Physics and Mathematics of Sustainable Energy

Finance Lab

Due Monday, May 6, 2013

Goals:

1. Gain a better understanding of key finance concepts, especially net present value (NPV), payback time, and internal rate of return (IRR).
2. Learn a few useful spreadsheet tricks and techniques.
3. Gain experience making useful, re-usable spreadsheets.

The Situation: You are investigating the feasibility of installing a PV system at your house. You are thinking of installing 20 panels. Each panel has a capacity of 240 W. The current average cost for panels, including installation, is around \$4.50/W. The solar cells are expected to operate at around 13% capacity.[1] You will get a federal tax rebate worth 30% of the installation cost. You will also get a 2000 rebate from the state of Maine.

You will calculate payback time, ROI, NPV, and IRR under a number of different assumptions. You should come up with a spreadsheet that will automatically adjust these numbers depending on the values of the following:

- Cost of power per kWh
- Discount rate
- System cost
- Capacity factor
- Rate at which the cost per power increases
- Capacity at which the cells operate
- Lifetime of the cells

Once you have the spreadsheet set up, use it to answer the following questions. Start by assuming a power cost of \$0.17 per kWh and that the cells operate for 25 years at 13% capacity.

1. Under these assumptions, calculate the payback time, ROI, NPV, and IRR for the solar cells. Determine the NPV for discount rates of 5, 10, 15, and 20%.
2. What is payback time and IRR if the lifetime of the system is 30 years? (Keep other variables the same as in problem 1.)
3. What is the payback time and the IRR if the cost of power grows at 1%?
4. What is the payback time and IRR if the turbine operates at 20% capacity? (Keep other variables the same as in problem 1.)
5. In Hawaii, the cost for electricity is \$0.32/kWh. What is the payback time, IRR, and ROI for this system in Hawaii? (Assume the same rebates and performance for Maine.)
6. Let's now return to Maine. In deciding whether or not to do this project you need to think about a pessimistic but reasonable worst-case scenario, and an optimistic but reasonable best-case scenario. What values for variables would you use, and what payback time and IRR do these variables yield?

[1] This sounds terrible, but it isn't that bad. Half of the time it is night, so the panels will be operating at zero percent capacity then.

7. Suppose the college is planning on building a home somewhere. Based on your analysis in this would you recommend the college spend the extra money to install solar panels on this house? Justify your position. (To support your position, it may be useful to know that the college draws 5% from its endowment.)

Write-up: For your report, write clear answers to the above questions. I would prefer it if you word-processed your responses, but if you have unusually neat handwriting, then handwritten responses are ok. Please give me a hard copy of your report and email or share on google a copy of your spreadsheet.