Fermi Problems and Computers

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1 Two Introductory Examples

E1 How many dentists are there working in Belgium?

E2 In the earth-moon-system there is a transfer of rotational energy from the earth to the moon. There results a steady increase of the mean distance between earth and moon of 0.04 m per year.

How many Joules are transferred by this process from the earth to the moon per year?

2 Problems to be solved in small teams

Please analyse at least one of the following problems in a small team. You may ask questions. Only a minimal amount of data will be needed and provided on request.

- Which data are ideally needed, which are available?

- What simplifications would fit a Fermi problem?

- How is technology used in your approach?

- Please prepare a short group presentation for a Fermi-like approximate answer.

The Questions

1. Suppose a power plant is supplying 1 GW of electrical power by thermally driven generators.

   (a) How big is the mass equivalent to its daily output of electrical energy?
   (b) How much mass is transformed into energy per day in this power plant?

2. How much energy does the earth get from the solar radiation per second?

3. How much kinetic energy is stored in the earth atmosphere?

4. How much energy is released by the falling rain in a thunderstorm?

5. There are various claims regarding the rise of the ocean levels since the year 1900. A quick look at various sources gives the following results in meters

$$0.2 \quad 0.25 \quad 0.35 \quad 0.5 \quad 0.6 \quad 0.65 \quad 0.7 \quad 0.75 \quad 0.8$$

   (a) List the effects that may cause a steady increase of the sea levels?
   (b) By how much does the level of the oceans rise, if the temperature of the waters is heated up by 1°C throughout?
   (c) How much energy is taken up in this expansion?
   (d) Which further effects cannot be excluded if the temperature of the oceans increases by 1°C?
   (e) Which ones of the claims might be ruled out? Which would you deem to consider plausible?