

PROBLEM SET 3: ENERGY ECONOMICS

Energy and the built environment CRP 570.004/470.004

Total Points: 20 pts

Due Date: 2/18, 12 pm, in class.

Grading: Most of the problems are worth 2 points: 1 point for completion, 1 point for clearly showing all steps of your work. Every number should have a unit next to it (unless they it is unitless, like efficiency).

1. Lighting Audit for a single room (14 pts – 2pts each)

- Choose 1 room in your home that has a light fixture that uses the most lighting (it is turned on the most)
- Fill out the information below for this bulb. Just make an estimate of the average hours/night for the bulb (e.g., if the bulb is left on 5 hrs/night for 5 nights/week, the average would be $5/7 * 5\text{hrs/night} = 3.6$ hrs/night). Get the price of electricity (\$/kWh) from your electric bill:

Price of electricity (\$/kWh) :

Type of bulb	
Power (W)	
# of bulbs	
Hours/night	

- Calculate the annual energy (kWh/yr) for the bulb(s) :
- PNM gets about 60% of its electricity from coal, 20% from natural gas, and 20% from nuclear. In 2012 the emissions factor for its electricity was about 0.66 kgCO₂/kWh. Calculate how many tons of CO₂/year result from your use of this bulb(s) :
- Calculate the variable cost of the bulb (annual electricity cost to operate the bulb(s))
- Look up information about the bulb (or a similar bulb) on home depots website). Specifically, find the capital cost of the bulb and its estimated lifetime (hours). Using your estimate for nightly use, calculate the lifetime of the bulb in years:
- Using the formula below, which converts the present value of a cost into annual (or monthly) payments, using a discount rate, calculate the annualized cost of the light bulb. Use a discount rate of 7%. U is the annualized cost of the bulb, P is the present value of the bulb (capital cost), r is the discount rate (7% = 0.07) and n is the lifetime of the bulb (years). Show your work!

$$U = P \left[\frac{r}{1 - (1 + r)^{-n}} \right] =$$

- What is the total annualized cost of the bulb:
Capital Cost (\$/yr) + Variable Cost (\$/yr) =

2. Light bulb replacement

- Now, using the spreadsheet provided, calculate the energy savings, \$ savings (or costs) , and CO2 savings that would result from switching to a more efficient bulb (either a CFL or LED), with the same light output.
NOTE: the data in the spreadsheet is for a 60W incandescent, 13W CFL, and 11W LED, which put out about 800 lumens. If your lightbulb puts out different lumens, then find the equivalent CFL and LED on Home Depot, look at their specs, and update the cost, power, and lifetime in the spreadsheet.
- You can use the spreadsheet, so you don't have to show your calculations. (2pts)
 - Energy savings (kWh/yr)
 - \$ savings (cost) : \$/yr
 - Emissions savings (kg CO2/yr)
- Recalculate the \$ savings (cost) by changing the discount rate to 20%. (2pts)
 - \$ savings (cost) : \$/yr
- If there are cost savings for swapping out your bulb, please explain why you haven't done it? Does this mean you have a high or low discount rate? (2 pts)