Assignment 2: *Case Study (CPR and Market Based Policy, week 2)*

Due Date: Friday, July 11ᵗʰ, 2025.

The paper "[Mining pollution in Greenland - the lesson learned: A review of 50 years of environmental studies and monitoring](...)" (Science of The Total Environment, 2022) reviews the environmental impact of mining in Greenland, beginning with the industrial extraction of cryolite in Ivittuut in 1854. However, environmental studies only began in the early 1970s, prior to the opening of the lead-zinc mine in Maarmorilik.

Three major legacy mine sites have contributed significantly to long-term environmental pollution, particularly with lead and zinc (see figure 1 below): (i) the cryolite mine in Ivittuut; (ii) the lead-zinc mine in Mestersvig; and (iii) the lead-zinc mine in Maarmorilik.

These sites have enabled decades of research into pollution dispersion, bioaccumulation, and toxicological effects under Arctic conditions. This research has informed the development of Environmental Impact Assessments (EIA) and monitoring guidelines for future mining operations.

Since the 1970s, monitoring of Greenland mine sites has been performed regularly at both operating and closed mines. In addition to the monitoring activities, numerous environmental studies have been carried out at the legacy mine sites over the years by different research groups. The paper concludes that the three legacy mines in Greenland caused metal pollution and areas are still polluted. In addition, monitoring must be site-specific, diverse, and take Arctic conditions into account.

Figure 1: location of former and current mine sites in Greenland

The paper emphasizes the importance of site-specific and diverse monitoring strategies to effectively link mining discharges to environmental impacts.

Instructions: Using the concepts discussed in Week 2, respond to the following questions.

1. **Externalities.** Considering the above paper, answer the following questions.
    a. Describe the externality problem presented in the paper.
    b. Who are the affected parties suffering from this externality?
    c. Can climate change exacerbate this problem? Please justify your answer.

2. **Policy Solutions.** During class we discussed different environmental policies that can address negative externalities.
    a. Identify a market-based policy that can potentially address the mining-related externality.
    b. What are the main challenges that a regulator might face when implementing this policy?

3. **Coasian Bargaining.** Consider a Coasian approach where parties are allowed to negotiate.
    a. Discuss at least three key issues that can hinder successful negotiation between polluters and victims.

4. **Strategic interaction.** Represent the strategic interaction between a polluter and a regulator. Consider a setting where the regulator does not have information about the environmental damage, which can be high or low with probability p and $(1-p)$ respectively, where $p \in (0,1)$.
    a. Clearly state your assumptions.
    b. Identify the optimal emission fee that induces the polluting firm to produce the socially optimal output.
    c. Interpret your results considering that the firm maximizes profits and the regulator maximizes social welfare.