Examination: Environmental Assessment (Master Renewable Energy)

Examiner:	Schäfer	February 23, 2023

WS 2022/23	student No.:	full name:	signature:

With my signature I confirm that

- I completed the exam on my own and only with the help of the admitted tools listed below,

- I feel healthy and able to take the exam. I am aware that the exam is considered to have been taken and will be evaluated once the examination assignments have been received.

- The examination assignments consist of three pages and have to be returned together with the solution!

- Dictionaries and non-programmable calculators are admitted tools.

- The maximum points achievable are 90.

- The examination time amounts to 90 minutes.

- Please write down all steps of calculation! Pure numbers without transparent calculation yield 0 points!

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1. **Market equilibrium, taxes and welfare**

   Assume perfect competition at the market for aluminum foils. Inverse demand is given by

   $$p(y) \quad = \quad 100 - 2y$$

   while supply equals

   $$p(y) \quad = \quad \frac{1}{2}y$$

   a) Calculate the market equilibrium p^*, y^* and illustrate it in an appropriate diagram with labeled axis intercepts. *(5 points)*

   b) Assume a producer tax with a tax rate τ=5. Calculate the new equilibrium and illustrate the new equilibrium quantity y_t^*, the price paid by consumers (demand) p_d^*, the price received by producers (supply) p_s^* and the tax rate τ in the diagram from subtask a). *(10 points)*

   c) Calculate consumer surplus CS, producer surplus PS, tax income T, welfare W and welfare change ΔW after introduction of the tax and illustrate it in the diagram of subtask a). *(10 points)*

   hint: If you could not solve subtask b), assume any quantity $y_t^* < y^*$ as new equilibrium.

   Please turn the page!

2. **Emissions abatement, emission tax and emissions trading**

   Assume two companies 1 and 2 with emissions E_1 and E_2 facing the following marginal abatement cost (MAC)

   $$MAC_1 = 30 - 2E_1$$
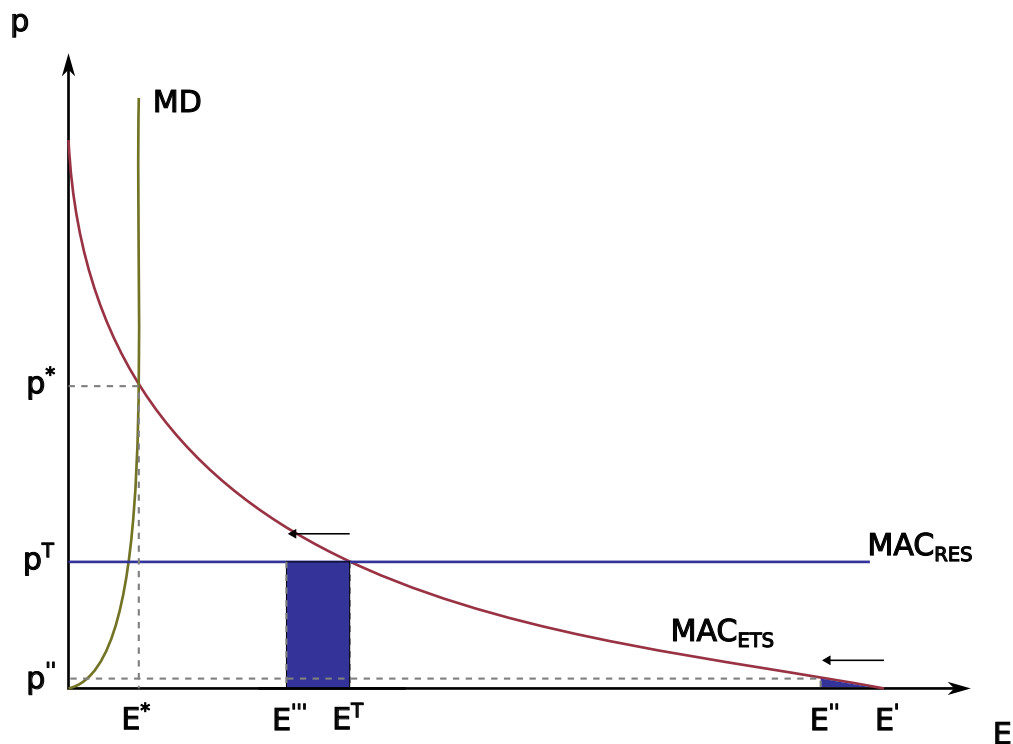 $$MAC_2 = 20 - E_2$$

   Assume no emission abatement in the business as usual scenario.

   a) Calculate emissions for each company (E_1, E_2) and in total (E) in the business as usual scenario. *(5 points)*

   b) Illustrate MAC_1 and MAC_2 in a labeled price-quantity diagram and mark the axis intercepts. *(5 points)*

   c) Assume emissions trading with each company allocated free certificates for 70 % of its emissions (30 % emission reduction). There shall be perfect competition at the certificates market. Calculate the price for certificates. *(10 points)*

   d) Calculate abatement costs (AC_1, AC_2) for both companies and in total (AC). Moreover, calculate costs (C_1, C_2) for both companies considering revenues/cost from selling/buying certificates. *(10 points)*

   e) Assume that instead of emissions trading there is an emission tax with a tax rate τ=7. Calculate total emissions. *(10 points)*

   f) Discuss similarities/differences and advantages/disadvantages of emission tax and emissions trading. *(10 points)*

   hint: An illustration and your results from the preceding subtasks might help you a bit.

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3. **Emissions trading and renewable energy**

Use the illustration above to explain why it might make sense to subsidize renewable energy sources (RES) simultaneously to an emission trading system (ETS) considering at least

- necessary properties of the ETS,

- assumptions about MAC assigned to RES and the ETS,

- time aspects.   *(15 points)*

Good luck!