
ECON1922 spring 2025
University of Oslo

Instructions:

- (i) All problems should be solved. Weights are reported in brackets.
- (ii) Each exercise indicates how the question should be answered, whether we expect you to explain in words and/or provide a graphical illustration.
- (iii) Restrict your answer to what the exercise asks for. Non-relevant information is given no credit. Full credit will only be given to figures and graphs that are fully explained, accurately presented, and properly labeled on both axes.

This exam consists of 4 main questions.

The weight of each question is indicated, and the maximum is 100 points.

Question 1. The target (25 points)

(a) **(10 points - figure and written answer)**

In class, we have discussed how pollution targets can be set by weighing costs and benefits. Draw a diagram with emissions E on the x-axis. Illustrate the marginal benefit of emissions and the marginal environmental damage. Indicate the efficient level of emissions, and explain briefly how it is determined.

(b) **(5 points – written answer)**

Under what circumstances can it be efficient to have zero emissions?

(c) **(10 points – written answer)**

In Chapter 1, S. Smith (2011) writes: *“Markets do many things well. They also do many things badly – in some cases disastrously. Economists refer to these cases as ‘market failure’ (...)”* Explain what externalities are, and why this type of market failure is especially relevant for environmental policy.

Question 2. Abatement (40 points)

In Figure 1 we illustrate a convex marginal abatement cost curve (MAC), as discussed in lecture 4.

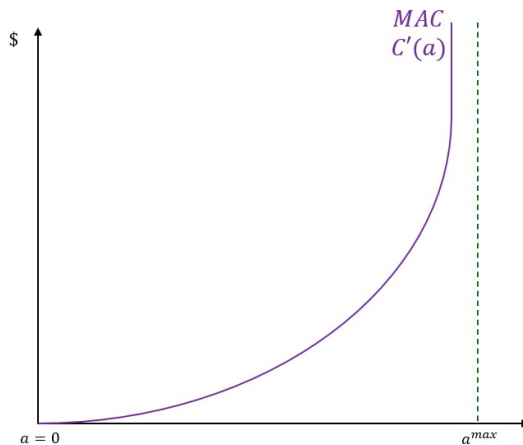


Figure 1: A convex marginal abatement cost curve

(a) **(10 points – written answer)**

What is abatement and what is the marginal cost of doing abatement? Give some examples of how firms can abate emissions, and explain why the MAC is most likely convex in some circumstances.

(b) **(10 points - written answer)**

What is a public good? Explain why the existence of public goods leads to market failure.

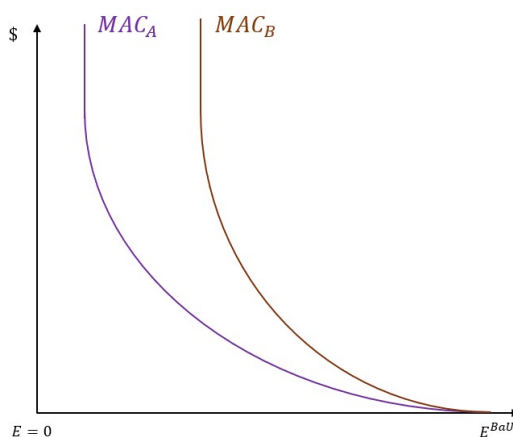


Figure 2: Marginal abatement cost curve for Firms A and B

Consider an industry consisting of two polluting firms, $i = A, B$, each with different abatement technologies. The two firms' MAC_i curves are illustrated in Figure 2.

(c) **(5 points - figure)**

Use figure 2 and draw an example of a command-and-control policy that requires the two firms to emit the same emission level. Mark total abatement costs.

(d) **(5 points - figure)**

Use figure 2 and draw an example of a uniform emissions tax t that requires the two firms to pay the same fee for each unit emitted. Mark how much each firm will emit and total abatement costs.

(e) **(5 points - written answer)**

What is the least cost theorem and why do economists favor economic incentive-based instruments and not direct quantity regulation?

(f) **(5 points - written answer)**

Can there be circumstances when command-and-control-policies are more appropriate than incentive-based instruments?

Question 3. Cost benefit analysis (25 points)

Consider a proposal to build a small-scale wind farm in an attractive natural area. The initial construction costs are estimated to be one million NOK, with annual maintenance of 5,000 NOK throughout the twenty-year lifespan. At the end of the period, the wind farm will need to be dismantled, and the site restored, at an expected cost of 300,000 NOK. The wind farm will produce electricity with a market value of 150,000 NOK each year operating. In Table 1 we have conducted a basic cost-benefit analysis (CBA) with a discount rate of $r = 3\%$.

