Petroleum:

a) consumption in 1980 $= \dfrac{135 \times 10^{8} \text{ J/year} *}{43 \times 10^{6} \text{ J/kg}}$

$$= 3.14 \times 10^{12} \text{ kg/yr}.$$

b) Natural gas consumption $= \dfrac{60 \times 10^{18} \text{ J/yr}}{3.9 \times 10^{7} \text{ J/m}^3}$

$$= 15.38 \overset{\times 10^{11}}{} \text{ Jm}^3/\text{kg yr}.$$

c) Coal consumption $= \dfrac{90 \times 10^{18} \text{ J/yr}}{29.3 \times 10^{6} \text{ J/kg}} = 3.07 \times 10^{12} \text{ kg/yr}$

$$CH_{1.5} + O_2 \rightarrow CO_2 + H_2O$$

CO_2 emission

d) from petroleum $= \overset{x}{3.14 \times 10^{12}} \text{ kg/yr} \times \left(\dfrac{98}{100}\right) \times \left(\dfrac{44.01}{13.5}\right)$

$$= 10.03 \times 10^{12} \text{ kg } CO_2/\text{yr} = 1.003 \times 10^{13} \text{ kg } CO_2/\text{yr}$$

Natural gas $= 15.38 \times 10^{11} \text{ m}^3/\text{yr} \times 0.88 \times 0.68 \text{ kg/m}^3 \times \dfrac{44.01}{15.6}.$

$$= 2.6 \times 10^{12} \text{ kg } CO_2/\text{year}$$

for coal $= 3.07 \times 10^{12} \text{ kg/yr} \times \dfrac{75}{100} \times \dfrac{44.01}{12.8}$

$$\overset{\times 10^{12}}{\approx 7.92} \text{ kg } CO_2/\text{yr}.$$