Quiz 3 Solution

Prob 1)

$$\text{Annual Energy} = 1.5\frac{MWh}{yr} + 4\frac{MWh}{yr} + 7.3\frac{MWh}{yr}$$

$$= 12.8\frac{MWh}{yr}$$

$$12.8\frac{MWh}{yr} \cdot \frac{1000 kWh}{MWh} \cdot \frac{\$0.13}{kWh} = \boxed{\$1660/yr}$$

$$NPV = \frac{1660}{0.1490} = \$11{,}000$$

Prob 2) Heat energy $= 1.5\frac{MWh}{yr} + 4\frac{MWh}{yr} = 5.5\frac{MWh}{yr}$.

Need to know energy per day

$$5.5\frac{MWh}{yr}\ \frac{1000k}{1M} \cdot \frac{3600kJ}{1 kWh} \cdot \frac{1yr}{365 days} = 54{,}000\frac{kJ}{day}$$

So need to store $54{,}000\frac{kJ}{day}$ for 2 days $= 108{,}000$ kJ

$$108000kJ \cdot \frac{\ell \cdot °C}{4.2kJ} \frac{1}{(90-60°C)} = 860\ell$$

$860 for the tank.

Quiz 3 Solution

Prob 3

Fixed array gives Solar energy of $6.4 \frac{kwh}{m^2 day}$

1) We need $7.5 \frac{mwh}{yr} \frac{1000 kwh}{mwh} \frac{yr}{365 day} = \boxed{21 \frac{kwh}{day}}$

2) $21 \frac{kwh}{day} \frac{m^2 day}{(6.4 \times 17\%) kwh} = \boxed{19 m^2}$

each cell is $125 \times 125 mm = 0.0156 \frac{m^2}{cell}$

2a) $19 m^2 \frac{1 cell}{0.0156 m^2} = \boxed{1218 cells}$

2b) $48V \cdot \frac{cell}{0.52V} = \boxed{93 cells/string}$ ← round up!

2c) $1218 cells \frac{1 string}{92 cells} = \boxed{14 strings}$

So actual system needs 14 strings of

2d) 93 cells each = $\boxed{1302 cells}$

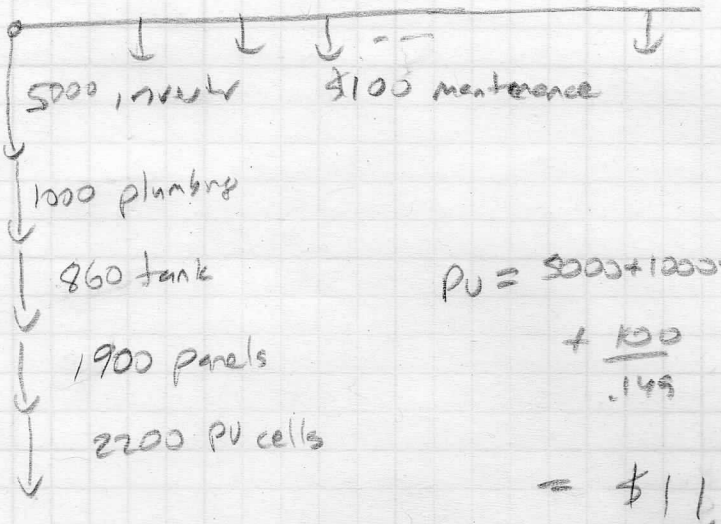
2e) $1302 cells \cdot \frac{\$1.7}{cell} = \boxed{\$2200}$

3) $11.3 \frac{mwh}{yr} \frac{1 yr}{365 days} = 31 \frac{kwh}{day} \frac{m^2 day}{(6.4 \times 75\%) kwh} = \boxed{6.5 m^2}$

4) PV is $19 m^2$ so $19 m^2 \frac{\$100}{m^2} = \boxed{\$1900}$

Quiz 3 Solution

Prob 4



$PV = 5000 + 1000 + 860 + 1900 + 2200 + \frac{100}{.149}$

$= \$11,100$

which is $100 more than PNM.

Prob 5

Solar energy with tracker is $8.8 \frac{kwh}{m^2 Day}$

we need $21 \frac{kwh}{Day} \cdot \frac{m^2 Day}{(8.8 \times 17\%)\,kwh} = \boxed{14\ m^2}$

$14\ m^2 \cdot \frac{1}{9} \cdot \frac{cell}{0.0156\ m^2} = \boxed{100 \text{ cells}}$

(9 ↑ concentration ratio)

each cell has a $5 less so it costs $\$1.7 + 5 = \frac{\$6.7}{cell}$

$100 \text{ cells} \cdot \frac{\$6.7}{cell} = \boxed{\$670}$

savings $= \$2200 - 670 = \boxed{\$1530}$

which you can spend on tracker.