Year	Discount factor $\beta = \left(\frac{1}{1+r}\right)^t$	Benefits	Present value of benefits	Costs	Present value of costs
0	1.00	kr -	kr -	kr 1,000,000	kr 1,000,000
1	0.96	kr 150,000	kr 144,231	kr 5,000	kr 4,808
2	0.92	kr 150,000	kr 138,683	kr 5,000	kr 4,623
3	0.89	kr 150,000	kr 133,349	kr 5,000	kr 4,445
4	0.85	kr 150,000	kr 128,221	kr 5,000	kr 4,274
5	0.82	kr 150,000	kr 123,289	kr 5,000	kr 4,110
6	0.79	kr 150,000	kr 118,547	kr 5,000	kr 3,952
7	0.76	kr 150,000	kr 113,988	kr 5,000	kr 3,800
8	0.73	kr 150,000	kr 109,604	kr 5,000	kr 3,653
9	0.70	kr 150,000	kr 105,388	kr 5,000	kr 3,513
10	0.68	kr 150,000	kr 101,335	kr 5,000	kr 3,378
11	0.65	kr 150,000	kr 97,437	kr 5,000	kr 3,248
12	0.62	kr 150,000	kr 93,690	kr 5,000	kr 3,123
13	0.60	kr 150,000	kr 90,086	kr 5,000	kr 3,003
14	0.58	kr 150,000	kr 86,621	kr 5,000	kr 2,887
15	0.56	kr 150,000	kr 83,290	kr 5,000	kr 2,776
16	0.53	kr 150,000	kr 80,086	kr 5,000	kr 2,670
17	0.51	kr 150,000	kr 77,006	kr 5,000	kr 2,567
18	0.49	kr 150,000	kr 74,044	kr 5,000	kr 2,468
19	0.47	kr 150,000	kr 71,196	kr 5,000	kr 2,373
20	0.46	kr -	kr -	kr 300,000	kr 136,916
Total:			kr 1,970,091		kr 1,202,586

Table 1: Cost-benefit analysis of the wind farm project, with $r = 3\%$ discount rate.

(a) **(5 points - written answer)**

Should this project, based on the CBA in Table 1, be recommended for approval/funding? Explain the criteria used for recommendation.

(b) **(5 points - written answer)**

Explain what discounting is and why we discount future values in a CBA. Comment on the present value of dismantling the wind farm in year 20, compared to the future value.

Suppose we have estimated the annual costs of compensating local residents for the visual impact of the windmills. These costs are calculated to be 58,000 NOK per year. The

environmental costs from the loss of habitats and ecosystems in this natural area are not valued in monetary terms and are therefore not included in the calculations. In a note to the CBA, we explain to the policymakers that these costs will be substantial and irreversible. The updated CBA is shown in Table 2.

Year	Discount factor $\beta = \left(\frac{1}{1+r}\right)^t$	Benefits	Present value of benefits	Costs	Present value of costs
0	1.00	kr -	kr -	kr 1,000,000	kr 1,000,000
1	0.96	kr 150,000	kr 144,231	kr 63,000	kr 60,577
2	0.92	kr 150,000	kr 138,683	kr 63,000	kr 58,247
3	0.89	kr 150,000	kr 133,349	kr 63,000	kr 56,007
4	0.85	kr 150,000	kr 128,221	kr 63,000	kr 53,853
5	0.82	kr 150,000	kr 123,289	kr 63,000	kr 51,781
6	0.79	kr 150,000	kr 118,547	kr 63,000	kr 49,790
7	0.76	kr 150,000	kr 113,988	kr 63,000	kr 47,875
8	0.73	kr 150,000	kr 109,604	kr 63,000	kr 46,033
9	0.70	kr 150,000	kr 105,388	kr 63,000	kr 44,263
10	0.68	kr 150,000	kr 101,335	kr 63,000	kr 42,561
11	0.65	kr 150,000	kr 97,437	kr 63,000	kr 40,924
12	0.62	kr 150,000	kr 93,690	kr 63,000	kr 39,350
13	0.60	kr 150,000	kr 90,086	kr 63,000	kr 37,836
14	0.58	kr 150,000	kr 86,621	kr 63,000	kr 36,381
15	0.56	kr 150,000	kr 83,290	kr 63,000	kr 34,982
16	0.53	kr 150,000	kr 80,086	kr 63,000	kr 33,636
17	0.51	kr 150,000	kr 77,006	kr 63,000	kr 32,343
18	0.49	kr 150,000	kr 74,044	kr 63,000	kr 31,099
19	0.47	kr 150,000	kr 71,196	kr 63,000	kr 29,902
20	0.46	kr -	kr -	kr 300,000	kr 136,916
Total:			kr 1,970,091		kr 1,964,354

Table 2: Cost-benefit analysis of the wind farm project, including environmental costs, with $r = 3\%$ discount rate.

