

Chicago Fed Letter

A market based approach to cleaner air

Several new programs aimed at protecting the environment and human health have been initiated under the 1990 Amendments to the Clean Air Act (CAA). According to official estimates, the annual direct costs of these regulatory programs will be around \$20 billion but other estimates are much higher. In addition to the direct costs of abatement, the economy will undergo difficult adjustments to changes in prices and wages. Some of these costs of pollution control will be mitigated by the recent adoption of a different approach to environmental regulation. The new Title IV of the 1990 CAA Amendments has introduced the market based approach for controlling sulfur dioxide (SO₂) emissions instead of continuing to rely on the so-called "command and control" approach which had been proposed in the 1980s for acid rain control. Title IV can potentially serve as a model for future market based pollution control programs, but this Title has unique features. The *Chicago Fed Letter* describes the market based approach to pollution control and assesses the new acid rain legislation as a prototype.

Market based versus command and control

Using the command and control approach, regulators have often required that industry apply the best available pollution control technologies to their industrial processes as a means of achieving the lowest levels of air toxic emissions or effluent water discharge. The obvious costs of this system are the large regulatory management systems which are needed to determine the best technology and to monitor and

administer the flow of regulations and permits. In addition, this approach can be very costly by not allowing firms the flexibility to discover and apply the least cost methods of lowering pollution. Such regulation may discourage the development of processes which lower pollution further; industry would be reluctant to develop such technologies for fear that, regardless of their cost, the new technologies would be mandated for their operations. Indeed, new technology mandates could be especially costly in those instances when the new technology must displace a firm's very recent investment in equipment.

In an effort to offset some of the financial burden on existing industry, command and control regulations are often applied only to new sources of emissions. However, new source performance standards (NSPS) have often been cited as encouraging the continued use of existing industrial equipment beyond the point at which it would otherwise have been economic to replace or update the equipment. Hence, NSPS regulations may lower investment in otherwise promising ventures.

In contrast, market incentive systems begin with an overall level or goal for emissions or discharge. Optimally, such a goal is determined by considering the costs of abatement in relation to the potential benefits to society. Subsequently, incentives are put into place to achieve the overall environmental goal in the least costly fashion. Under market incentive programs, firms are awarded the rights or allowances to pollute, with the distribution of allowances following some fair or equitable considerations. The owners of allowances are then free to use the allowances as a pollution permit or,

alternatively, to reduce their rate of pollution while selling their excess rights to pollute to other parties. In this way, those firms that can control their emissions at least cost have the (profit) incentive to do so, while those firms who would otherwise find it unduly burdensome to restrict emissions can purchase the right to pollute. Market incentive systems have better long run properties as well; they encourage the development of more cost effective control technology and investment in cleaner processes and bring forth competitive suppliers in the marketplace.

Acid rain control of coal-fired electric utilities

The three major pollutants regulated under Title IV on acid deposition control, as well as under Title I on nonattainment areas and other CAA regulations, are nitrogen oxides (NO_x), volatile organic compounds (VOC), and sulfur dioxide (SO₂). The Midwest's share of the nation's total emissions approximately mirrors its share of economic activity with the exception of SO₂. The region emits sulfur dioxide at a rate two-thirds higher than its share of economic activity largely because its electric utilities tend to heavily rely on high sulfur coal which is locally mined (see Table 1).

Title IV creates a market incentive system based on SO₂ "emission allowances." An allowance must be obtained and expended for each ton of SO₂ emitted. Once allocated by the U.S. EPA, the allowances can also be traded among companies rather than expended for emissions. In addition, allowances are tradable between years, a concept called "emission banking" whereby allowances can be retained as a reserve for future use as a hedge

1. 1985 Midwest emissions and GSP

Pollutant or economic activity	Share in Midwest by sector (%)			
	All	Utility	Transportation	Industrial and other
SO ₂	37.3	42.9	16.4	25.1
NO _x	24.2	30.9	22.6	17.6
VOC	21.6	22.2	21.6	21.6
Gross state product (GSP)	21.5			

against higher future emission allowance prices or even for purely speculative purposes.

