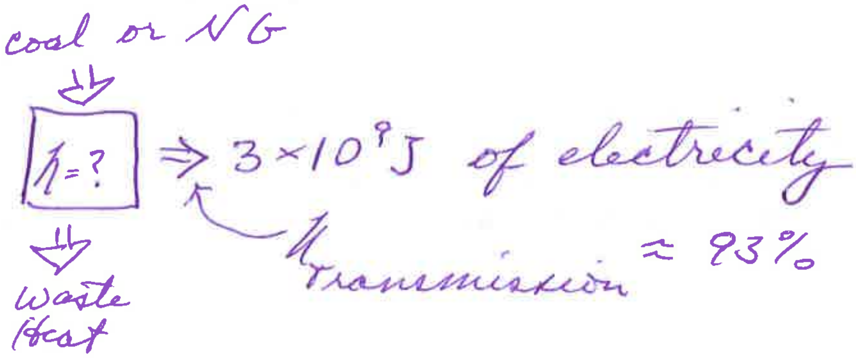
3) Energy $= P \cdot t = 0.1\text{ kW} \cdot 8760\text{ hrs} = \underline{876\text{ kWhr}}$

$100\text{ W} \cdot 1\text{ year}$

$= 876\text{ kWhr}\left(\frac{3.6\text{ MJ}}{\text{kWhr}}\right) \approx 3000\text{ MJ} = 3\times10^{9}\text{ J}$



$E_{\text{electricity to consumer}} = \underbrace{\eta_{\text{conversion}}\,\eta_{\text{transmission}}}\,E_{\text{Heat of Coal or NG}}$

$\eta_{\text{coal}} \approx 30\% \qquad \eta_{NG} \approx 60\%$

$E_{\text{heat}} = \frac{E_{\text{electricity}}}{\eta} \approx$ $5\times10^{9}\text{ J}_{\text{Heat}}$ (NG); $1\times10^{10}\text{ J}_{\text{Heat}}$ (coal)

a) NGCC Power Plant burns $5\times10^{9}\text{ J}$ NG

Carbon intensity $\approx \frac{15\text{ g}(C)}{\text{MJ}_{\text{Heat}}} \cdot \frac{44\text{ g}(CO_2)}{12\text{ g } C} = \frac{55\text{ g}(CO_2)}{\text{MJ}}$

CO_2 Produced $= 5\times10^{3}\text{ J} \times \frac{55\text{ g}(CO_2)}{10^{6}\text{ J}} \approx 275\text{ kg } CO_2$

b) for coal: $\frac{25\text{ g}(C)}{\text{MJ}} \cdot \frac{44\text{ g}(CO_2)}{12\text{ g}(C)} = \frac{92\text{ g}(CO_2)}{\text{MJ}}$

CO_2 Produced $= 10^{10}\text{ J} \cdot \frac{92\text{ g}(CO_2)}{\text{MJ}} \approx 900\text{ kg } CO_2$

Energy Density of NG ≈ $\frac{55 \text{ MJ}}{\text{kg}}$

Coal ≈ $\frac{24 \text{ MJ}}{\text{kg}}$

c) we need NG: $5 \times \cancel{10^9}^{\,10^3} \cancel{J} \left(\frac{\text{kg}}{55 \text{ M}\cancel{J}}\right) \approx 90 \text{ kg NG}$

D) we need Coal $\approx 10 \times \cancel{10^9}^{\,10^3} J \left(\frac{\text{kg}}{24 \text{ MJ}}\right) = 400 \text{ kg Coal}$