

Topic 11: Air Pollutions

“Setting-the-scene’ information provides a brief introduction of the problems of air pollutions, the connection with climate changes and examples of clean air measures to reduce emissions. This topic will provide more insights on economic approach to air pollution controls.

11.1 Command-and-control (CAC) policy framework

This is a historical approach to air pollution control which primarily depended on emissions standards. Under this approach, the National Ambient Air Quality Standards (NAAQS) is established to set legal ceiling on the allowable concentration of the pollutant in the outdoor air averaged over a specified time period. Two types of standards are:

- Primary standard – designed to protect human health which had the earliest deadlines for compliance and required a sufficient level to be set to protect the most sensitive groups of population without considering the costs to do so.
- Secondary standard – designed to protect other aspects of human welfare such as houses, monuments, vegetation, etc.

Is this approach efficient?

The ambient standards will be efficient if the marginal benefit equals to the marginal cost, depending on five aspects of the standard-setting process:

- 1) **The threshold concept:** For primary standard, health threshold is set, defined with a margin of safety sufficiently high that no adverse health effects would be suffered by any member of the population as long as the air quality was at least as good as the standard. Is the threshold valid? – evidence suggests that adverse health effects can occur at pollution levels lower than ambient standards.
- 2) **The level of the ambient standard:** Considering efficiency, standard would be set to maximize the net benefit, which includes a consideration of costs as well as benefits. The current policy explicitly excludes costs when considering the ambient standard setting.
- 3) **Uniformity:** Standards apply to all parts of the country, not considering the number of people exposed, the sensitivity of the local ecology, or the costs of compliances in various areas
- 4) **Timing of emissions flows:** The timing of emissions is important. The economic efficiency point of view suggests the need to tailor the degree of control to the circumstances (stringent control over meteorological conditions and less control under normal conditions). The reliance on a constant degree of control raise compliance costs, in particular when it requires a high degree of control.

- 5) **Concentration versus exposure:** Ambient standards are currently defined in terms of pollutant concentrations in the outdoor air. However, human exposure to health effects is determined by the level of air pollutant's concentration but also the number of people exposed, and the amount of time spent in each place. For example, in the US., about only 10% of population's hours are spent outdoors, indoor air becomes more important in designing strategies to improve the health risk of pollutants but very little attention has been focused on indoor air pollution.

Is this approach cost-effective – whether the ambient standards are being met in the least costly manner possible?

The cost-effectiveness of CAC depends on local circumstances such as prevailing meteorology, the spatial configuration of sources, stack heights and the degree to which costs vary with the amount controlled. This requires complex modelling to compare the costs of the CAC allocation costs to the lowest cost of meeting the same objective of each study. The allocation of responsibility among emitters for reducing pollution has led to high control costs than necessary to achieve the air-quality objective. Stringent controls usually result in excessive control costs when the policy is lack of temporal flexibility. Traditional approach was not able to identify enough appropriate technologies to produce sufficiently stringent reductions.

11.2 Market-based approaches

Market-based approaches (see handout in economics of pollution control topic for more details) are more cost-effective and implemented around the world.

Emission charge: Economists typically envision two types of emissions charges.

- An efficiency charge – designed to force the polluter to compensate completely for all damage caused.
- A cost-effective charge – designed to achieve a predefined ambient standard at the lowest possible control costs.

Examples of emission charge implementation could be drawn from experience in France and Japan.

- In Japan, the emission charge was based on damages to human health implemented through the Law for the Compensation of Pollution-Related Health Injury. Emission charge on sulfur dioxides (SO₂) is determined by the administrative process and based on the revenue needs for funding compensations to victims of air pollution. Unexpectedly high charge rates are necessary to raise sufficient revenue for the compensation and provide quite an incentive effect on emissions reduction.

- In France, air pollution charge was designed to encourage the early adoption of pollution control equipment. The charge is levied on all industrial firms having a power-generating capacity of 20 MW or more or industrial firms discharging over 150 metric tons of taxable pollutants. The revenue from the charges are used to subsidize installations of pollution control equipment.

Evidence suggest that emission charge is more cost-effective in reducing SO₂ emissions, resulting in more equalized marginal costs which is a condition for cost-effectiveness, than CAC which raises the marginal cost of additional control than necessary. Although the emission charge is cost-effective, it may not be popular, particularly in heavily polluting power plants as emission charge would require the company to also pay for uncontrolled emissions such as acid rain. The additional expense of paying emissions charges may outweigh the savings from lower equipment and operating costs achieved because of emission charge. This dilemma is resolved by adopting an emissions trading system (e.g., sulfur allowance trading program) designed to complement, not replace, the traditional CAC.

Cap-and-trade markets: The allowance prices respond automatically to changing market conditions.

- Example is “California’s Regional Clean Air Incentives Market or RECLAIM”, which has almost 400 industrial polluters participating with annual allocation of pollution limit for nitrogen oxides and sulfur dioxide. Polluters are allowed great flexibility in meeting these limits, including buying credits from other firms that have controlled more than their legal requirement. The burden of identifying the appropriate control strategies has shifted from the control authority to the polluter in this case.

11.3 Regional pollutants

While local pollutants damage the environment near the source of emissions, regional pollutants can cause damage some distance away. Regional pollutants can impose external costs to impose proper incentives to implement efficient control measures, when the influence of pollutant zones extends beyond local boundaries. Example of this case is acid rain. It is difficult to find the solutions to acid rain problems when those bearing the costs of further control are not those who will benefit from the control. For example, in the U.S., the acid rain legislation was delayed due to opposition of some states due to its potential effects on increased electricity price, employment loss in high-sulfur, coal-mining industry. These barriers were overcome by the sulfur allowance program instituted through the 1990 Clean Air Act Amendments.

Reference: [TL] – Tietenberg, T. and Lewis, L. Environmental Natural Resource Economics, 2015 (10th edition), Pearson, Chapter 15.