy
Homework One
Due April 1, 2011

1. A 0.8 kg bird flies at 2 m/s. What is its kinetic energy?
2. Heating oil is pumped into a tank at the rate of 2 gallons/sec. How much oil flows into the tank in one minute?
3. The lights in an office draw 120 W. Suppose I have the light s on for three hours a day for a month.
   (a) How much energy does this use? Express your answer in both kWh and J.
   (b) How much does this amount of electrical energy cost in Maine?
4. What wattage light bulb uses 1 kWh in one day?
5. In a typical day a typical person typically eats around 2500 calories of food.[1] These are dietary calories. Confusingly, 1 dietary calorie equals 1000 "real" calories.
   (a) How many Joules does a typical person consume in a day?
   (b) What power is this? Express your answer in kW.
   (c) Most of the food energy you consume ultimately gets converted to heat. Thus, we can view people as heaters—they convert chemical food energy into thermal energy. How many people would you need to have in a room to have a heating power roughly equivalent to one 1500 W space heater?
6. Take a look at the greenhouse gas conversion factors on page 335 of SEWTHA. Note the enormous difference from country to country. The carbon intensity of electricity production in Denmark is ten times larger than France and Sweden. Why do you think this is? Discuss briefly.

[1] I believe this is the average for men in the U.S. I'm sure it's different in other counties and different for women and children.