

An example just for illustration:

Equivalence of CO₂ and Soot Reduction Cost/Benefit Consideration

Estimate of carbon-dioxide generation from burning 1 Litre of diesel-fuel.

1. CO₂-Estimate from carbon content in fuel:

- 85% weight carbon in diesel fuel (= df)
- $\rho = 850 \text{ kg/m}^3$... df mass- density
- $M_{rC} = 12$
- $M_{rO} = 16$ relative molar weights
- $M_{rH} = 1$
- $M_{rCO_2} = 44$

Hence, 0,85 kg df make 1 litre and this litre consists of = 0,7225 kg C !
Consequently, due to $M_{rCO_2} / M_{rC} = 44/12 = 3,67$ the mass of CO₂ generated by 1 litre of diesel fuel is found to be $m_{CO_2} = 2,68 \text{ kg}$!

2. CO₂- estimate from minimum air required Rosin & Fehling

- Density, carbon content and reative molar weights as above
- Rosin and Fehling:**
- $V_{Amin} = a \cdot Hu/1000 + b \text{ Nm}^3 \text{ kg Brennstoff}$
 - $a = 0,203$; $b = 2$
 - df: $Hu = 40.000 \text{ kJ/kg} \Rightarrow$
 - $V_{Amin} = 10,12 \text{ Nm}^3/\text{kg df} \Rightarrow 13,09 \text{ kg Air} \Rightarrow$
 - $\Rightarrow 11,12 \text{ kg Air/litre of diesel fuel}$

Oxygen content is only slightly more than 20%, hence about 2.3 kg of oxygen are required to burn 1 litre of diesel fuel. From the ratios of relative molar weights we obtain 3,16 kg CO₂ to be obtained from 1 litre of df !
Compare : 2,68 kg above ! Also some published test ÖAMTC: 2,7 !

Estimate of soot-particles, least generation EURO 5 / 6- PM = 0,01g/kWh

How many kilowatts are delivered at the shaft by burning 1 litre of diesel fuel?
(engine efficiency = 40%)

df enthalpy = 40000 kJ/kg = 0.85 . 40000 /3600 = 3.78 kWh/litre

According to EURO 5 and EURO 6, mass of soot permissible is 0.01g/kWh, hence by rounding we conclude mass of soot is 0.04g/kWh !

Equivalence Soot and CO₂

$$\text{Mass-Ratio. Soot/CO}_2 = 4 \cdot 10^{-5} / 4 = 10^{-5}$$

$$\text{Ratio of driving forces for global warming} = 5 \cdot 10^{-5} \cdot 10^5 = 5$$

Note: Assuming EURO 5 or EURO 6 is the most unfavourable assumption!

Conclusion: Eliminating soot by means of existing and proven technology is likely to reduce the driving force of global warming 5 times more as if (only ideally in thought) one could eliminate all CO₂!

Considerations of costs (specific assumption):

Consider:

- HdV, consumption 40litre/100kilometre, 50000km/year,
df = 20000 litre/year, consequently,
 - CO₂-Produktion = 4 · 20000 = 80000kg

Reduction of driving force of gw by means of soot elimination is to result in the equivalent of 400.000 kg CO₂-Reduktion

Cost-estimate of 1 DPF for HdV € 15.000,- in retrofit; if retrofit to be done on a broad base probably one half of it!

DPF-Guaranteed life-time: 500.000km

- => for 1.500,-€/year maximum the CO₂-Equivalent of 400t is bought! or
- Equivalent of reduction 1t CO₂ results into maximum cost of 1500/400 = 15/4 = 3,75 €.

Soot reduction means 3 flies with only one flap:

- Improving public health
- Reducing global warming
- Buying time for manufacturing industry to develop production processes of lesser CO₂ generation

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