Tutorial Energy & Sustainability

Exercise Sheet 2
–Sketch of Solution–

Exercise 1

a) $50\ Euro + 0.06\ kW \cdot 50,000\ h \cdot 0.25\frac{Euro}{kWh} = 800\ Euro$
$7\ Euro + 0.008\ kW \cdot 50,000\ h \cdot 0.25\frac{Euro}{kWh} = 107\ Euro$
$\Rightarrow \Delta = 693\ Euro$

b) $1\ Euro\ + 0.06\ kW \cdot x \cdot 0.25\frac{Euro}{kWh} = 7\ Euro + 0.008\ kW \cdot x \cdot 0.25\frac{Euro}{kWh}$
$x = 461.54\ hours$

c) cf. tutorial

d) $50\ Euro + 0.06\ kW \cdot 50,000\ h \cdot x = 7\ Euro + 0.008\ kW \cdot 50,000\ h \cdot x$
$\Rightarrow x \leq -0.0165\frac{Euro}{kWh}$

Exercise 2

cf. tutorial

Exercise 3

cf. tutorial

Exercise 4

cf. tutorial

Exercise 5

cf. tutorial

N a t u r a l G a s

Exercise 6

$$2944.2 \cdot 1.03^0 \ + \ 2944.2 \ \cdot 1.03^1 \ + \ 2944.2 \ \cdot 1.03^2 \ + ... \ = 175,005$$

$$2944.2 \cdot \sum_{t=0}^{x} 1.03^t \ = 175,005 \ \left[geometric\, series : \sum_{t=0}^{n} q^t \ = \frac{q^{n+1}\ -1}{q-1} \right]$$

$\Leftrightarrow \frac{1.03^{x+1}-1}{1.03-1} = 59.44$

$\Leftrightarrow 1.03^{x+1} = 2.78$

$\Leftrightarrow x+1 = log_{1.03}2.78$

$\Leftrightarrow x+1 = \frac{ln2.78}{ln1.03} = 34.59$

$\Leftrightarrow x = 33.59\ years\ \Rightarrow$ approx. 34 years

Exercise 7

cf. tutorial

Exercise 8

a) transport of natural gas **Pipeline**

$2000\ km \cdot 2.08 \frac{USD\ cent}{t\ \text{TOE} \cdot km} \cdot 7.580\ t\ \text{TOE} = 31,532.8\ USD\ cent = 315.33\ USD$

transport of natural gas **LNG**

LNG: $10,000\ m^3 \cdot 0.7580 \frac{kg\ \text{TOE}}{m^3} \cdot 54 \frac{USD}{t\ \text{TOE}} = 409,32\ USD$

$Transport$: $2000\ km \cdot 0.58 \frac{USD}{t\ \text{TOE} \cdot km} \cdot 7.580\ t\ \text{TOE} = 87.928\ USD$

$\Rightarrow \sum = 497.25\ USD$

b) **Pipeline**: $315.33\ USD\ /\ 2000\ km = 0.1577\ USD/km$

LNG: $497.25\ USD\ /\ 2000\ km = 0.2485\ USD/km$

c) $K_{Pipe} = 0.1577 \cdot x\ km$

$K_{LNG} = 409.32 + 0.04396 \cdot x\ km$

equalising:

$0.1577 \cdot x = 409.32 + 0.04396 \cdot x$

$0.11374 \cdot x = 409.32$

$x = 3598.7\ km$

Further possibilities for transportation: truck, train.