

ENGR290: Renewable Energy

Quiz 4: Power and energy calculation review

Nov 12, 2013.

Problem 1

On average, a \$2000 wind turbine produces the power shown in Figure 1. PNM sells energy at \$0.13/kWh and buys energy at \$0.05/kWh. My house uses an average of 24kWh/day. Assume a 10 year investment and 6% interest rate.

1. How much energy does one turbine produce each year? $\frac{4400 \text{ kWh}}{\text{yr}}$ $\frac{12 \text{ kWh}}{\text{day}} \frac{365 \text{ days}}{\text{yr}} = \frac{4400 \text{ kWh}}{\text{yr}}$
2. How much energy do I consume each year? $\frac{8800 \text{ kWh}}{\text{yr}}$ $\frac{24 \text{ kWh}}{\text{day}} \frac{365 \text{ days}}{\text{yr}} = \frac{8800 \text{ kWh}}{\text{yr}}$
3. If one turbine's energy is sold directly to PNM
 - (a) How much money is it worth each year? $\$220$ $\frac{4400 \text{ kWh}}{\text{yr}} \cdot \frac{\$0.05}{\text{kWh}} = \$220/\text{yr}$
 - (b) What is the present value of that energy over 10 years? $\$1600$ $\frac{220}{0.1359} = \$1600$
4. If one turbine's energy is used to offset my present energy consumption:
 - (a) How much money is it worth each year? $\$570$ $\frac{4400 \text{ kWh}}{\text{yr}} \cdot \frac{\$0.13}{\text{kWh}} = \$570/\text{yr}$
 - (b) What is the present value of that energy over 10 years? $\$4200$ $\frac{\$570}{0.1359} = \4200
5. Extra Credit: How much money (present value) would I gain or lose:
 - (a) If I buy and install one turbine? $+\$2200$ $\$4200 - 2000$
 - (b) If I buy and install two turbines? $+\$4400$ $\$8400 - \4000
 - (c) If I buy and install three turbines? $+\$4000$ $\$8400 + \$1600 - \$6000$
 - (d) How many turbines should I buy? 2 $\begin{matrix} \uparrow & \uparrow \\ \text{offset} & \text{sell} \end{matrix}$

Average wind turbine power during 1 hour intervals

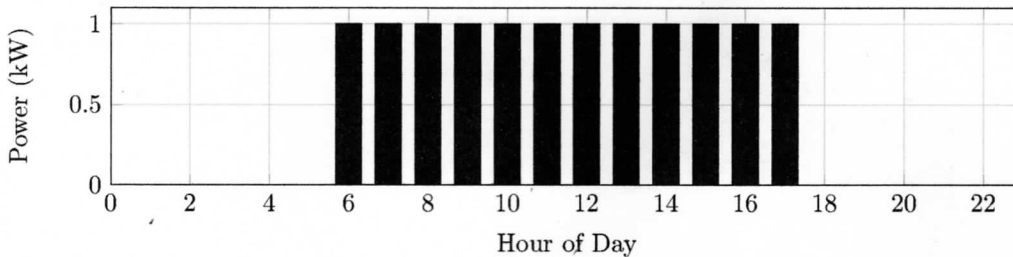


Figure 1: Wind turbine Power Output