

Physics and Mathematics of Sustainable Energy

Homework Six

College of the Atlantic

Due May 16, 2014

1. Suppose the diameter of a wind turbine was increased by 20%. What would happen to the turbine's power output?
2. Suppose the windspeed near a turbine decreased by 10%. What would happen to the turbine's power output?
3. Suppose you are driving a car and you increase your speed by 15%. What would happen to the power needed by the car?
4. You are driving from Mount Desert Island to Rivière-du-Loup, Quebec in a Toyota Prius that usually gets 45 mpg driving on highways. For this trip you have two sea kayaks attached to the roof of the car. Approximately what gas mileage do you think you will get under these conditions? (Briefly explain the reasoning behind your estimate.)
5. You need to go from Dallax, TX to Calgary, AB and back. How much energy would you use per person if you:
 - (a) Drove by yourself?
 - (b) Took an airplane?
 - (c) Took a train?
6. You live in Bar Harbor and are deciding between two beer options for a senior party: A Hop Devil Ale by Victory Brewing Company, and Punk IPA by BrewDog Brewery. You need to purchase two tons of beer. Make reasonable assumptions about the modes of transport that will be used by BrewDog and Victory. What is the energy cost of transporting each beer to you?
7. **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?