(c) **(5 points - written answer)**

With the updated information and CBA in Table 2, would you recommend the project for approval/funding?

(d) **(5 points - written answer)**

Explain the methods that can be used to estimate the compensation to local residents.

(e) **(5 points - written answer)**

Suppose the wind farm is built near a disadvantaged area where many low-income families live. Housing values in this area may drop significantly as a result. Some would argue that it is especially unfair to impose this burden on a vulnerable group. Define Pareto efficiency and explain why an efficient allocation of resources may not necessarily be fair.

Question 4. Historical emissions (10 points)

We tend to focus on CO₂ emissions occurring today, which makes sense since it is in the present that we can take action to reduce them. However, historical contributions are a factor in the current consequences of climate change. In figure 3 we see a visualization of the historical contributions to CO₂ emissions from some countries.

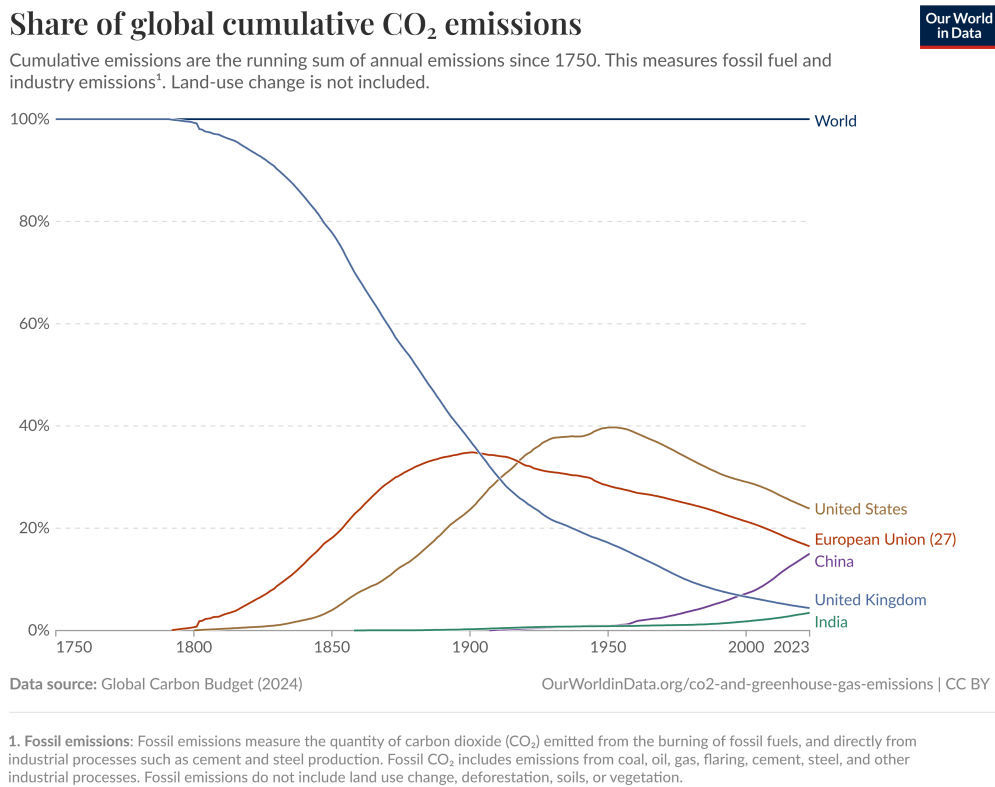


Figure 3: Share of global cumulative CO₂ emissions. Note: 'European Union (27)' is without UK, Norway, Switzerland and Iceland. Source: Our World in Data.

(a) **(5 points - written answer)**

Help us interpret Figure 3. What does it show, and what are the key takeaways?

(b) **(5 points - written answer)**

Explain the difference between a stock pollution damage and flow pollution damage, use examples related to CO₂.