The Clean Air Mercury Rule:
Understanding the Controversy

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1. Introduction

The Environmental Protection Agency's Clean Air Mercury Rule (CAMR), which outlines a cap-and-trade system for regulating mercury emissions, has been causing controversy since its March 2004 proposal. The cap-and-trade type of system, in which polluters trade pollution credits at market rates, has been applied to many other pollutants in the US and around the world, and has generally met with great success and public support. However, in May 2005, the Environmental Protection Agency (EPA) received petitions from five environmental groups, 14 states, and four tribes requesting a reconsideration of the rule. EPA has not granted a stay of the rule, but has extended the public comment period for a review of the key issues.

What caused so much outcry in the case of CAMR, and not for other pollutants? Why was the rule finalized by EPA in the face of these protests? This paper will examine the unique properties of mercury emissions, the potential gains and drawbacks of applying cap-and-trade regulation, and the political perspectives of the involved actors, in order to demonstrate the many facets of the mercury regulation issue and the motivations which shaped the current policy.

2. Working with Mercury

When examining policy pertaining to mercury emissions, it is necessary to consider three things: how mercury is produced and emitted, the effects of those emissions, and the availability of technology to reduce or eliminate those emissions. Regulations which mandate certain actions on behalf of polluters must take into account chemical realities of that pollutant in addition to the administrative possibilities available to industry.

2.1 Mercury Production and Emission

Mercury is often released into the atmosphere as one of many chemicals in the smoke produced by burning coal. Roughly half of mercury emissions in the US are from power plants in this manner (EPA), while most of the remaining portion comes from the incineration of waste materials containing mercury, such as thermometers, certain plastics and colorings (CBF). These emissions occur across the entire country. Some of the gaseous emissions dissipate in the atmosphere and travel around the world (Anderson).

While it can also be deposited directly into bodies of water, even gaseous mercury eventually finds its way back to earth with the rain. When it falls to the ground, microorganisms in the soil metabolize some of it into the bioaccumulative and toxic compound methylmercury. With the rainwater, the chemicals are washed through the soil and run off into rivers and lakes (EPA).

2.2 Mercury's Effects

Any pollutant in air, water, or soil is ingested by organisms which need to be consuming nutrients instead of that pollutant. To some extent, mercury emissions have detrimental effects on all organisms, because they obstruct the normal metabolic processes of those organisms. The effects of mercury, however, have such grave effects on human health that this general type of harm pales in comparison (UNEP).

Atmospheric mercury generally occurs in relatively low concentrations. This is in part because the gas can dissipate freely, but also because much of the emitted mercury precipitates from the atmosphere. The pollutant's main effects, therefore, occur as a result of methylmercury in water. Fish in the water ingest the methylmercury, which builds up in their body tissue. This is harmful to the fish themselves, and continues to wreak havoc as the fish are consumed by humans. 41 states and the Environmental Protection Agency have issued over 2,000 advisories against the consumption of certain species of fish from certain areas, based on which fish have developed the highest tissue concentration of mercury (Anderson).

The United Nations Environment Programme's 2002 report on mercury advises, "Methylmercury is a potent neuro-toxin, hence human exposure to methylmercury is clearly unwelcome and should be regarded with concern." Methylmercury's effects are some of the worst, since it is toxic to the human nervous system as well as the kidneys and liver. Fetuses and young children are exposed to the greatest risk from methylmercury ingestion, since the neurotoxic effects impair brain development. Adults are still at risk, though they are less likely to suffer severe neurological damage. Other effects of methylmercury consumption include damage to sense perception, such as sensation disturbances or loss of peripheral vision, as well as muscle coordination problems (EPA).

2.3 Emission Reduction Technology

It is possible to burn coal in "better" ways – ways that result in less mercury emissions. Fortunately, some of the same technology that reduces the output of sulfur dioxide, another pollutant which has been regulated by cap-and-trade, reduces mercury emissions as well. Scrubbers, fluidized bed boilers, and other recently developed and developing technology allow coal plants to achieve higher heat rates (that is, to generate more power per unit of coal burned) while simultaneously polluting less.

