Physics and Mathematics of Sustainable Energy
Homework Five
Due May 6, 2011

1. You invest \$15,000. Assuming your money grows at 4% annually, how much money do you have in ten years?

2. Someone will give you \$10,000 in ten years.

   (a) What is the present value of this payment? Answer this question using discount rates of 5, 10, and 15%.

   (b) Repeat the above analysis, but assume that the payment comes in 100 years and not 10 years.

3. A set of solar panels costs \$8,000 and will produce, on average, 300 kWh of electricity each month. Calculuate the ROI and payback time under each of the following scenarios.

   (a) The solar panels last 15 years and that the cost of power is \$0.17/kWh.

   (b) The solar panels last 20 years and that the cost of power is \$0.17/kWh.

   (c) The solar panels last 15 years and that the cost of power is \$0.20/kWh.

   (d) The solar panels last 20 years and that the cost of power is \$0.20/kWh.

4. For the solar panels described above, what would the cost of power need to be so that the payback time was 5 years?

5. (**Optional.**) *This problem requres some slightly advanced math, and/or the use of a spreadsheet. To do it without a spreadsheet, notice that the NPV is a partial geometric sum.* Consider again the solar panels described above.

   (a) What is the net present value of this investment if the panels last 15 years and electricity costs \$0.17/kWh? Assume a discount rate of 5%.

   (b) What is the net present value of this investment if the panels last 15 years and electricity costs \$0.17/kWh? Assume a discount rate of 15%.

   (c) What is the net present value of this investment if the panels last 25 years and electricity costs \$0.17/kWh? Assume a discount rate of 15%.

   (d) Determine an algebraic expression for the NPV as a function of the discount rate r, the cost of power c, and T, the number of years that the cells last. Make plots of NPV vs c, T, and r for reasonable values of the other variables. Discuss.