PS#9, Due in class, Monday, March 9nd

1. Please repeat my comparison of an electric car with an ICE. Imagine planning to use this car for 11 years – the average time for a car to stay on the road. Feel free to use the two versions of the Hyundai Kona that I used in class, but you can also look at other cars and trucks.
   a) Please compare the sticker prices and performance data,
   b) Please estimate how many miles you will drive in the car's lifetime.
   c) Please compare the costs of fuel for the two different cars.
   d) Please compare the maintenance costs for the two different cars.
   e) Please compare the lifetime CO_2 emissions of the two different cars.
   f) Please make any other comparisons that may be relevant.
   g) Which would you buy if given the choice?

2. Let's say you live in a moderately cold place… like the temperature is just freezing around you, 0 Celsius and you like your house warm, let's say 25 C. Your house requires on average about 1000 W to stay warm. You can use either a heat pump or burn natural gas. As we pointed out in the last problem set, NG (because of fracking) is at an all time low: ½ cent/kWh.
   a) Is 25 C actually warm? What is it in Celsius?
   b) What is the maximum COP (coefficient of performance) possible under these circumstances?
   c) What if the heat exchangers to the house and the outside world required about 10 C difference in temperature to drive 1000 W of thermal power? What would be the maximum COP you could expect *now*? Keep in mind that there will be other losses, and this still represents a "best case scenario".
   d) In the above scenario, how much electrical power is required to drive 1000 W of thermal energy to the house?
   e) How is it that a heat pump can put more energy into your house than electrical energy consumed?
   f) If you buy a natural gas heater, assume it is 80% efficient because some of the exhaust to the outside world is still hot.
   g) For an entire year of heating, please calculate the total energy needed by each technology. For the heat pump, please put your answer in kWh. For the NG heater, please put your answer in MMBTU (or millions of BTU, which is about a GJ).
   h) How much money will each of these two heating technologies cost you for a year?
   i) How much CO_2 is emitted by each of these two heating technologies for a year?
   j) How much does a heat pump for a house cost vs installing a NG heater?
   k) Are there any other considerations to take into account?
   l) Which would you buy for your little home if you were building one now?

3. Please repeat your assessment #9 in fine form. The assessment with some (hopefully) helpful comments has been posted on the main class website.

4. Representing a renewable energy company installing Vestas (Vestas.com) turbines, you are looking for places to install wind turbines! You are thinking of paying a farmer to install them on his corn field… but then another farmer boasts that she has an average

wind speed that twice as high because her pasture land is on a hill top. BUT she wants you to pay her *three times as much*. On top of that, the installation costs (about 1/3 of the entire turbine costs) will be 50% higher because of the hill top site.

a) Should you blow the extra money to put the turbines on the hill top? Explain.
b) The hill top is way out in a rural area… what other expenses would this present?