

# Physics and Mathematics of Sustainable Energy

## Homework Two

Due April 12, 2013

### Area:

In addition to getting a feel for energy units, we also need to get a feel for areas. The reason for this is that many renewable technologies—especially solar and wind—require large areas to produce a meaningful amount of energy.

1. Look up the size of COA's campus. Do not include Beech Hill Farm or any other "off-campus" land—just consider the main campus. Do some conversions and express this area in the following units:
  - (a) Square meters
  - (b) Square kilometers
  - (c) Square miles
  - (d) Acres
  - (e) Hectares
2. Repeat the above exercise but with some other small-ish area that you are very familiar with: perhaps a football field, the size of your neighborhood or your grandparents farm, or a city block, etc.
3. Repeat the above exercise but now use a large area, perhaps a province or state or a small country. Choose something that is familiar and meaningful to you.

### Wind:

1. Suppose you are deciding between two locations for a wind turbine. In one location the average wind is 40% faster than the other. How much more power would you expect to generate in the windier location?
2. What power would you expect from a turbine with blades that are 3 meters in diameter operating someplace where the average wind speed is 8 m/s?
3. The Beech Hill Farm wind turbine over the last year has generated around 2000 kWh of electricity.
  - (a) Is this a lot or a little? Explain. There are many ways to answer this question. Perhaps calculate how many months this would keep a 40W light bulb on. Or the wattage of a light bulb that this keep light for an entire year.
  - (b) How much money is 2000kWh of electricity worth in Maine?
4. First Wind claims that the 34 MW of wind capacity at its Bull Hill wind installation are sufficient to power 18,000 homes. Does this seem right? Why or why not? Assume that the turbine operates at around a third of capacity. (<http://www.firstwind.com/projects/bull-hill>)