But at what cost are these new technologies available? This depends on several variables which differ from plant to plant (Ellerman). The cost of retrofitting a large, old factory with modern technology is clearly higher than the cost of tweaking a relatively new and/or small plant in order to meet a slightly stricter emissions allowance. In addition to size and age, the cost of implementing new technologies could depend on its location. A generating unit in a remote, rural location – as highly polluting plants often are – could incur additional costs of transportation when trying to bring in new technology. Sensitive or elaborate equipment would be expensive to properly ship over long distances. These are only three variables; the unique circumstances of a particular plant could influence costs in other ways as well.

The means to reduce mercury emissions exist, but an investment in the necessary technology is not necessarily economically viable for every firm. Cap-and-trade regulation is intended to compensate for the differences between firms while cutting harmful pollution. How, exactly, does such a system work?

3. The Ins and Outs of Cap-and-Trade

Cap-and-trade is only one of many market-based approaches to emissions regulation. Regulators have turned to these economic methods in recent years in the hopes that the "invisible hand" which guides us to the correct price for goods and services will also help us find the most efficient solution to environmental problems. With a cap-and-trade system, however, it is perhaps easiest to see market forces at work.

The basic mechanism is strikingly simple. Regulators decide upon a maximum amount of pollution for a region. That amount is divided up into units, credits for which are distributed in some regular way among polluters. A plant may not produce more emissions than the amount for which it has credits. These credits are tradable just like any other commodity, and their price is set by the market. If a plant's costs of retrofitting more environmentally-friendly machinery are very high, it may be more profitable for them to purchase additional pollution credits to supplement the amount allotted to them. Conversely, businesses with low remodeling costs might find it more economical to install new machinery and reduce their emissions, selling any unneeded credits to others. In this way, total emissions are reduced to the amount set by regulators, and they are reduced in the most economically efficient way, maximizing profits (Carlson et al. 2000).

Future adjustments to emissions levels are easy for regulators to make. In order to decrease total emissions, the number of available credits can decrease over time. Publishing plans of this sort at the commencement of a cap-and-trade policy will allow businesses to take into account the return on investments in environmentally-friendly technology compared to the probably-increasing price of pollution credits. With greater information, plants can make more accurate determinations of their costs, and can thereby choose the strategy that leads toward the most efficient outcome.

A cap-and-trade system for mercury was announced as part of the EPA's Clean Air Mercury Rule, which lays out acceptable levels of emissions for each of the fifty states as well as two tribes. Under CAMR, it is mandatory for "each state [to] submit a State Plan revision detailing how it will meet its budget for reducing mercury from coal-fired power plants" (EPA). The Environmental Protection Agency's model plan uses cap-and-trade, and while it is not necessary for every state to adopt the model plan, EPA expects most to do so.

3.1 Previous Applications of Cap-and-Trade

One major factor in the choice of cap-and-trade for the CAMR model program was the success it demonstrated when applied to other pollutants. Economists and environmental activists alike have touted cap-and-trade as an innovative and valuable tool in the regulator's arsenal against pollution. Many of the reasons for the system's efficacy in the context of other pollutants continue to apply in the case of mercury (Ellerman).

A key example of past cap-and-trade use is the sulfur dioxide (SO2) regulation in Title IV of the 1990 Clean Air Act Amendments; it has been in effect for many years, resulting in a great deal of data, and many members the environmental economics community have done detailed analyses to understand its implications. The 1990 legislation announced a cap-and-trade program which was separated into two phases: Phase I, which ran from 1995 to 1999 and applied to large power generators (at least 100 MW capacity), and Phase II, which was applied to all units generating at least 25 MW from 2000 on.

The plants which produce the greatest output also pollute the most. One would expect Phase I to yield large reductions in emissions simply because of the relevant scale. However, research indicates that the reduction which occurred in 1995 – the first year in which the policy was applied – was substantially more than was necessary to meet the constraints (Ellerman and Dubroeucq 2004, 11). It appears that forward-looking firms overcompensate in the first year such a system is implemented. Not only was this first-year effect an unexpected plus, but the reductions also happened in exactly the areas where emissions were previously at their highest levels: the Midwest.

