Reasoning

Anthony Steel

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Chapter 1

Electric Cars

1. **If an electric car uses electricity generated by coal does it produce less carbon emissions per unit of energy then an ICE?** Consider the mass of carbon emmitted per unit distance driven by an electric car and an ICE denoted η_{e} and η_{ICE} respectively. The dimensions are:

$$[\eta_{\mathrm{e}}] = \frac{[M]}{[L]} = \underbrace{\frac{[M]}{[E]}}_{a}\underbrace{\frac{[E]}{[L]}}_{1/b}$$

where a is the mass of carbon produced per kWh by a coal plant, and b is the number of km's per kWh of charge. The U.S Energy Information Administration estimates $a = 0.42$ kg/kWh. For a Tesla Model 3:

$$b = \frac{50}{400}\frac{\mathrm{kWh}}{\mathrm{km}} = \frac{5}{40}\frac{\mathrm{kWh}}{\mathrm{km}}$$

giving:

$$\eta_e = 2.1\frac{\mathrm{kg}}{\mathrm{km}}$$

For the ICE:

$$[\eta_{\mathrm{ICE}}] = \frac{[M]}{[L]} = \underbrace{\frac{[M]}{[L^3]}}_{c}\underbrace{\frac{[L^3]}{[L]}}_{d}$$

where c is the number of kg's of carbon per litre and d is the number of litres per km. The National Resources of Canada estimates $c = 2.3$ kg/L and $d = 9.0$ L/km. Therefore:

$$\eta_{\mathrm{ICE}} = 20.7\frac{\mathrm{kg}}{\mathrm{km}}$$

So an electric car produces 10 times less carbon emission even if the fuel is generated by coal.