Physics and Mathematics of Sustainable Energy
Homework Three
Due April 26, 2013

1. Suppose it is -10 C outside and your thermostat is set at 15 C. By what fraction would your heating bill decrease for that day if you set your thermostat to 13 C instead?

2. Estimate the energy required to heat the water for a typical shower. Express your answer in kWh/d (assuming that you shower once a day).

3. Consider a two-story house that is 50 feet by 20 feet. Assume the air in the house changes once every hour, and that the overall R value for the house is 15. The house is in Bar Harbor, where the degree days per year are around 7500.

   (a) Determine an approximate value for the average power needed to heat this house. This is a multi-part question—be sure to make your steps clear and state any assumptions that you make. Express your answer in BTU/h and kWh/d.

   (b) Assume that you provide heat for this house by burning fuel oil in a furnace that is 70% efficient. How many gallons of fuel would you need to use in one year. (There is a chart on page 199 of MacKay that will be useful.)

   (c) How much would this fuel oil cost in Maine?

   (d) How much greenhouse gas would be emitted as a result of burning this fuel? (There is a chart on page 335 of MacKay that has some useful info.)