WRITTEN EXAMINATION

RESOURCES & SUSTAINABLE DEVELOPMENT

2010-2011

13-01-2011

- This examination contains 5 questions
- Answer each question on a separate sheet of paper!!
- Write your name on each sheet of paper

Tip 1: Read the whole question carefully before starting answering sub-questions.
Tip 2: Make a draft first (keywords, etc.) this will probably result in more compact and
       better structured answers.
Tip 3: Keep an eye on the time.

Good luck !!

1) Producing electricity from renewable sources. (6 pts, 15-20 minutes) (use separate sheet of paper)

a) shortly explain two different methods of converting solar light to electricity.

b) discuss two problems when increasing the share of wind power in the current electricity production system. Give solutions to each of these problems.

c) when and where in the life cycle of electricity production from renewables (solar and wind) is the majority of the green house gasses emitted? Explain your answer

2) Radiative Forcing (10 pnt, 25-30 minutes) (use separate sheet of paper)
Many trace gases in the earth's atmosphere act as so-called "greenhouse gases".

$\frac{1}{2}$ (a)   Explain the general radiation characteristics of these greenhouse gases.

$\frac{1}{3}$ (b)   Give the three most important (natural) greenhouse gases, with their ranking.

The atmospheric concentration of several of these gases is influenced by human behaviour. This raises concern about the climate effects that might be caused by this. In order to compare the influences of increasing concentrations of different greenhouse gases in a quantitative way, the concept of "Radiative Forcing" is most suitable.

(c)   Explain what is meant by "Radiative Forcing".

For atmospheric CO_2, the expression for Radiative Forcing (RF) is:

$$RF\ [W/m^2] = 5.41\ \ln(C/C_0),$$

in which C_0 is the original, natural concentration of CO_2 in the atmosphere (278 ppm= 278000 ppb), and C is the present-day concentration (389 ppm= 389000 ppb). (ln is the natural logarithm).
Similarly, for methane (CH_4) the RF is:

$$RF\ [W/m^2] = 0.036\ (\sqrt{C} - \sqrt{C_0}),$$

in which C_0 is the original, natural concentration of CH_4 in the atmosphere (700 ppb), and C is the present-day concentration (1850 ppb).

(d) Explain why these RF's are not linearly dependent on the concentration.

2 (e) What are the present-day RF's for CO_2 and CH_4 ?

One of the anthropogenic sources of methane is losses during oil mining. If this methane cannot be used, it is usually combusted (gas flaring). This prevents CH_4 from escaping into the atmosphere, but it obviously produces CO_2

2 (f) Suppose gas flaring would prevent 20 ppb of CH_4 emission, and thus at the same time would cause 20 ppb extra CO_2 emission. Calculate the RF effects of both on the present day atmosphere, and give the net RF result of flaring compared to letting the methane escape into the air. What do you conclude?

3) Nature management (6 pts, 15-20 minutes) (use separate sheet of paper)
You are a manager of the State Nature Conservation Services in The Netherlands. Your boss has bought 100 hectares of former agricultural grasslands on peat soils in an area which has been intensively drained in the past and still is. What would you recommend for management? You have several options:
1) increase water levels and make the area suitable for meadow birds
2) increase water levels and make the area suitable for species-rich meadows
3) increase water levels and plant trees
4) do nothing.

In your decision you have to consider that we have a new government that is now cutting budgets for Nature Conservation, so funds are very limited.
Explain shortly your choice.

4) Environmental indicators (10 pnt, 25-30 minutes) (use separate sheet of paper)
An environmental scientist presents the following statement "The environmental impact of household consumption is reliably expressed by four indicators: the direct energy requirement, the indirect energy requirement, the tap water use and the amount of waste generated by households."

This statement seems to imply that material use per se is unimportant as environmental problem related to household consumption.
However you could also believe that some environmental problems related to material use are already included in some way within the four indicators mentioned.
a) Explain which material related environmental problems are addressed by this set of four indicators.
b) Give also an example of a material related environmental problem that is not addressed by this indicator set. Explain.

Important household functions are: housing, feeding, clothing, transport, personal hygiene, education, communication and recreation. These household functions can be related to the four indicators. To accommodate these functions direct energy is required, indirect energy is required, tap water is used and waste in produced.

c) Give an overview of the most demanding household functions for each indicator.
d) Discuss, using this overview, for each of the four indicators some technical and behavioural measures to mitigate substantially the environmental impact of households. Clarify for each of the presented measures how it may contribute to the decrease of the environmental impact.

5) Bio-energy (6 pts, 15-20 minutes) (use separate sheet of paper)
In Brasilia ethanol produced from sugar cane (named bio-ethanol) is being promoted as a sustainable car fuel. In some EU countries bio-ethanol is also promoted. However large scale worldwide introduction of bio-ethanol may imply a substantial change in the energy system, in the economy and for the environment.

Discuss in about a half page the sustainability of large scale use of bio-ethanol for passenger cars for your home country (China, Germany, Indonesia, Malaysia, Netherlands). Consider in this discussion all three sustainability dimensions (planet, people, and profit; or ecological, social and economic effects).

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