ROI-TCO worksheet

ROI/TCO lab

1. The PV panel we tested in class produces 250 Watts in ideal sunlight. The cost for this panel today is about $0.50 per Watt
2. Calculate the price for this panel
3. If this panel collects 5.5 hours of sunlight per day, how many kWh does it produce each day?
4. At $0.40 per kWh, how much money does this panel harvest each day?
5. Divide the price by the amount collected per day, this should give you the number of days needed to pay off the panel.
6. How many days or years is this? This is called ROI or return on investment.
7. Total cost of ownership (TCO) is the total cost of operating the system. If the system lasts 25 years, how much money would it produce?
8. Subtract the cost of the unit from the money the unit produced, the result is the TCO, or total cost of ownership. If this is negative, you made money on the system.
9. Repeat these steps with the following data:

Solar PV panel:

- PV cost: $0.50 per Watt
- 250 Watts (0.250 kW)
- 5.5 hours per day production
- lifespan 25 years
- energy per day:
- money per day:
- cost of panel:
- ROI:
- TCO:

Solar thermal panel:

- 2.5 m2 area
- 1500 W/m2 solar insolation

- 5.5 hours per day
- cost: $900
- lifespan: 30 years
- total power:
- energy per day:
- money per day:
- ROI:
- TCO:

Wind turbine:

- 2 kW output
- 8 hours per day (night time too)
- cost: $10,000
- lifespan: 5 years
- energy per day:
- money per day:
- ROI:
- TCO:

check your answers:

PV

- 1.375 kWh (0.250 * 5.5)
- $0.55 per day (kWh * $0.40/kWh)
- $125 (250W * $0.50/kW of PV)
- 227 days or 0.62 years ($125/0.55 per day)
- $4898 (25 years - 0.6 years = 24.4 years, 24.4 * 365 * $0.55)

solar thermal

- 3750W or 3.75 kW (2.5 m2 * 1500 W/m2 = 3750 W)
- 20.6 kWh energy per day (3.75 kW * 5.5 h = 20.6 kWh per day)
- $8.25 per day (20.6 kWh * $0.40 per kWh)

- 109 days or 0.3 years ($900/8.25 = 109 days)
- $89,434 (29.7 years * 365 * $8.25 = $89,434)

wind

- 16 kWh (2 kW * 8 hours)
- $6.40 per day
- 1562 days or 4.3 years, or 4 years 4 months
- $+656 (note cost of device and lifespan, not including maintenance costs)

PPA array lab

1. Look up the power produced by the PPA array here: http://10.14.8.1
2. Look for PPA gen/use
3. Look up the solar radiation for the same time here: https://tempestwx.com/station/133324
4. go out and measure the effective size of each panel, and count the panels
5. find the total area of the array in m2
6. multiply the solar radiation (insolation) by the area to get ideal power capacity
7. divide the actual power by this number to get % efficiency

Lab questions:

1. A solar panel is 2m x 1.5 m and collects 120 Watts in solar radiation of 1000 W/m2. What is the efficiency?
2. How much heat power could we collect from a solar thermal panel 3m x 2m in 1500 W/m2 solar insolation?
3. What are the three clues we can use to detect energy use on a telemetry system like elab2?
4. What impacted you the most about the e2 film about the Grameen Bank?
5. Energy storage and efficiency are keys to the ROI and TCO of the devices above. Explain.
6. Storing 15 kWh of energy as hot water using a well insulated hot water tank costs $1000. How much is this per kWh?
7. About how many hours can this store the energy (stay hot)?
8. Lithium storage batteries like those in the student union now cost $500/kWh for a 15 kWh system. How much did this cost?
9. How long can this store the energy?
10. Why is insulating a hot water heater so important?

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