Thermodynamics of Energy Conversion and Storage

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EXERCISES 2

1) Calculate the average power per capita if the world primary energy demand is $170 \cdot 10^{12}$ kWh a^{-1} ($7.5 * 10^9$ people).
$P = 170 \cdot 10^{12}$ kWh $a^{-1} / 7.5 \cdot 10^9 / (365 \cdot 24h) \cdot a = 2.6$ kW/capita

2) Calculate the economic benefit of 1 kWh of available energy.

In the linear region of the curve:
20'000 US$/capita/year corresponds to 50 MWh/capita/year
20'000/50'000 US$/kWh = 0.4 US$/kWh

3) Estimate the world energy demand in 2050. What will be the average power per capita? Population increases to from $6 \cdot 10^9$ to $11 \cdot 10^9$

Energy consumption 2016: $(2 \cdot 0.25 + 2 \cdot 0.5 + 1 \cdot 4 + 1 \cdot 8)/6 = 13.5/6 = 2.25$ kW/capita
Energy consumption 2050: $(2 \cdot 0.25 + 3 \cdot 0.5 + 3 \cdot 4 + 3 \cdot 8)/11 = 38/11 = 3.45$ kW/capita
The energy consumption will increase from $13.5 \cdot 10^9$ kW today to $38 \cdot 10^9$ kW in 2050

4) Calculate the population development when the birth rate is 2 kids per woman and the death rate is 1%.

$dN/dt = +N/2 \cdot 0.02 - N \cdot 0.01$
$dN/N = (0.02/2 - 0.01) \cdot dt$
$\ln(N) = a \cdot t + C$ ($a=0$)
The population remains constant.

5) Locate an average Swiss student and an EPFL Professor in the global wealth distribution.

An average Swiss student has about 3000.-/month available that corresponds to approx. 100 $ / day. This is in the top 5% of the world.
A full Professor at EPFL has a salary of around 20'000.-/month that corresponds to approx. 715.- / day. This is in the top <1% of the world.