Emissions trading and banking provide cost savings over mandatory technologies in achieving long run environmental goals. These gains are achieved because, rather than adopting mandatory control technology or abandoning production altogether, firms gain the flexibility to reduce pollution by choosing from among the cheapest technologies, alternative fuels, and alternative time schedules in lowering emissions. Factors which will affect the least cost choice are a plant's design suitability for retrofit, land availability, economies of scale in abatement technology, access to alternative fuels including differences in competition in transportation to power plants at different locations, and alternative local air quality requirements.

Gains from trade can be illustrated with a simple example. Suppose 100 tons of emission reduction are needed to meet the environmental objective. Suppose plant A has a marginal abatement cost (MAC) of \$300 per ton and plant B has a MAC of \$500 per ton. Under a uniform rollback policy each plant would reduce emissions 50 tons at a total cost of \$40,000. However, suppose each plant is issued 50 tons of tradable emission allowances. Then plant A, which has a lower MAC, can sell its allowances to plant B for, say, \$400 per ton. Plant A then reduces emissions 100 tons for \$30,000, and gains \$20,000 in revenue from the sale of allowances. Thus, the net cost to A of the reduction in emission is \$10,000. Plant B's \$20,000 cost of purchasing allowances is less than the \$25,000 it would have had to pay to reduce emissions by 50 tons. The total cost of the 100 ton emission reduction is

\$30,000—\$10,000 for A and \$20,000 for B—rather than the \$40,000 cost under the uniform rollback policy.

Under Title IV, allowances are issued *gratis* to existing polluting utility units based on their "baseline" fuel use as measured by the annual average of 1985-87 Btu consumption. Emissions are ratcheted down over time by issuing allowances over two different phases of increasing stringency with Phase I running from 1995 to the year 2000 (see Table 2).

The market price of allowances is currently expected to be low in the early 1990s and to rise steadily over the course of Phase I and II through the middle of the next decade because an excess stock of allowances is expected to be held at the outset. The actual time path of prices will depend not only on several uncertainties such as fuel switching costs and the growth of electricity demand, but also on the motivations of market participants. Utility risk aversion provides a motive to bank allowances, thereby increasing the current price of allowances. Forward contracts and futures markets for SO₂ allowances, such as those proposed by the Chicago Board of Trade, may also influence allowance prices by facilitating the entry of speculators who are willing to bear some of the risks of risk averse utilities. By lowering costs and risks everyone can gain, including rate payers and utility shareholders alike.

Will the market be allowed to work?

Some skeptics question whether the benefits envisioned by market proponents will materialize. Much of the efficiency gain is envisioned to come about as profit motivated firms choose the least cost compliance strategy. However, the firms in question are largely state regulated public utilities. To the extent that utilities are guaranteed a fair rate of return on their invested capital, it is alleged that utilities may have a diminished incentive to engage in least cost planning. There are also conflicts between least cost choices and the preservation of mining jobs in those regions that mine high sulfur coal. In

particular, some states have already moved to circumvent the choice process of utilities in various ways. For example, the state legislature in Illinois has mandated the use of smokestack "scrubbers," which remove impurities caused by the burning of high sulfur coal, thereby eliminating the option of using low sulfur coal for two generating plants.

Fortunately, the aforementioned impediments to market decision making are unlikely to dominate. Partly owing to the rising costs of utility services in recent decades, public scrutiny and opposition have made utility rate hikes far from automatic. For this reason, utilities do have incentives to engage in cost efficiency measures so as to ensure their shareholders a good rate of return on investment. States with high sulfur coal mining interests are likely to continue to provide a base market for their coal products by mandating the use of scrubbers at some utility plants. However, cost considerations will dictate that the plants chosen are those where the costs of the scrubbing option are well within reason. And the fact that states without mining interests may choose other options means that the price of high sulfur coal would be bid down relative to the price of low sulfur coal, making scrubbing a cost efficient choice for some fraction of the utility market in any case.

