

Exercise Sheet 1

–Scetch of solution–

Exercise 1

a)

$$1 \text{ Mt Crude oil} \cdot 1458 \frac{\text{kg HCU}}{\text{t Crude oil}} = 1.458 \cdot 10^9 \text{ kg HCU} = 1.458 \text{ Mt HCU}$$

b)

$$1 \text{ Mt Lignite} \cdot 9.04 \cdot 10^9 \frac{\text{J}}{\text{t Lignite}} = 9.04 \cdot 10^{15} \text{ J} = 9.04 \text{ PJ}$$

$$1 \text{ Mt Lignite} \cdot 0.308 \cdot 10^3 \frac{\text{kg HCU}}{\text{t Lignite}} = 0.308 \cdot 10^9 \text{ kg HCU} = 0.308 \text{ Mt HCU}$$

$$1 \text{ Mt Lignite} \cdot 2.511 \cdot 10^6 \frac{\text{Wh}}{\text{t Lignite}} = 2.511 \cdot 10^{12} \text{ Wh} = 2.51 \text{ TWh}$$

c)

$$1 \text{ EJ} = 1 \cdot 10^{18} \text{ J}$$

$$1 \cdot 10^9 \text{ GJ} \cdot 0.278 \cdot 10^6 \frac{\text{Wh}}{\text{GJ}} = 0.278 \text{ PWh} = 278 \text{ TWh}$$

$$1 \cdot 10^{18} \text{ J} \cdot 1 \frac{\text{m}^3 \text{ Natural gas}}{3.52 \cdot 10^7 \text{ J}} = 28.4 \cdot 10^9 \text{ m}^3 \text{ Natural gas}$$

$$1 \cdot 10^{18} \text{ J} \cdot 1 \frac{\text{t Crude oil}}{42.7 \cdot 10^9 \text{ J}} = 23.4 \cdot 10^6 \text{ t Crude oil} = 23.4 \text{ Mt Crude oil}$$

$$1 \cdot 10^{18} \text{ J} \cdot 1 \frac{\text{t Heating oil light}}{42.8 \cdot 10^9 \text{ J}} = 23.36 \cdot 10^6 \text{ t Heating oil light} = 23.4 \text{ Mt Heating oil light}$$

Exercise 2

a)

$$1 \text{ MWh}_{el} \cdot \frac{1}{0.42 \leftarrow \text{efficiency}} = 2.38 \text{ MWh}_{th}$$

$$2.38 \cdot 10^3 \text{ kWh} \cdot 1 \frac{\text{t Lignite}}{2.511 \text{ kWh}} = 0.95 \text{ t Lignite}$$

b)

$$\Rightarrow \text{efficiency loss} = 1.38 \text{ MWh}_{th}$$

c)

$$2.8 \cdot 10^3 \text{ kWh}_{el}/a \cdot \frac{1}{0.42} = 6.67 \cdot 10^3 \text{ kWh}/a$$

$$6.67 \cdot 10^3 \text{ kWh}/a \cdot 1 \frac{\text{t Lignite}}{2.511 \text{ kWh}} = 2.66 \text{ t Lignite per annum}$$

Exercise 3

$$2.5 \cdot 10^3 \text{ kcal} \cdot 1 \frac{\text{t Crude oil}}{10.2 \cdot 10^6 \text{ kcal}} = 245 \text{ g of Crude oil}$$

$$0.245 \text{ kg Crude oil} \cdot 1 \frac{\text{Barrel}}{136 \text{ kg Crude oil}} \cdot 49.72 \frac{\text{USD}}{\text{Barrel}} \cdot 1 \frac{\text{Euro}}{1.3064 \text{ USD}} = 0.069 \text{ Euro}$$

Exercise 4

a)

$$478 \cdot 10^9 \text{ kg HCU} \cdot 0.7 = 334.6 \text{ Mt TOE}$$

b)

$$478 \cdot 10^9 \text{ kg HCU} \cdot 29.308 \cdot 10^6 \frac{\text{J}}{\text{kg HCU}} = 14.01 \text{ EJ}$$

c)

$$478 \text{ Mt HCU} \cdot 1 \frac{t \text{ Crude oil}}{1.458 t \text{ HCU}} = 327.8 \text{ Mt of crude oil}$$

$$327.8 \cdot 10^6 t \text{ Crude oil} / 3000 = 109,267 \text{ vessels per year} = 300 \text{ per day (approx.)}$$

$$327.8 \cdot 10^6 t \text{ Crude oil} / 320,000 = 1025 \text{ vessels per year} = 2.8 \text{ per day}$$

Exercise 5

a)

$$40.43 \cdot 10^9 \text{ kWh} \cdot 0.12 \frac{kg \text{ HCU}}{kWh} = 4.97 \cdot 10^9 \text{ kg HCU} = 4.97 \text{ Mt HCU}$$

$$40.43 \cdot 10^9 \text{ kWh} \cdot 0.086 \frac{kg \text{ TOE}}{kWh} = 3.48 \cdot 10^9 \text{ kg TOE} = 3.48 \text{ Mt TOE}$$

b)

$$40.43 \text{ TWh}_{el} \cdot \frac{1}{0.45} = 89.84 \text{ TWh}_{th}$$

$$89.84 \cdot 10^9 \text{ kWh} \cdot 1 \frac{t \text{ Hard coal}}{8.32 \cdot 10^3 \text{ kWh}} = 10.8 \cdot 10^6 t \text{ Hard coal} = 10.8 \text{ Mt Hard coal}$$

$$10.8 \text{ Mt Hard coal} \cdot 58.25 \text{ Euro/t} = 629.10 \text{ Million Euro} \Rightarrow 1.6 \text{ ct/kWh}$$

Exercise 6

$$1000 \text{ m}^3 \cdot 33.3 \cdot 10^3 \frac{Btu}{m^3} = 33.3 \cdot 10^6 \text{ Btu of crude oil}$$

$$\Rightarrow 6.5 \frac{USD}{MBtu} \cdot 33.3 \text{ MBtu} = 216.45 \text{ USD} \cdot 1 \frac{\text{Euro}}{1.3 \text{ USD}} = 166.50 \text{ Euro}$$