DEMONSTRATING EMISSIONS TRADING IN TAIYUAN, CHINA

Richard Morgenstern, Robert Anderson, Ruth Greenspan Bell, Alan Krupnick, and Xuehua Zhang

Can market-based instruments be effective in a country where monitoring and enforcement systems are still untested and state enterprises are the biggest polluters?

Can market-based instruments (MBIs) be effective tools for improving environmental quality in the People's Republic of China (PRC)? Can such instruments really reduce emissions at lower costs than conventional command-and-control approaches in a planned-market system where monitoring and enforcement systems are still in their infancy and where state-owned enterprises are the dominant polluters? No one knows for sure whether MBIs are suitable for such an application. But a number of senior Chinese officials, along with experts from the Asian Development Bank, are betting that the time is ripe to test out these ideas in a full-scale experiment. Toward this end, they have recruited a team of international and domestic experts, led by RFF researchers, to try to demonstrate the feasibility of emissions trading in Taiyuan, a heavily polluted industrial city in northern China.

Since spring 2001, the RFF team has been assessing the local situation and, most recently, designing a program for emissions trading among large emitters in Taiyuan, the capital of Shanxi Province. Currently, a formal regulation that would implement the trading system is sitting on the mayor's desk, awaiting official signatures. Trading is expected to begin in early 2003. How the system will actually work, whether the design will prove viable in Taiyuan, whether tangible environmental improvements can be obtained at reasonable cost, and what modifications might be necessary to improve the system are all unknown at this time. What is known is that there is strong interest in trying to adapt the western-style emissions trading experience to the real-world conditions in China—and a major effort is under way to demonstrate the viability of such an approach.

BACKGROUND

Heavy reliance on relatively uncontrolled coal combustion as a source of heat and power has created serious environmental problems in China—particularly in its coal-rich northern provinces. Particulate matter (PM) and sulfur dioxide (SO_2) are the major pollutants of concern, although with recent progress in reducing PM emissions, attention is increasingly shifting to the control of SO_2. In many urban areas, high SO_2 concentrations—along with fine particles created by the atmospheric transformations of SO_2 into sulfates—represent a serious public health threat.

Situated about 500 kilometers southwest of Beijing, Taiyuan has a population of 2.7 million and covers an area of almost 7,000 square kilometers. Topographically, the city is surrounded by mountains on three sides, resulting in a Los Angeles-type of smog trap in which air pollutants tend to accumulate. A 1998 report by the World Bank identified Taiyuan as among the most polluted cities in the world. SO_2 concentrations—which have been relatively flat over the past decade—averaged 200 parts per million (ppm) in 2000, more than three times the PRC's Class II annual standard (60 ppm). With recent economic growth averaging 10% per year, the reported absence of deterioration in air quality reflects the considerable effort that has already been devoted to environmental improvement.

In China, local governments generally take their cues for controlling pollution from the central government. Currently, the national control policy relies on emissions standards based on the concentration of SO_2 in the boiler's stack at a specific point in time. Pollutant concentrations are based on self-reported data from the enterprises and periodic stack testing by the local Environmental Protection Bureaus (EPBs). These estimated concentrations are combined with limited data on pollutant flows to calculate mass emissions from the enterprises. The calculated mass emissions, in turn, form the basis of a small emissions levy ($25/ton), which is used to support local EPB activities with the balance returned to individual enterprises to finance their pollution control investments. It is widely recognized that the current approach to calculating mass emissions is not robust enough to support more aggressive efforts to reduce emissions—including via emissions trading.

A new, more sophisticated mass-based system—"total emissions control" (TEC)—is being implemented in China as a supplement to the existing stack-gas concentration standards. The TEC system is similar in many ways to individual facility-level caps on SO_2 emissions imposed under Title IV of the U.S. Clean Air Act. Once it is fully implemented and enforced, the mass-based TEC system will be able to serve as a key building block of an emissions trading system.

