

Physics and Mathematics of Sustainable Energy

Homework Five

Due May 7, 2010

1. You invest \$15,000. Assuming your money grows at 4% annually, how much money do you have in ten years?
2. You are considering buying a skystream 3.7 wind turbine. The specs for the turbine can be found at <http://www.skystreamenergy.com/>. Fully installed the turbine costs \$15,000. You will get a \$3000 tax credit, so the net cost is only \$12,000. There is no maintenance associated with the turbine after it is installed. Assume that you install the turbine at a location that has an average annual wind speed of 12 mph.
 - (a) Using the current price of power, estimate the payback time for this investment.
 - (b) What would be price of power need to be so that the payback time was ten years?
 - (c) Suppose you were able to put the turbine someplace where the average wind speed was 20 mph. What is the payback time now?
 - (d) How much CO₂ would you prevent from being released into the atmosphere if you purchased the turbine? How does this compare to the annual carbon emissions of an average American?
 - (e) Assume that the cost of power grows by 2% annually and that you keep the wind turbine for 15 years. What is the net present value of the investment? Assume a discount rate of 4%. Note: You'll almost surely want to use a spreadsheet to do this calculation.
3. How much would you pay today for 2000 euros three years from now? Explain your reasoning.
4. Suppose you take a five minute shower using an efficient 2.5 gallons per minute shower head.
 - (a) Estimate how much energy it takes to heat the water you need for the shower. State any assumptions that you make. Express your answer in kWh.
 - (b) If you used electricity to heat this water, how much would this shower cost?
5. The Atlantis Platform in the Gulf of Mexico daily production capacity is 200,000 barrels of oil a day.¹. Assume that it typically operates at 50% capacity. The lifetime of this oil well is supposed to be 15 years.
 - (a) What is the effective power of this oil well? I.e., take its total oil production, divide by fifteen years, and convert to Watts.
 - (b) What area would be required for a wind farm that produced a similar amount of power? Assume the wind farm produces 3 W/m². Convert this area to something meaningful. I.e., compare it to a state or a country or something.

¹<http://www.offshore-technology.com/projects/atlantisplatform/specs.html>