CH7 CE10 1. Nuclear power plant: heat engine  
   2. Diesel locomotive: heat engine  
   3. Electric locomotive: not heat engine - electric motor  
   4. Geothermal power plant: heat engine  
   5. Wind turbine: not heat engine - electric generator  
   6. Solar hot water heater: not heat engine - no work

CE16 \[ W = 100 \text{ J} \quad Q_c = 400 \text{ J} \]
\[ = \text{ input} Q_{in} = W + Q_c = 500 \text{ J} \]
\[ \text{efficiency} = \frac{W}{Q_{in}} = 20\% \]

CE22 Pan of liquid water freezes \(\Rightarrow\) entropy of water alone decreases.

But 2nd law is about total entropy of system, which includes cold air being warmed by water giving off heat \(\Rightarrow\) air entropy increases and it works out that total entropy of air + water increases.

CE30 \[ \text{PME} = 30 \text{ people} \times 200 \text{ km} / 3800 \text{ l gas} \]
\[ = 20 \text{ people km/l} \]

CE34 Usefull work = \(\frac{980 \text{ MW}}{2500 \text{ MW}} = 36\% \)
\(\Rightarrow\) out of 100 tons coal, 36 tons produce useful elect. 64 tons are wasted.
Note: it's really $T_c$ on output of turbine that counts, that's where cooling is done. Rest of cooling to 30°C just goes into atmosphere. So this is overestimate, but is best possible efficiency.

P8 1 person, 2800 mi
   car: 22 mi/gal $\Rightarrow \frac{2800 \text{ mi}}{22 \text{ mi/gal}} = 130 \text{ gal}$
   air: 50 pass mi/gal $\Rightarrow \frac{2800 \text{ mi}}{50 \text{ pass mi/gal}} = 56 \text{ gal/pass}$
   bus: 80 pass mi/gal $\Rightarrow \frac{2800 \text{ mi}}{80 \text{ pass mi/gal}} = 35 \text{ gal/pass}$
   train: 144 pass mi/gal $\Rightarrow \frac{2800 \text{ mi}}{144 \text{ pass mi/gal}} = 19 \text{ gal/pass}$

P10 Power flux = 200 W/m²
   Football field area = 100 m x 30 m = 3000 m²
   $\Rightarrow$ power = $\frac{200 \text{ W}}{\text{m}²} \times 3000 \text{ m}² = 6 \times 10^{5} \text{ W}$
   $= 600 \text{ kW}$
   $= 0.6 \text{ MW}$