Why did the abatement occur where it was desired? The increased availability and attractiveness of lower sulfur coals in the Midwest provides part of the answer, but an equally important cause is the changed incentive structure of cap-and-trade programs. Deep abatement technologies, such as scrubbers, are more economic at units where a lot of sulfur can be removed, that is, at large units burning high sulfur coal, which in this instance were located in the Midwest (Ellerman 2003, 4).

Thus, based on the results of Phase I, it appears reasonable to expect that plants emitting large amounts of mercury would have some of the strongest incentives to upgrade their facilities, since a small investment in technology would affect a relatively large amount of emissions.

Phase II provided further information about the application of cap-and-trade. Phase I allowed credits to be accumulated and used later; it was initially unclear whether the banking behavior noted during Phase I was rational. Economic theory predicts that banking, if properly employed, ought to enable firms to effectively disregard yearly changes in allowance rates. Studies indicated that this theory was confirmed (Ellerman 2003, 8), and that banking was not excessive, but rather "reasonably efficient" – firms generally banked credits only when necessary (Ellerman and Montero 2002, 4). In addition to the banking issue, Phase II also resolved unanswered questions about the implications of the policy on new generating units, which were not allocated any permits. The data reveal that "nearly all of the zero-allowance units are [ones] that emit little SO2" (Ellerman 2003, 13), implying that the policy incentivizes the construction of more environmentally-friendly generators. Again, these effects seem just as likely to apply to mercury as to SO2; one may suppose that banking and the inclusion of new generating units would pose no problems in a mercury cap-and-trade system.

Cap-and-trade has also been applied to nitrogen oxide (NOx) with similar success, though on a more voluntary basis. Several states, under the direction of the Ozone Transport Commission, have initiated regional trading programs for bankable permits (Hatch 175-76). Confirming the general model behind cap-and-trade, these programs take advantage of economic incentives to improve air quality.

In other countries, cap-and-trade programs have received great support. Notably absent from US regulations but well-established in the European Union and elsewhere is a system to regulate greenhouse gas emissions (GHGs). The United Kingdom has been trading carbon dioxide (CO2) permits since 2002. Although theirs is a voluntary system, and a young one at that, already it has demonstrated that it encourages a high volume of permit trades, which indicates that firms have the ability to make the arrangements which would optimize their circumstances. New South Wales, Australia began its GHG permit trading plan in 2003, and the European Union created theirs last January (Lecocq 2005, 25-27). In 2002, Slovakia, China, the Netherlands, and Chile initiated or prepared for future SO2 and NOx cap-and-trade markets (Ali and Yano 2004, 11). While none of these markets have been in place long enough to demonstrate clear successes, the widespread adoption of the cap-and-trade structure suggests that policymakers generally agree that the model is useful in reducing emissions.

Of course, any reasonable system of regulation – taxes on emissions, strict command-and-control limits, etc. – would improve environmental conditions. The unique benefit of cap-and-trade according to its supporters is that it achieves environmental improvements with minimal costs. The cost data available are largely from US cap-and-trade initiatives rather than from foreign programs; nevertheless, studies of this data reveal answers to questions about how low costs actually are, and what those costs genuinely reflect.

Permit costs were observed to be much lower than originally predicted by regulators. There has been some dispute over the reasons for the lower costs. It is not unreasonable to suppose, as the regulators did, that the market price for a pollution permit should equal the cost of installing regulation-compliant machinery to reduce emissions by the amount allowed by one permit. However, the prices for SO2 permits were far below the marginal cost of upgrading technology. Some interpret this, as before, as a gross overestimate in the original plans for the program. However, this ignores several factors that could lead to low permit prices. These factors include perverse incentives, such as those which arose from awarding additional permits to firms which installed irreversible, expensive technology even when economically inefficient. If a plant's decisions are no longer governed by economic efficiency, the cap-and-trade model cannot be expected to apply. Another potential cause for low permit prices is the unaccounted-for variable of local regulations, which could be more strict than the federal cap-and-trade system would have required. In such circumstances, local statutes could require plants to reduce their emissions to some set level, which would cause some of those plants to sell now-excess permits which they would otherwise have used. This increases the supply of permits beyond what the economic model would dictate, thus lowering the price. It is evident that the low permit cost in a theoretical cap-and-trade system is not quite as low as the cost turned out to be in the case of SO2 regulation (Montero and Ellerman 1998).