Nevertheless, certain provisions of the Clean Air Act itself may be working against the market based approach introduced in Title IV. Title V of the 1990 Amendments legislates a new comprehensive permitting program authorizing specific compliance strategies such as those found in a command and control system. The interaction among competing regulations under the CAA, resulting from the fact that SO₂, NO_x, and VOC are controlled under two or more major Titles, caused the EPA to seek the comprehensive permitting program so that one permit will be issued for each industrial source. However, reopening the permitting process for existing industrial facilities also provides an opportunity for intervention by such parties as the National Park Service,

2. Estimates of SO₂ emission reduction requirements

	Phase I affected units ¹			Phase II ²		
	U.S.	Midwest ³ % of U.S.		U.S.	Midwest % of U.S.	
Number of generating units	261	137	52	1107	443	40
Capacity (thousand megawatts)	81	39	48	294	97	33
SO ₂ emissions (million tons)	8.3	4.5	55	15.1	7.1	47
SO ₂ allowances (million tons)	5.6	2.6	46	8.9	2.5	28
Reduction needed to meet allowances (percent) ⁴	33	43		41	65	

¹Phase I affected units are listed by name in Table A of the 1990 Amendments; these are the larger, higher emitting units in the country.

²A few small units are not included.

³Illinois, Michigan, Wisconsin, Indiana, Ohio, Minnesota, Iowa, and Missouri.

⁴Required reduction based on no net trading of allowances outside the region.

SOURCE: Argonne Utility Simulation Model for 1989.

environmental interest groups, and others in the same state or neighboring states to argue for more stringent emission controls to protect "air quality related values" such as visibility in cities and national parks. As the state and federal governments undertake this massive permitting process of industrial sources, delays and uncertainties are to be expected, and once a permit is issued, plant facilities will lose flexibility in adapting to changes in product demands or adjusting their manufacturing processes for competitive reasons.

The consequences of this loss of flexibility are as yet poorly understood. Certainly, the potential gain under the SO₂ trading system comes into question. More generally, Title V is only one of several within the overall CAA whose structure and nature reflects the command and control approach to emissions control rather than a market based approach.¹

New directions and exceptions

Despite the conflicting approaches to emission control within the CAA, Title IV may stand as a turning point beyond which environmental regulation will never return. Policymakers are extending the scope of the market based approach to new areas. For example, urban ozone nonattainment

is typically a regional airshed problem, e.g., the south coast area of California around Los Angeles or the vicinity of Chicago and Milwaukee metropolitan areas which have been designated as "extreme" and "severe" (respectively) nonattainment areas under Title I of the CAA. The South Coast Air Quality Management District of California is moving rapidly ahead toward a program of tradable emission permits in reactive organic compounds which contribute to ozone formation and smog. In contrast to acid rain controls, which focus on relatively few, large sources nationally, the urban smog program addresses individual vehicles, dry cleaners, and household and firm use of surface coatings, solvents and cleaning fluids. Other potential market based programs include allowing firms to buy and dispose of "old clunker" cars as a way to reduce urban emissions, and limiting motor vehicle trips into congested cities while allowing the trading of vehicle trip permits.

While a market based approach holds many potential advantages over command and control, some situations may be inappropriate for the trading of permits. Regarding the control of industrial hazardous air pollutants (i.e., air toxics) the 1990 Amendments call for a three-pronged program: 1) technology requirements for a list of 189 chemicals (called maximum achiev-

able control technology or MACT); 2) subsequent risk/benefit studies to evaluate whether a second round of controls beyond MACT may be required; and 3) special regulations to prevent accidental releases of very toxic chemicals. The last type of environmental concern, which has a very low probability but high potential damage from a discharge, may represent a type of situation where technology based regulations are the best approach to protect health and environment.

Conclusions

Prior to the CAA, market based approaches to reducing pollutants had been widely discussed but largely untried. Certainly, the acid rain Title IV amendments will provide a major testing ground for many of the institutional features of the market based approach including the trading and banking of emission allowances. Should this approach prove to be successful, we can expect to see it widely applied to other areas such as the regulation of water, toxic sites, and urban air pollutants.

—Donald A. Hanson and
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¹See Donald A. Hanson, "The 1990 Clean Air Act: a tougher regulatory challenge facing Midwest industry," *Economic Perspectives*, May/June 1992, pp. 2-18.

