The Carbon cycle – reflection

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a) Area = 1 hectare.

b) Domination kind of wood - Beech wood.

c) The estimated biomass (beech wood) per hectare is ca. $500\frac{m^3}{hectare^2}$

d) The density of beech wood with 64% of water is $910\frac{kg}{m^3}$

e) Assume that all the dry matter in the beech wood is cellulose – this is a pretty crude assumption that underestimates the carbon content in beech wood by 5%.

f) The energy content (i.e. heat of combustion) of carbohydrates is $q_{carbohydrate} = 17\frac{kJ}{g}$.

The mass of the dry matter of the Beechwood according to the data above is

$$m_{dry} = 500 * 910 * 0.34 = 154700kg$$

The mass of cellulose is equal to the mass of the dry matter.

$$m_{cellulose} = m_{dry}$$

The energy emitted into surroundings while burning can be estimated as follows:

$$E = m_{cellulose} * q_{carbohydrate} = 1547 * 10^5 * 17 = 2629900MJ$$

CO_2 release:

$$C_6H_{10}O_5 + 6O_2 \rightarrow 6CO_2 + 5H_2O$$

$$n_{C_6H_{10}O_5} = \frac{m_{cellulose}}{M_{cellulose}} = \frac{154700000}{6 * 12 + 10 + 5 * 16} = 954938.27\, mol$$

$$n_{CO_2} = n_{C_6H_{10}O_5} * 6 = 954938.27 * 6 = 5729629.63\, mol$$

$$m_{CO_2} = n_{CO_2} * M_{CO_2} = 5729629.63 * 48 \approx 275000 kg$$

According to the data[1] Denmark emits 5.05 tons of CO_2 per capita.

[1] https://www.statista.com/statistics/270508/co2-emissions-per-capita-by-country/