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**Examination: Energy and Economy (0EM72)**

**Date:** 30 January 2012

**Time** 9.00 – 12.00 h.

Please read the instructions carefully:

- This exam consists of six questions, but you need to answer only five, according to your choice.
  - Each question earns you a maximum of 20 points. You can earn a maximum of 100 points in total.
  - You need to earn 55 points or more in order to pass the course.
  - No formula sheet has been provided because you will not need it.
  - Write down your name and student number on every answer sheet that you hand in.
  - Total number of pages of this exam: 4
  - Success!
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**Question 1** (a: 5 points; b: 2; c: 5; d: 8)

- a) What does the environmental Kuznets curve express?
- b) Mention one form of pollution where the environmental Kuznets effect seems to work well as countries become richer over time.
- c) Why does the environmental Kuznets effect not work well in respect of the mitigation of greenhouse gas emissions?
- d) How could the Clean Development Mechanism (CDM) of the Kyoto Protocol help to change the shape of the environmental Kuznets curve of emerging economies such as China, which is gaining a lot of carbon credit funds? Please illustrate with a graph to explain your point.

**Question 2** (a: 3 points; b: 4; c: 4; d: 5; e: 4)

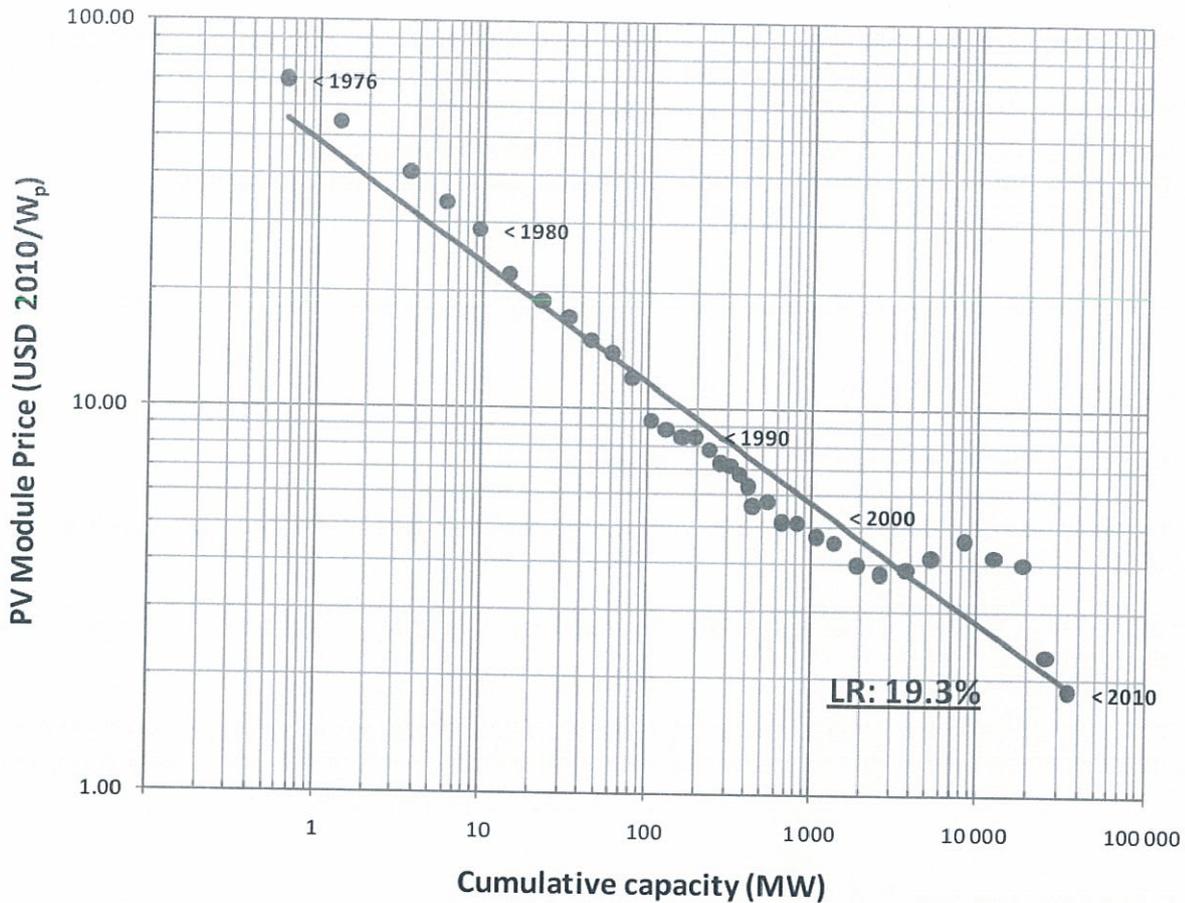
There are two important types of policy interventions with which we can try to mitigate carbon emissions: incentive-based interventions and non-incentive based interventions.

- a) What is the essential difference between these two types of interventions?
- b) Briefly discuss one advantage and one disadvantage of each intervention type.
- c) The imposition of an emission cap, with imposition of fines in case of overshooting of the target, is an important non-incentive based policy instrument. How does the European incentive-based “cap & trade” system to reduce greenhouse gas emission reductions (ETS) differ from a non incentive-based cap policy?
- d) As an alternative to a “cap & trade” policy instrument to curb emissions, imposition of a tax on emissions can also be used. According to economic theory, these two policy measures have the same effect on emission reductions. Demonstrate this by means of a graph.
- e) Given the fact that the effects on emissions of the two policy instruments are equal, then why is there so much discussion and controversy in policy circles about the choice of taxes versus cap & trade policies?

