MARKET BASED INSTRUMENTS FOR ENVIRONMENTAL MANAGEMENT IN THE PEOPLE'S REPUBLIC OF CHINA
TA No. 2951-PRC

Public Information Report

October 1999

PREFACE

The market-based instruments project was sponsored by the Asian Development Bank (ADB) and implemented by the Harvard Institute of International Development (HIID) in close collaboration with Chinese experts. The duration of the study was June 1998-December 1999.

The primary objective of this technical assistance project was to support improved environmental management for the People's Republic of China (PRC) through:

- An analysis of the most suitable market-based instruments (MBIs) in the PRC, and,
- The formulation of a program for their adoption, specifically in the water and energy sectors.

This study was compiled from information from HIID's project team and their project counterparts in China. Most of this report is excerpted from the project's final report submitted to the Asian Development Bank and the Chinese State Environmental Protection Administration in November 1999. The technical assistance for this project was concluded in May 1999.

TABLE OF CONTENTS

INTRODUCTION

China faces a tremendous challenge to reconcile the demands of economic growth and environmental protection as it heads into the next century with a flourishing economy and ever increasing pressure on its natural resources. It is becoming evident that the environmental damage that is a byproduct of development in China currently is no longer tolerable. A recent study by the World Bank concluded that air and water pollution costs China about eight percent of its GDP annually.[1] These damages include health losses, chronic diseases, nervous system damage and premature deaths due to pollution as well as crop losses and forestry damage from acid rain. Looming global problems such as global climate change and ozone depletion promise to present even more challenges to Chinese policymakers and civil society. During the past twenty years, environmental issues have taken on increasing importance in China due to a growing recognition by China's leadership that environmental protection must go hand in hand with economic development. Legislation has been drafted and amended and administrative bodies have been established to cope with environmental regulation, monitoring and enforcement.

Despite many real accomplishments, the overall performance of environmental policy in China has been mixed, whether judged in terms of stated objectives, environmental effectiveness or economic efficiency. In recent years, the system has exhibited further signs of deterioration and a gap between objectives and performance is growing. Explanatory factors include deficient policy design, implementation and enforcement difficulties, the transition from a planned economy and the complications raised by a rapidly changing social and economic environment.

Similar to many other countries designing environmental policy reform, there is a general tendency to introduce new laws and regulations rather than to improve them or enhance their effectiveness in enforcement. New regulations and instruments do not always replace the old ones, but are sometimes create poor incentives, bureaucracy and confusion. For example, the introduction of a volume-based charge on industrial wastewater in 1993 took precedence over the old charge, thus creating perverse incentives.

Five Main Problems with Environmental Management in China

1. The inherent weaknesses of the **Pollution Levy System (PLS).**
2. **T**he **proliferation of taxes and charges.**
3. The **lack of an overall cap or limit on pollution.**
4. Increased **decentralization of administrative functions**.
5. **Lack of understanding of how revenue can be shifted** to environmental investment.

China must be credited with taking the initiative to explore a variety of regulations and economic instruments that would change administrative and industrial behavior to account for the environment. This report assesses the effectiveness and efficiency of the methods and policies currently employed and proposes ways to improve them. This report concludes that economic or "market-based" instruments are the best method in China for modifying behavior so that the adverse effects of pollution are mitigated.

[1] Clear Water, Blue Skies, pg. 23.

Specifically, this report identifies **five main problems** with environmental regulation in China: First, the inherent weaknesses of the **Pollution Levy System (PLS)**, especially the low level of the charges. Second, the **proliferation of taxes and charges,** which have resulted in high administrative costs, confusion and an undue burden on industry. Third, the **lack of an overall cap or limit on pollution** in the face of rapid economic growth and the problems associated with the introduction of Total Amount (TAC), the tool which has attempted to address this very issue. Fourth, increased **decentralization of administrative functions** and, lastly, a **lack of understanding of how revenue can be used for environmental investment**.

To address these main problems, a Policy Action Plan will be presented at the end of this report, which recommends very concrete actions and appropriate requirements for promoting the set of market-based instruments that could work best for China. Specific procedures for testing certain instruments based on this analysis were developed in the form of three case studies that will also be reviewed briefly in this report.

The Policy Action Plan proposed in this report identifies methods to improve and streamline the current policies and existing instruments, suggests new market-based instruments and recommends improvements in environmental investment. The recommendations that constitute the Policy Action Plan are intended to provide guidance to the Chinese government, particularly to the State Environmental Protection Administration (SEPA) and its colleagues on how to proceed with environmental policymaking and management.

