

Physics and Mathematics of Sustainable Energy

Homework Six

Due May 20, 2011

For this problem set you'll need to use figures from the Weber and Matthews paper as well as from Chapters 15, H, and I of MacKay.

1. You live in Boston and are deciding between two beer options, A Hop Devil Ale by Victory Brewing Company, and Punk IPA by BrewDog Brewery. Assume that the Punk IPA travels to you by container ship and the Hop Devil via truck. What is the energy cost of transporting each beer to you?
2. **Optional:** Suppose you live somewhere in the middle of the U.S. California wine arrives at your local wine store via truck, originating in San Francisco. Spanish wine takes a container ship from Málaga to New York, at which point it takes a truck the rest of the way. If you are in New York, it is better to get the Spanish wine. (I.e., it uses less energy. We'll assume that the Spanish and Californian wines you are considering are of similar quality and price.) Approximately where in the U.S. is the energy cost of transporting the two wines the same?
3. Suppose you decide to eat red meat at one less meal each week. Instead, you eat grains. How much less CO₂e is emitted into the atmosphere each year as a result of this decision. Is this a lot or a little?
4. According to Weber and Matthews, the average CO₂e footprint associated with the food system for a U.S. household is 8t/CO₂e per year. Use this fact to make a very rough estimate of the CO₂ emissions associated with COA's food services. How much would it cost to offset this at the rate of \$7.50/t?
5. The BHF solar cells will generate around 2.5 MWh of electrical energy in one year. How much carbon does this save per year? (See the table on page 335 of MacKay. Ignore the energy costs associated with making and installing the solar cells.) How much Carbon will this save in 20 years? Suppose BHF can get \$7.50 per ton of carbon saved. How much would this be? How does it compare to the cost of the cells?
6. Estimate the embodied energy in a hard copy of *Sustainable Energy without the Hot Air*. Estimate the energy associated with transporting a copy of the book from the U.K.
7. Assume that it takes 50,000 kWh to make a car. If you buy a new car every eight years, how many kWh per day is this?
8. **Optional:** Analyze the energy costs of the following two scenarios. Scenario 1: You buy a new car that gets 40 mpg and drive it for ten years. Scenario 2: You buy a used car that gets 20 mpg. It lasts for five years, you buy another used car that lasts another five years and also gets 20 mpg. Which scenario uses more energy? Does the answer depend on how much you drive?