China typically experiments with new pollution control programs through pilots or demonstrations. The Taiyuan city government began experimenting with emissions permits and earlier pilot versions of the TEC system in the 1980s. As early as 1985, emissions controls were introduced in local regulations issued by the Taiyuan government. The city conducted experiments with emissions offsets and (administratively determined) trading in the mid-1990s. In 1998, the Taiyuan city government issued TEC "management rules," including a provision for "permit exchange," a form of emissions permit trading. The Taiyuan EPB has begun to issue updated permits with TEC-based limits to large enterprises. So far, more than three dozen permits have been issued—all of them to large enterprises. Although widely seen as extremely ambitious, the Tenth Five-Year Plan for Taiyuan calls for 2005 SO_2 emissions to be reduced to about 50% of 2000 levels.

KEY QUESTIONS FOR USING MBIs IN TAIYUAN

Since early 2001, members of the RFF team have made almost a dozen trips to Taiyuan to collect data and work with local officials and enterprise managers on design issues. Several critical questions need to be considered at the outset:

Do market-based instruments really have the potential to reduce environmental control costs in Taiyuan?

The RFF team conducted an assessment of expected SO_2 control costs for different enterprises in the city. The marginal costs of abatement, as shown in the accompanying table, suggest reasons for at least a prima facie case for MBIs. Estimates of these costs range from \$60–\$1,160 per ton of SO_2. In a western context, this wide range of abatement costs would certainly provide an incentive for both government and industry to look favorably on MBIs. The alternative—a traditional command-and-control approach—would likely force some firms to undertake unnecessarily expensive mitigation options to achieve the same emissions reductions available at lower cost.

If conditions are ripe for MBIs, why not simply increase the existing pollution levy?

The current levy is clearly not high enough to create incentives to change behavior. Therefore, substantially increasing the levy, as was recently done in Beijing, is a potential option. After extensive discussions with provincial and local officials, however, it became clear that reforming the current levy while simultaneously increasing the rate to create significant new abatement incentives would not be politically acceptable in Taiyuan. Introducing an MBI in the context of the newly established TEC was seen as being more acceptable, especially to the enterprises, which feared the imposition of higher taxes in the form of levies.

Could an emissions trading program survive in a place that historically lacks strong enforcement and compliance systems?

Our purpose is to translate the international experience with emissions trading to the real-world conditions in Taiyuan, a resolve that required us to consider China's unique historical, institutional, and technological context. Emissions trading works in the United States and elsewhere when certain conditions—often the same conditions necessary to support traditional methods of environmental control—are present. But Chinese environmental institutions are still in their infancy in the development of their compliance and enforcement systems. Why try to save money on regulation if you aren't expending any to begin with or if the system is so riddled with exceptions that enforcement is not sure?

The courts generally cannot be relied on for an independent source of compliance oversight, as judges owe their appointments, salaries, and social benefits to the provincial and local governments, the same institutions that own and control most heavy industry and pay the salaries of the local EPB officials. Similarly, the penalties for violating pollution standards are inadequate to support an enhanced environmental management system of any type (see below).

Is the current monitoring system suitable for emissions trading?

The dearth of experience with consistent monitoring raises questions about whether the appropriate incentives exist for industry to participate in a trading program. Whatever environmental management system is ultimately adopted in Taiyuan, the basic tracking, recordkeeping, and enforcement functions will need extensive upgrading and renewed compliance commitments. The monitoring system is a case in

point: continuous emissions monitors (CEMs) of the type used in the U.S. acid rain program are currently installed in only a handful of units in Taiyuan. Although there are ambitious plans to add several hundred more CEMs by the end of 2002, there have already been significant delays. Thus, alternative and generally less accurate methods of estimating emissions will be necessary during the demonstration.

If emissions trading is to be introduced in Taiyuan, which sources would participate in the program and how would the permits be allocated?

The obvious choice is to expand the ongoing efforts to introduce the TEC mass-based permit system among large emitters. The possibility of allocating permits via auction was discussed early on but it was clear that existing financial and political constraints would stymie such an effort. However, the proposed regulation does allow the city government to retain a small portion of the permits to be auctioned to the highest bidder.

To improve the local capacity to manage the demonstration program, the U.S. Environmental Protection Agency (US EPA), which has extensive experience in developing and managing trading programs, has helped provide training under a parallel agreement with the Asian Development Bank. To date, the training has focused on the technical aspects of MBIs, U.S. and other international experiences with emissions trading, design elements of a trading program, measurement, emissions and allowance tracking, and emissions verification. In addition, the RFF team has formed a highly successful alliance with the Chinese Research Academy of Environmental Sciences, which has provided technical assistance on a wide range of issues.