Even though permit prices were low because of external factors rather than properties inherent in the cap-and-trade model, careful analysis still reveals that even when accounting for those factors, prices were on the low end of the expected range (Smith, Platt and Ellerman 1998). The fact that these prices do correspond with theoretical predictions implies that cap-and-trade can bring the economic efficiency that its supporters contend.

In general, previous applications show that cap-and-trade regulation is on the whole more efficient than the command-and-control style "maximum achievable control technology" (MACT) standards. The Title IV regulations were found to be "more effective in reducing emissions during the eight years it has been in effect than the conventional, source specific, prescriptive regulation had been in reducing emissions in the then years preceding 1995" (Ellerman and Dubroeucq 2004).

3.2 Criticisms of Cap-and-Trade

The central criticism of cap-and-trade as a program does not pertain to the theoretical effectiveness of the system. Instead, it questions the situations in which such a system ought to be employed. There are some circumstances, say critics, in which cap-and-trade encourages a more environmentally detrimental outcome than strict MACT regulation.

Under cap-and-trade, regulators set and control the total pollution level of a large region. Pollution becomes distributed within that region based on the economic incentives for each firm. With no restrictions on pollution levels for a particular plant other than what it can obtain permits for, a plant may emit many times the amount of emissions considered to be within a safe range. With atmospheric pollutants like SO2 and NOx, this is not a large problem. Wind will transport the chemicals far from the source, and there will be little if any detrimental effect to the immediate region around the highly-polluting plant. However, this is not the case for all pollutants. Even though a great deal of mercury pollution is emitted in gas form, the better portion of it persists locally, precipitating from the atmosphere with rain or snow.

A worst-case scenario is easy to imagine: several plants in the same locality, of similar type, all finding that the most economically efficient action for them to take under a cap-and-trade policy is to buy up more pollution credits and emit more mercury. Each plant alone could be emitting many times the level which would have been enforced under a MACT system, and the emissions from all plants would be accumulating in the immediate local environment. The immense toxic risk that such a scenario would pose is what lends the name "hotspot" to the circumstance.

If this criticism is valid, it severely undermines the appeal of cap-and-trade. Without ever contending with the benefits championed by proponents of the policy, it highlights a major – and potentially incorrect – assumption built into it: that reducing the total amount of emissions is the primary goal of regulation. While cutting total pollution is obviously a good thing, it is important to recognize the fallacy in equating the reduction in average pollution over a large area to the creation of a uniform distribution of pollution over that entire area. With primarily atmospheric pollutants, these outcomes are practically equivalent, since wind diffuses any hotspots which might arise. Yet in the cases where such diffusion cannot occur, the benefits of the latter situation —in which it would be possible to reduce emission levels to within human tolerance levels —appears to be preferable to the dangers of hotspots.

Some important questions, however, are left unanswered until the policy is actually realized and the results are observed. How realistic are these fears of hotspots? In the case of SO2 regulation under Title IV, huge reductions in emissions did in fact occur at the highest-polluting plants. Such an outcome is possible when applied to mercury, but it is nearly impossible to tell before the policy has been in place for several years. Moreover, though, how severe would these hotspots actually become? Is it even a reasonable assumption to make, that hotspots would occur? It is possible that the economic incentives of cap-and-trade – especially taking into account the decreasing amount of permitted emissions over time – would eventually encourage reductions everywhere. Before the policy is actually implemented, it is difficult to determine the exact incentive structure, and whether the reductions would occur soon enough to abate serious health risks.

Another criticism of cap-and-trade policy is that the permit system is regressive. Some suggest that the allocation of permits to previously existing, highly polluting plants unfairly prejudices the system against new generating units while grandfathering in the pollution that happened to exist before the policy was implemented (Parry 2003). This line of argumentation must stand up to the previously-discussed instances in which large generators vastly reduced their emissions despite being allocated the permits as well as the issue of cap-and-trade policies incentivizing the creation of more environmentally friendly new units (Ellerman 2003). The possible regressive aspect is nevertheless another issue to be taken into account when implementing such a system.