Defining Market-Based Instruments

Market-based instruments (MBIs) are economic tools (i.e. impact levies, tradable pollution permits, user fees) that create incentives for consumers and producers to change their behavior in ways that will lead to more efficient and sustainable policies and actions that, in this case, are environmentally sound. For developing countries, there is significant evidence that MBIs provide the most effective solution to improving environmental management with low cost and relative ease of implementation. Alternative approaches, such as uniform policies or charges are less practical and usually more costly for developing countries like China which often lack the appropriate agencies and institutions to follow through on these policies. Moreover, the vastness and diversity of China precludes the use of uniform environmental standards. Flexible economic instruments can more efficiently address China's heterogeneity and extensive environmental degradation, often at lower cost.

Market-based instruments (MBIs) are economic tools (i.e. impact levies, tradable pollution permits, user fees) that create incentives for consumers and producers to change their behavior in ways that will lead to more efficient and sustainable policies and actions that, in this case, are environmentally sound.

Economic instruments are superior to the "command and control" regulations, as they are called in the United States, that have characterized China's approach to environmental policy and pollution to date because they encourage both consumers and polluters to alter their behavior while imposing a minimal administrative burden on government. MBIs also raise revenue, which can be used to further investment in environmental protection efforts.

EVALUATING THE CURRENT SYSTEM

The command economy in China left a legacy of poor environmental conditions. Rapid economic growth during the past two decades, which could have exacerbated environmental problems, has actually resulted in less pollution per unit produced. Damages from pollution to property and health, however, are increasing while aggregate emissions are still growing. The reduction in pollution per unit can be attributed to improved efficiency in production, cost reduction incentives and government reforms. Though the Chinese government has demonstrated a commitment to protecting the environment – indeed, China leads the developing Asian nations in taking bold steps to improve environmental management – there is a need to evaluate current policies and the agencies that are implementing them.

Evaluation of the current system in this report will be conducted by using the criteria of **cost-effectiveness, economic efficiency, institutional performance, efficacy of policy, and appropriate use of incentives.**

China's environmental problems and policies are much better understood today than they were only a few years ago. Most of the credit for this goes to the Chinese themselves. Since the early 1980s, much work has been done to formulate answers to the puzzles associated with increasing environmental stress. In addition, outside comments that would have been interpreted as hostile not so long ago are now more readily interpreted as an invitation to engage in further analysis and action. Multilateral banks have played an important role in this process by demanding and supplying justification of investment decisions in sectors that can impinge on the environment. In the process, more information has been generated. The Chinese themselves have responded quickly to the challenge of analyzing and presenting environmental problems in ways with which China's foreign partners were comfortable. This process helped secure additional funding for many foreign-funded energy and urban infrastructure projects.

There is still much more work to be done and obstacles to be overcome. First, a number of studies have remained compartmentalized and have therefore had little influence on policy formulation. This is the case, for instance, of some important public health research. Second, detailed data are often inaccessible to the public and to foreign analysts, making useful and accurate analysis more difficult, if not impossible. Some assumptions underlying environmental policy in China therefore continue to rest on uncertain foundations.

Cost Effectiveness and Efficiency

The current system in China of *uniform standards and charges* across locations and industries fails to exploit differences in pollution control costs among industries and in damage costs. Such differences must be taken into account if social welfare is to be maximized (efficiency) or at least the overall pollution control cost minimized (cost-effectiveness). Given the vastness of China and diversity of its industry, cost differences are substantial and uniformity of standards imposes compliance

Definitions

A **cost-effective** pollution control system takes advantage of the fact that it costs firms varying amounts to reduce pollution. The **cost-effective** approach minimizes overall costs by making the marginal cost of pollution reduction the same for all sources. Similarly, an **economically efficient** system determines the ideal overall level of pollution control by identifying how much demand exists for pollution control in relation to the marginal cost of control. **Uniform standards and charges** do not take account of the marginal cost, nor the demand for pollution control. They simply impose the same policy on all firms.

and enforcement costs, thereby raising the costs at which environmental protection can be achieved. Higher costs result in lower levels of control, especially in light of China's strong emphasis on development. This is expressed in inconsistent enforcement, compliance exemptions, and subsidization of pollution control.

