ECN 275/375 Environmental and natural resource economics
Exercise set 4

Exercise 4.1 – Benefits and damages from emissions reductions

Let M denote flow emissions in tons. Total benefits from emissions in an economy are given by: $B(M) = -\frac{1}{2}M^2 + 10M - 9{,}5$ while total damages are $D(M) = 9\ln(M)$ in monetary terms.

(a) Find the marginal benefit and marginal damage functions.

(b) Graph total benefits, total damages, and net benefits in the same figure for emissions $1 \leq M \leq 12$. What appears to be the optimal emission level.

(c) Graph marginal benefits and damages for emissions emissions $1 \leq M \leq 12$. What is now the optimal emission level.

(d) Verify this by solving for the optimal emission level.

Exercise 4.2 – Investment in abatement technology

A firm has the following marginal abatement function: $MAC_1(m) = 10 - m$ where m denotes yearly emissions. Assume that marginal abatement costs cannot be negative.

(a) What is the firms current emissions? Justify your answer.

(b) A tax on emissions is introduced with the tax rate $t_a = 3$ € per emitted unit.

Suppose a new abatement technology becomes available, so that $MAC_2(m) = 5 - m/2$.

To use the new technology the firm needs to invest 100 €. For simplicity assume the lifetime of the technology is infinite (no new technologies that is better are foreseen), and that the real interest rate, r, is 5%.

(c) Suppose that the firm chooses to adopt the new technology. What would the firm's new emission level be with the emission tax rate $t_a = 3$ € per emitted unit?

(d) Does it pay for the firm to adopt this new technology? (justify your answer)

(e) Suppose the emission tax rate is increased to to $t_b = 3$ € per emitted unit? Does this change the firm's investment decision regarding the new abatement technology? If so, why?

(f) What conclusions do you make regarding the profitability in investments and emission tax rates. A simple graph may make your discussion easier to follow.