27.08.
Solution to: Global_energy_resources_and_consumption

1. Compare the direct costs to the consumer of using a succession of ten 100 W incandescent light bulbs with an efficiency to visible light of 5%, a lifetime of 1000 h, and a price of 50 cents with one compact fluorescent lamp giving the same illumination at 22% efficiency, a lifetime of 10 000 h, and a price of $3. Assume a price of electricity of 10 cents per kWh.

10 x light bublbs Power input: 10 x 100 W Efficiency to VIS: 5% Lifetime: 1 000 h Price: $0.5	Fluorescent lamp Power input: ? W Efficiency to VIS: 22% Lifetime: 10 000 h Price: $3
Illumination (10 x bulbs) = Illumination (one fluorescent lamp)	

Luminous efficiency η = Illumination/Power input = [lm]/[W]

$$\eta = \frac{P_{out}}{P_{in}}$$

P_{in} ..... η
1000 W 5%
x W 22%

x= 227 W

Looking for $/h

10 x Light bulbs

Buying + Electrocity

$$\frac{\$\ 0.5}{1000\ h} + 10 \cdot 100\ W \cdot 0.1\ \$/kWh = 0.1005\ \$/h$$

1 x fluorescent lamp

$$\frac{\$\ 0.3}{10000\ h} + \ 227\ W \cdot \ 0.1\ \$ / kWh \ \ = \ 0.0230\ \$ / h$$

$$\frac{0.1005\ \$/\mathrm{h}}{0.0230\ \$/\mathrm{h}} = 4.37$$

Fluorescent lamp is cca 4.4 more efficient compare to 10 bulbs in line.

6. How large would a square side of side L need to be so that if it were covered by 10% efficient solar cells in the middle of the Sahara desert, the power generated would be enough to satisfy the world´s present energy needs (use ? Assume that the incident solar radiation is 1000 W/m2.

Intensity of incident solar radiation:

1000 W/m^2 = 1 kW/m^2
10% -> 0.1 kW/m^2

World energy consumption per year:

152053 TWh = 152053 * 10^{12} Wh / (365 * 24) h = 17,36 * 10^9 kWh

$$l = \sqrt{\frac{17,4 \cdot 10^9\ kW}{0,1 \frac{kW}{m^2}}} = 417\ \mathrm{km}$$

8. Discuss reasons why exercises 5-7 should be taken as academic, what assumptions they require (are they realistic?) and what other factors are important and necessary to include in predictions about the future of energy and energy technologies. Discuss the value/use and/or potential dangers in energy predictions.

5 – 7 approx. model. First view on the energy consumption predictions with growing human population.

When the electricity is transfering there are always some loss for current flux by the change of electric energy to heat due to ohmic resistance of conductors (shape and material), interference with magnetic fields which may cause electromotive force (voltage) against current flux, transformators, ohmic and capacitive circuit elements, random errors. More far is the source from consumer more loss will occur.

When we consider PV solar cells in Sahara, we need to consider also their lifetime and also local change in seasons, climate, maintenance costs, conductors costs and difficulty of construction.

Dangers: depletion of ‘quick’ fossil fuels, increasing energy requirment in high populated Africa and Asia. Possibility of war for the owing energy sources and control production.