Ultimately, the expected benefits of a mercury cap-and-trade system must be weighed against the potential costs.

> ... [E]mission reductions for mercury would surely decline almost everywhere, but the decline may be greater at one location than at another, leaving some apparent peaks at plants where there are fewer reductions. Critics have labeled these locations as potential hotspots and argued this is unacceptable. But, whether the situation would be worth it really depends on whether the prospect of cost savings improves the political prospects that a policy—and significant overall reductions—would be passed (Burtraw and Krupnik 2003).

This weighing of pros and cons is ultimately left up to the Environmental Protection Agency. What mechanisms underlie EPA's decision-making process? While we certainly cannot know for sure, we can make educated guesses based on the motivations the Agency faces.

4. Political Motivations

In order to understand the policy decisions in light of information about mercury and cap-and-trade systems, it is important to examine the political interests behind the groups involved in that policy.

At the state or local level, concerns about possible hotspots are most prominent. Although the state would benefit from an overall reduction in mercury emissions, on a smaller scale the harm of a community with extremely high mercury concentrations is much more potent than it might appear on the national scale. For example: the Chesapeake Bay plays an enormous role in the culture and economy of Maryland. Many highly-emitting plants are situated on the Chesapeake, resulting in fish consumption advisories for the region and health problems for local residents (Saks). If a policy allegedly designed to solve mercury emission problems does not actually require these plants to conform to standards which resolve the health issues, it is natural for the Maryland government and local environmental activists to oppose the policy. This is exactly the stance that both the state of Maryland and the Chesapeake Bay Foundation – along with 14 other states, four tribes, and five other environmental groups in similar situations – took when they filed a lawsuit against the Environmental Protection Agency this past May (CBF). The Chesapeake Bay Foundation announced in its 2004 comments in response to EPA's Notice of Proposed Rulemaking on mercury:

Recent studies have indicated that local atmospheric sources of mercury can have local impacts. ... [R]esults of atmospheric modeling efforts for the Chesapeake Bay watershed have suggested that a large portion of the mercury generated locally deposits in the watershed, presumably as reactive gaseous mercury. As noted above, Maryland is already a "hotspot in the country ... . This problem could be exacerbated under a cap and trade program, if higher emissions are allowed in the mid-Atlantic region (CBF 2004).

The major criticism of cap-and-trade policy noted above, that hotspots can be exacerbated without regulation, appears most compelling to state or local advocacy groups.

The federal government, on the other hand, tends to look at what policy would create the best outcome for the nation as a whole. In the status quo, some regions of the United States face high local concentrations of mercury. The track record of cap-and-trade systems indicates that it would be useful in reducing the overall amount of pollution in the nation, and that it is likely to reduce pollution in some of the hardest-hit areas. Even if some hotspots occur, it is unlikely that they will exist at every area currently having problems with mercury. There will probably be fewer hotspots than under the current system, so using the policy would achieve a greater good for a larger population.

Obviously, EPA as a federal agency would lean naturally toward the federal perspective on this issue. The Agency's mission statement explains that they are "working for a cleaner, healthier environment for the American people." Because they focus their evaluations on the needs of America as a whole, they have chosen to stand by CAMR even as local organizations protest it.

5. Conclusion

Pollution regulation design is a complex endeavor. In addition to taking into account the chemistry of the pollutant and the technical aspects of polluting and eliminating pollution, it is important to understand the economic implications of the regulations and the incentive structure it creates. It is also necessary to examine carefully the goals of the policy. Is it intended to create an average effect which is better than the status quo, or to ensure that lower level of pollution somewhat uniformly across the region?

When we examine political motivations, the policy of EPA's Clean Air Mercury Rule becomes more clear. The benefits from implementing a cap-and-trade system appeal to national interests, despite the possible downside on a local scale. While state and local groups file suits and protest, the federal authority of the Environmental Protection Agency is standing firm on its stance that a cap-and-trade program for mercury emissions is the best for the nation.