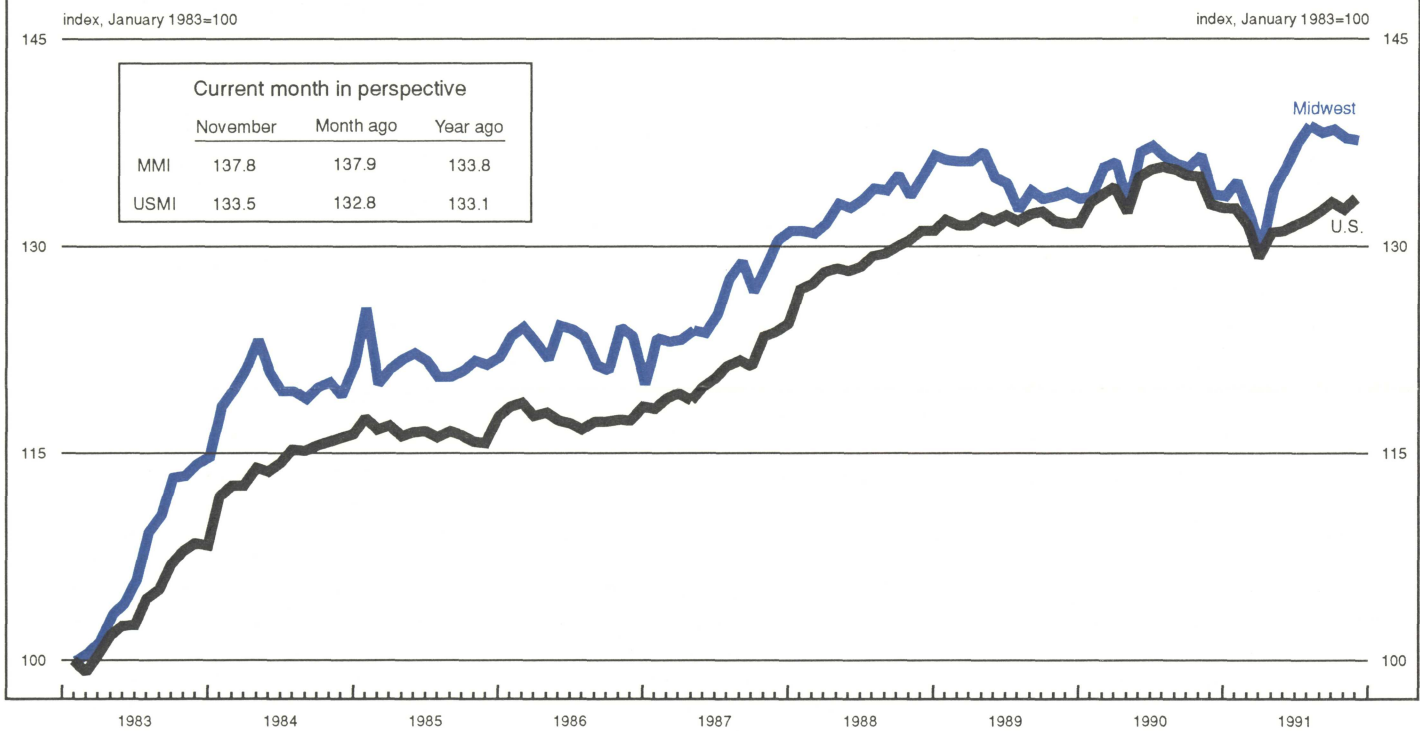
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MMI — Midwest Manufacturing Index: current expansion



Midwest manufacturing activity ended 1991 on a sour note, as the MMI declined 0.6% in December, continuing a downward slide that began at mid-year. Much of the recent weakness has come from the transportation sector. However, that sector scored a respectable gain (up 1.1%) in December. With auto production plans over the first quarter of 1992 showing a steady rise, the sector should continue to make a positive contribution to the MMI in the early part of 1992.

The December decline in the MMI also marked one of the few times in recent years that the region has underperformed manufacturing activity nationwide for a full quarter. The region's weakness underscores the importance of its transportation sector to its overall performance.

NOTE: The MMI and the USMI are composite indexes of 17 manufacturing industries and are derived from econometric models that estimate output from monthly hours worked and kilowatt hours data. For a discussion of the methodology, see "Reconsidering the Regional Manufacturing Indexes," *Economic Perspectives*, Federal Reserve Bank of Chicago, Vol. XIII, No. 4, July/August 1989.

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