THE CURRENT SITUATION

Twenty-six of the largest enterprises—representing about half the reported emissions in Taiyuan—are slated to participate in the new trading system. Apart from a few small adjustments to reflect recent investments and expansions, the baseline for individual enterprises is the actual reported SO_2 emissions in 2000 – 2001. Although discussions are still continuing on this point, the 50% reduction mandated in the Tenth Five-Year Plan is reflected in the 2005 initial permit allocations slated for individual enterprises. Targets for interim years also have been established. New sources may purchase permits from existing sources or from the small set-aside held by the local EPB. Banking of permits is allowed.

The largest sources are required to install CEMs. For others, a new emissions tracking system has been developed to integrate into a single data system all the relevant information reported by the government as well as by the enterprises concerning emissions, fuel purchases (including sulfur content), output, and other factors. A parallel allowance-tracking system has also been developed by the US EPA to monitor actual trades. It is anticipated that the operation of both the emissions and the allowance-tracking systems, in combination with the available CEMs, will provide a credible basis for emissions trading.

Establishing the appropriate penalty for violations is an issue that still must be resolved. Based on international experience, it is clear that the penalty for exceeding permitted emissions must be high enough to ensure that sources have adequate incentives to either control their emissions within permitted levels or to trade with other sources in order to satisfy their obligations. However, pursuant to a regulation previously issued by the provincial government, the maximum penalty the local EPB can impose on a sin-

gle enterprise is less than $4,000 per violation. Discussions are still continuing on how to interpret the notion of an "individual violation," for example, whether to calculate on a per-year or a per-ton basis, or whether the provincial regulation itself must be revised. The outcome of these discussions will be an important bellwether of the commitment of both the local and provincial governments to an enhanced environmental management regime via MBIs or any other approach

Once the regulation is formally adopted, implementation will get under way. Further training on data reporting, emissions and allowance tracking, and other topics will be conducted later this year. Actual trading is expected to begin in spring 2003. The RFF team will continue to provide technical assistance to both the enterprises and the local officials, and will also conduct an evaluation of the program later in the year. Revisions to the program will be recommended as they are identified. Depending on the results of the demonstration, officials may try to expand the Taiyuan emissions trading system to other cities in the province and beyond.

Overall, there is widespread interest, among both the Chinese and the international community, in the SO_2 trading demonstration project in Taiyuan. Although the operational success of the demonstration is still unknown, the prospect of a regulation being formally issued by the city government is a major milestone. Regardless of the ultimate outcome, important lessons will be learned about the suitability of MBIs for developing countries, particularly for planned-market systems such as the People's Republic of China. Further, the city of Taiyuan will have in place a much-improved system for administering whatever type of regulatory system it ultimately implements. ■

TABLE 1

COST-EFFECTIVENESS OF SO_2 CONTROL MEASURES IN TAIYUAN

Control Measure	Where Applied	$/ton
Treat post-combustion gas	Taiyuan District Heating	($60) *
Flue Gas Desulfurization (FGD)	Eastern Mountain Plant	($80)
Lower sulfur coal (~1.3%)	Taiyuan #1 & #2, Taiyuan Iron & Steel	($100)
FGD (simplified)	Taiyuan #1	($240) **
FGD	Taiyuan #1 (Planned)	($180) *
Add limestone to fuel	Coal gasification plant (Planned)	($130)
Coal washing	Future Sites (Possible)	($1,160)

* as reported by plant officials to RFF team, March 2001.

** plus unspecified investment costs paid for by the government of Japan.

Richard Morgenstern and Alan Krupnick are senior fellows at RFF. Ruth Greenspan Bell is a visiting fellow at RFF, and Xuehua Zhang, a research assistant. Robert Anderson is a private consultant.

Fore More Information

Bell, Ruth Greenspan, and Clifford Russell. 2002. "Environmental Policy for Developing Countries, Issues." *Science and Technology* (Spring); reprinted in electronic journal *Failsafe* (http://www.felsef.org/summer02.htm#4b, accessed July 19, 2002).

Cole, Daniel H., and Peter Z. Grossman. Forthcoming. "Toward a Total-Cost Approach to Environmental Instrument Choice." In *Research in Law and Economics*, R. Zerbe and T. Swanson (eds.).