References

Ali, Paul A.U. and Kanako Yano. Eco-Finance: The Legal Design and Regulation of Market-Based Environmental Instruments. The Hague: Kluwer Law International, 2004.

Anderson, John W. "Mercury's Toxic Emissions and How to Reduce Them." http://www.rff.org/rff/News/Features/Mercurys-Toxic-Emissions-And-How-to-Reduce-Them.cfm. Accessed 10 October 2005.

Burtraw, Dallas and Alan J. Krupnick. "A Mercurial Reaction on Mercury?" http://www.rff.org/rff/News/Features/A-Mercurial-Reaction-on-Mercury.cfm. 12 December 2003. Accessed 11 October 2005.

Carlson, Curtis, et al. "Sulfur Dioxide Control by Electric Utilities: What Are The Gains From Trade?" Resources for the Future Discussion Paper 98-44-REV. April 2000.

Chesapeake Bay Foundation. "CBF Position on Mercury Contamination." http://www.cbf.org/site/PageServer?pagename=resources_facts_mercury_ Chesapeake_Bay. Accessed 13 October 2005.

Chesapeake Bay Foundation. "Testimony of the Chesapeake Bay Foundation in Opposition to the Interstate Air Quality Rule and the Utility Mercury Reductions Rule." Presented to the United States Environmental Protection Agency. Philadelphia: 25 February 2004.

Ellerman, A. Denny. "Lessons from Phase 2 Compliance with the U.S. Acid Rain Program." WP-2003-009, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research. May 2003.

Ellerman, A. Denny. Senior Lecturer, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research. Correspondence with author, September 2005.

Ellerman, A. Denny and Florence Dubroeucq. "The Sources of Emissions Reductions: Evidence from U.S. SO2 Emissions from 1985 through 2002." WP-2004-001, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research. January 2004.

Ellerman, A. Denny and Juan-Pablo Montero. "The Temporal Efficiency of SO2 Emissions Trading." WP-2002-003, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research. September 2002.

Environmental Protection Agency. "EPA: Mercury." http://www.epa.gov/mercury/. 26 September 2005. Accessed 13 October 2005.

Hatch, Michael T., ed. Environmental Policymaking: Assessing the Use of Alternative Policy Instruments. Albany: State University of New York Press, 2005.

Lecocq, Franck. "State and Trends of the Carbon Market—2004." World Bank Working Paper No. 44. Washington, DC: The World Bank, 2005.

Montero, Juan-Pablo and A. Denny Ellerman. "Explaining low sulfur dioxide allowance prices: The effect of expectation errors and irreversibility." WP-98011, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research. September 1998.

Saks, Joshua. Legal Assistant, Chesapeake Bay Foundation. Correspondence with author, 28 September 2005.

Smith, Anne E., Jeremy Platt and A. Denny Ellerman. "The Costs of Reducing Utility SO2 Emissions – Not As Low As You Might Think." WP-98010, Massachusetts Institute of Technology Center for Energy and Environmental Policy Research. August 1998.

Parry, Ian W.H. "Are Emissions Permits Regressive?" Resources for the Future Discussion Paper 03-21. June 2003.

United Nations Environment Programme. "Global Mercury Assessment." Geneva: Inter-Organization Programme for the Sound Management of Chemicals, 2002.

Works Consulted

"Air Pollution Prevention and Control." U.S. Code. 2005 ed. Title 42, Sec. 7661-7661f.

Fischer, Carolyn. "Combining Rate-Based and Cap-and-Trade Emissions Policies." Resources for the Future Discussion Paper 03-32. May 2003.

New York Public Interest Research Group. "NYPIRG's Energy Project: The Facts on Mercury." http://www.nypirg.org/energy/mercury.html. Accessed 13 October 2005.

Stavins, Robert N. "Environmental Economics." Resources for the Future Discussion Paper 04-54. December 2004.

Toman, Michael. "Understanding the Design and Performance of Emissions Trading Systems for Greenhouse Gas Emissions: Proceedings of an Experts' Workshop to Identify Research Needs and Priorities." Resources for the Future Discussion Paper 03-33. May 2003.