

In-class exercise on aggregating MAC curves and the equimarginal principle

Let's return to the Upper Peninsula of Michigan, where we're pretending that there are exactly two power plants in operation, Marquette and Escanaba. Let's now say that both are coal-fired plants, but Marquette is an older company, with an aged plant, whereas Escanaba is a newcomer in the market and uses the state-of-the-art technology. Both firms employ locals, improve quality of life in the area by bringing jobs, cheap electricity, and heat to residents and local businesses. However, due to both plants' use of cheap, low-quality coal, the Upper Peninsula and downstream areas of the northeastern U.S. and eastern Canada are experiencing considerable damage from these plants' sulfur dioxide emissions. The Michigan House of Representatives must act!

Now assume that the marginal abatement cost curves for the two plants are:

$$MAC_{\text{Marquette}} = 7000 - 35e$$

$$MAC_{\text{Escanaba}} = 5250 - 35e$$

The Michigan House of Representatives has funded a study to determine the total damages caused to downstream communities from these two power plants.

The study estimates the damage function to be $MD_{\text{total}} = 20e_{\text{total}}$.

Your tasks:

- Graph the MAC curves for each plant, as well as the total (aggregate) industry MAC curve.
- Taking these finds into consideration, approximately how much reduction in emissions should a sound acid rain prevention law dictate? What would be the total costs for U.S. and Canadian society associated with implementing this law?
- **Equiproportionate vs. equimarginal reductions:** If equiproportionate reductions were introduced, how much would each firm abate? What about equimarginal reductions? Which solution would be cheaper for each power plant in particular? Which solution would be cheaper for society as a whole?
- **Bonus question:** Suppose that Escanaba has introduced still newer technology, leading to even lower marginal abatement costs. Draw an arbitrary new MAC curve for Escanaba reflecting this - and consider the effects of this new curve on overall abatement and damage costs for society as a whole assuming equimarginal reductions are applied.