Question 3 (a: 6 points; b: 8; c: 6)

Please refer to the graph, which shows steadily declining costs of PV modules over time.

Figure 6.3 Cost degression of solar PV modules, 1976-2010



Source: Breyer and Gerlach (2010).

**Key point:** Historically, every doubling of installed capacity coincided with a 19.3% reduction of PV module prices.

- There are two major reasons behind these cost reductions. What are these? Use graphs as an aid in your explanation if you need.
- Some economists tend to argue that the effects of cost reductions over time will be sufficient for PV systems to become competitive with fossil-based electricity provision, but other economists do not agree with this point of view. What is the main reason why many do not believe that cost reductions in PV on their own will be sufficient?
- What policy intervention(s) do these people recommend to foster the widespread diffusion and adoption of PV systems (and other renewable energy technologies)?

**Question 4** (a: 3 points; b: 4; c: 5; d: 4; e: 4)

Throughout the world, regulation of the energy system has changed dramatically since the late 1970s, moving away from integrated monopolistic models.

- a) Explain the essential features of the integrated monopolistic model of energy system regulation.
- b) What are the four main features of the regulatory changes that have taken place since the late 1970s? (explain each feature briefly in 1-2 sentences)
- c) How do you characterise the current “ideal type” of post-reform model of energy system governance, and what are the supposed advantages of this system over the old integrated monopoly system?
- d) In his paper about (EU) energy market regulation, Ocana discusses several problems of the new system of energy sector governance that are proving to be major problems in practice. Discuss three of these problems. You may choose to discuss/illustrate these problems in relation to the situation obtaining in a country or region of your choice.
- e) According to some orthodox pro-free market economists, the problems with the current energy system governance occur because reform has not gone far enough yet, and the “teething problems” will be ironed out over time. However, others are concerned that the current system has inherent flaws which will not go away. Which position do you take in this debate? Motivate your answer.

**Question 5** (a: 3 points; b: 5; c: 5; d: 4; e: 2)

- a) Briefly discuss the three biggest energy challenges, which – by common agreement – are facing the world today.
- b) Food supply / food security is another major issue. Indicate how this problem relates to each of the three energy challenges in Q6a.
- c) Imagine an economy which is fully running on domestically produced bioethanol, which has an EROI of 1.34 [estimate by Shapouri et al. (2002) “The energy balance of corn ethanol: an update”, Agric Econ. Reports, Office of the Chief Economist, Washington, D.C., 2002]. How much is the share of the country’s energy sector in the country’s total energy consumption?
- d) In the light of your answer to Q 5c, discuss the feasibility and desirability of a large scale energy transition (as e.g. envisaged by the USA, to 1<sup>st</sup> generation biofuels such as corn ethanol).
- e) When a fuel has an EROI smaller than 1, what does that mean?

**Question 6** (a: 2 points; b: 2; c: 3; d: 4; e: 4; f: 5)

Many investment decisions in the energy sector can be analysed usefully with a technique called Cost-Benefit Analysis (CBA).

- a) There are three key decision criteria that are commonly applied in CBA, namely the Net Present Value, the Internal Rate of Return, and the Pay Back Period. Which of these three criteria is the least accurate, and why?

- b) Please refer to the table below, which represents the estimated project cash flows for a mini biomass gasifier in India (in constant prices of year 0). Looking at the data given in the table, is this project expected to be profitable? Please explain your answer. (You do not need to conduct calculations of your own to answer this question).
- c) What is the estimated Pay Back Period of this project? Is this acceptable for a project of this nature, in your opinion?
- d) Calculate the NPV for the project without income from the sale of carbon credits. What do you conclude?
- e) Which cash flow items would you definitely include in a sensitivity analysis (risk assessment) of this project? Motivate your choices.
- f) What is a switching value, and how is the calculation of switching values of cash flow items useful in a sensitivity analysis?

yr	Investment and expenditure				Income and subsidy				F-CBA				
	Investment	Training to local people for biomass production	Labour costs	Biomass consumption	Overhead	Electricity sales	Sales from charcoal produced	Carbon credits	Government subsidy	Benefits minus costs	discount factor	Discounted CF (B-C)	Cumulative discounted CF (B-C)
0	-€ 50.000	-€ 5.000								-€ 55.000	1,00	-€ 55.000	-€ 55.000
1		-€ 250	-€ 1.104	-€ 3.360	-€ 250	€ 6.720	€ 336	€ 1.525	€ 12.000	€ 15.617	0,95	€ 14.890	-€ 40.110
2		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,91	€ 8.035	-€ 32.075
3		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,87	€ 7.661	-€ 24.414
4		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,83	€ 7.304	-€ 17.110
5		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,79	€ 6.964	-€ 10.146
6		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,75	€ 6.640	-€ 3.506
7		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,72	€ 6.331	€ 2.825
8		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,68	€ 6.036	€ 8.860
9		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,65	€ 5.755	€ 14.615
10		-€ 250	-€ 1.104	-€ 6.720	-€ 250	€ 13.440	€ 672	€ 3.051		€ 8.839	0,62	€ 5.487	€ 20.102