ESTIMATING CONTEMPORARY ENERGY USE AND CO₂ EMISSIONS (A) ESTIMATING CO₂ EMISSIONS FROM CARS (C) **EMISSIVE** NON-EMISSIVE \approx 5 L / (day × car) $V_{gasoline}$ $E_{gasoline} \approx 4 \times 10^{7} J/L$ $\approx f \times 10^9 \text{ cars}$ N cars $\approx V_{\text{gasoline}} \times E_{\text{gasoline}} \times N_{\text{cars}} \times 365 \text{ days}$ $\approx \frac{5 \text{ L}}{\text{day} \times \text{car}} \times \frac{4 \times 10^7 \text{J}}{\text{I}} \times f \times 10^9 \text{ cars} \times 365 \text{ days}$ $\approx f \times 10^{20} \text{ J/yr}$ $\rho_{CO_2}^{(gasoline)} \approx 10^{-7} \text{kg CO}_2 / \text{J}$ $CO_2^{\text{(cars)}} \approx E^{\text{(cars)}} \times \rho_{CO_2}^{\text{(gasoline)}}$ $\approx f \times 10^{20} \text{J} / \text{yr} \times 10^{-7} \text{kg CO}_2 / \text{J}$ solar Coal Cas Hydro nuclear $\approx f \times 10^{13} \text{kg CO}_2 / \text{yr}$ (B) (D) (fossil fuels) $\approx CO_2 + CO_2$ (power plants) $\approx f \times 10^{13} \text{ kg CO}_2 / \text{yr}$ ESTIMATING CO₂ EMISSIONS FROM ELECTRICITY $- P^{\text{(capita)}} \approx f \times 100 \text{ W / person}$ $- N_{\text{people}} \approx f \times 10^9 \text{ people}$ Friedlingstein et al. 2019 $P^{(global)} \approx P^{(capita)} \times N_{people}$ estimated total emissions estimated power plant emissions $\approx 10^{12} \text{ W}$ ${
m CO}_2$ emissions $[10^{\,12}~{
m kg}~{
m CO}_2$ / yr] 50 $\rho_{CO_2} \approx 10^{-7} \text{kg CO}_2 / \text{J}$ $CO_2^{\text{(electricity)}} \approx P^{\text{(global)}} \times \rho_{CO_2} \times 3 \times 10^7 \text{ s} / \text{yr}$ 40 $\approx 10^{12} \text{ J/s} \times 10^{-7} \text{kg CO}_2/\text{J} \times 3 \times 10^{7} \text{ s/yr}$ 30 $\approx 3 \times 10^{12} \text{ kg CO}_2 / \text{yr}$ 20 10 0 1985 1970 2000 2015

year