Thermodynamics of Energy Conversion

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EXERCISES 3

1) Calculate the max. oil price that corresponds to the economic benefit.

Course 2 Ex. 2 0.4 US$/kWh Oil 11 kWh/kg·156l·0.88kg/l·0.4 US$·25% = 154 US$/barrel

2) Calculate how long each resource lasts

Current energy demand: 16 TW
If each resource would cover the energy demand entirely:
Coal: 900 TWy i.e. 900 TWy/16 TW = 56 y
Oil: 240 TWy i.e. 240 TWy/16 TW = 15 y
Natural gas: 215 TWy i.e. 215 TWy/16 TW = 14 y
Uranium: 90 – 300 TWy i.e. 300 TWy/16 TW = 20 y

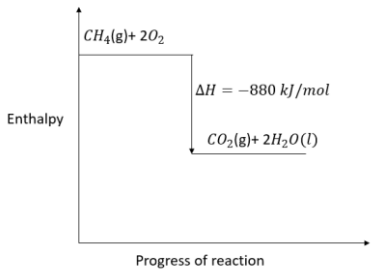
3) Calculate the production of biomass in energy per surface area and time.

250 dt dry mass per ha and year.
25t/10'000m^2/year = 2.5 kg/m^2 per year
2.5 kg/m^2 · 2.0 kWh/kg per year = 5 kWh/m^2 per year

4) Construct an enthalpy diagram for the oxidation of methane ($CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$) and calculate the reaction enthalpy.

Enthalpy:
CH_4: -75 kJ/mol
CO_2: - 393 kJ/mol
H_2O: -285 kJ/mol

ΔH_R = - 393 kJ+ 2·-285 kJ - (-75 kJ) = -880 kJ



5) Estimate the temperature increase if all the fossil fuels are burned.

Fossil C emitted is 345 Gt C, corresponding to 1086 Gt CO_2 lead to 120 ppm increase of the CO_2 concentration in the atmosphere and a temperature increase of 0.8°C.
Proven reserves are approx. 1404 Gt C.
ΔT = 0.8°C/345 Gt·1404 Gt = 3.3°C