


ESTIMATING CONTEMPORARY ENERGY USE AND CO₂ EMISSIONS

(A)


ESTIMATING CO₂ EMISSIONS FROM CARS



$$\begin{aligned}
 V_{\text{gasoline}} &\approx 5 \text{ L} / (\text{day} \times \text{car}) \\
 E_{\text{gasoline}} &\approx 4 \times 10^7 \text{ J} / \text{L} \\
 N_{\text{cars}} &\approx f \times 10^9 \text{ cars} \\
 E^{(\text{cars})} &\approx V_{\text{gasoline}} \times E_{\text{gasoline}} \times N_{\text{cars}} \times 365 \text{ days} \\
 &\approx \frac{5 \text{ L}}{\text{day} \times \text{car}} \times \frac{4 \times 10^7 \text{ J}}{\text{L}} \times f \times 10^9 \text{ cars} \times 365 \text{ days} \\
 &\approx f \times 10^{20} \text{ J} / \text{yr} \\
 \rho_{\text{CO}_2}^{(\text{gasoline})} &\approx 10^{-7} \text{ kg CO}_2 / \text{J} \\
 \text{CO}_2^{(\text{cars})} &\approx E^{(\text{cars})} \times \rho_{\text{CO}_2}^{(\text{gasoline})} \\
 &\approx f \times 10^{20} \text{ J} / \text{yr} \times 10^{-7} \text{ kg CO}_2 / \text{J} \\
 &\approx f \times 10^{13} \text{ kg CO}_2 / \text{yr}
 \end{aligned}$$

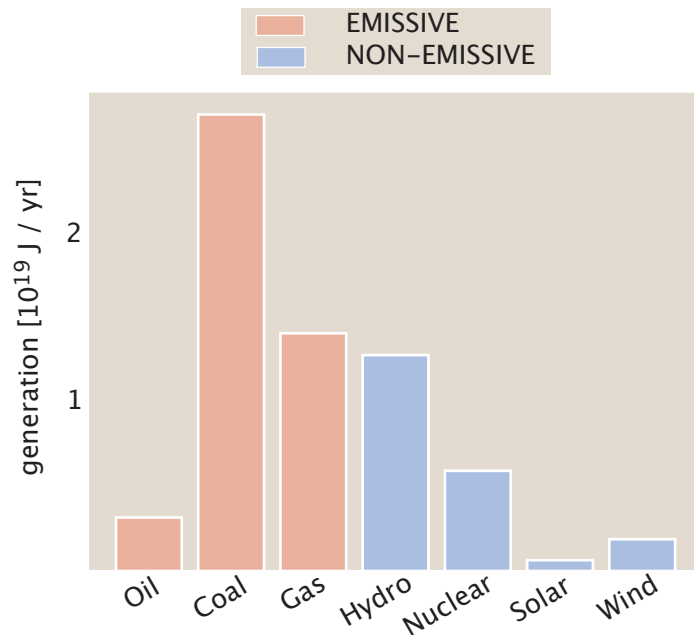
(B)

ESTIMATING CO₂ EMISSIONS FROM ELECTRICITY



$$\begin{aligned}
 p^{(\text{capita})} &\approx f \times 100 \text{ W} / \text{person} \\
 N_{\text{people}} &\approx f \times 10^9 \text{ people} \\
 p^{(\text{global})} &\approx p^{(\text{capita})} \times N_{\text{people}} \\
 &\approx 10^{12} \text{ W} \\
 \rho_{\text{CO}_2} &\approx 10^{-7} \text{ kg CO}_2 / \text{J} \\
 \text{CO}_2^{(\text{electricity})} &\approx p^{(\text{global})} \times \rho_{\text{CO}_2} \times 3 \times 10^7 \text{ s} / \text{yr} \\
 &\approx 10^{12} \text{ J} / \text{s} \times 10^{-7} \text{ kg CO}_2 / \text{J} \times 3 \times 10^7 \text{ s} / \text{yr} \\
 &\approx 3 \times 10^{12} \text{ kg CO}_2 / \text{yr}
 \end{aligned}$$

(C)



(D)

$$\text{CO}_2^{(\text{fossil fuels})} \approx \text{CO}_2^{(\text{cars})} + \text{CO}_2^{(\text{power plants})} \approx f \times 10^{13} \text{ kg CO}_2 / \text{yr}$$