One alternative, the pollution charge (or levy) is set with the goal of achieving an emission or effluent standard. Pollution charges are often set far below the actual compliance costs, which renders the charge ineffective. The charges or levies are, however, rather effective as financing instruments for environmental investments. Emission and effluent standards are usually set separately and without regard to the ambient standards that they aim to achieve, or to the cost minimization objective that is implicit in the policy of economic growth with concurrent environmental improvement. The discharge permit or license system currently under experimentation in China aims to rectify this weakness by prescribing specific discharge limits necessary to meet ambient water and air quality levels. Of course, the number of permits for each airshed or watershed must also be constrained so as to control the overall pollution to the level necessary to meet the environmental goal. The current permit system aims to control total pollution from existing facilities, leaving new plants to be controlled through other means.

Getting Incentives Right

The principal economic investment instrument used in China right now is the pollution levy system, which was introduced in the early 1980s. The existing levy system does not provide the right incentives for changing polluters' behavior. Pollution charge rates are far too low, much lower than the marginal cost of pollution control for meeting the set standards. Also, the pollution charges are set without consideration of the marginal environmental damage. Charges are simply used as financing mechanisms to mobilize resources from polluters for environmental investments. This is not a very efficient mechanism given both the high administrative costs of collection and redistribution. Leakage of the investment also occurs within both the government bureaucracy and the enterprise. Because existing levels of levies are below the level of marginal damage costs and below the marginal compliance cost, it is not surprising that enterprises prefer to pay the levies instead of making the investments necessary to meet the standards.

> ***Incentive Effect:*** *Pollution charges must be high enough to induce a behavioral change on the part of polluters that will accomplish the environmental objectives.*

Even worse, the charges are not indexed to the general price level and, as such, are eroded by inflation. For example, in the first decade of implementation, emission fees were only raised 25-40% but inflation was more than 100%. Thus, even thought the fees were raised, their 1990 real value was less than 50% of their 1979 value. Predictably, firms prefer to pay the charge rather than comply with the standards. The advent of this type of behavior could have been avoided if the charge rates were set at the marginal damage cost level or at least at the marginal abatement cost for achieving the set standards.

Indeed, existing charges are non-compliance levies, not true pollution charges, since polluters do not pay for pollution levels below the standard. In other words, firms do not pay for pollution

incrementally but only if they exceed the standards. Chinese policy makers recognize this and it is addressed through fee escalation: if a firm does not comply for three consecutive years, the charge is increased by five percent per year. Furthermore, the charge is doubled for new enterprises (built after 1979) which exceed the standard or pre-existing enterprises that fail to invest in pollution-reducing equipment. A fine of 0.1% per day is imposed on any delay of more than 20 days in the payment of the charges. Fines are also imposed for falsifying reports or resisting inspection. Nevertheless, even after adding these 4 fines (known as the "four small pieces") to the charge rates, the benefits from non-compliance (avoided pollution control expenditures needed to meet the standards) far exceed the overall charges and penalties combined. Finally, a large number of small-scale and scattered TVEs pay proportionately far lower charges than other industries because the probability of detection is low and the cost of fine collection high.

Surprisingly, given the current low charge rates, existing or installed pollution control equipment and waste treatment facilities may purposely not be used because operation and maintenance costs are generally higher than charges and fines. For example, the average operating cost of wastewater treatment facilities in one city were estimated to be eight times the fee imposed for not operating the equipment. The Luohuang Power Plant provides another example in the Chongqing municipality, where SO_2 abatement costs are Yuan 0.37 per kg, while the SO_2 emission charge is only 0.2 Yuan per kg. As expected, the enterprise prefers payment to abatement (Zhong *et al.* 1994).

In China, fees account for less than one-tenth of one percent of total output value compared with over one percent for US manufacturing, indicating that the fees are not motivating pollution control enough in Chinese firms.

An effective pollution control system cannot be evaded.

As we have seen above, the pollution levy system, the principal economic instrument used in China, is not actually a discharge fee but a non-compliance penalty (or enforcement incentive) since it is only charged on the quantity of pollution that exceeds the standard. Furthermore, it is assessed only on the pollutant that is most in violation of the standard in any one waste system (not on the others), regardless of control costs involved or damages caused. For example, until 1991 no fees were collected on SO_2, CFCs, or solid waste. This encourages substitution to lower or evade pollution charges. Trial SO_2 emission fees were introduced recently, however, and other "true" emission fees are being considered. Another flaw in the current system is the specification of effluent standards in terms of allowable concentrations rather than mass flow rates. Taking advantage of this loophole, some enterprises have met discharge standards and avoided the discharge fees by diluting their wastewater with freshwater (Florig *et al.* 1995) or using taller smokestacks. To address this problem, some local governments introduced fines for dilution. A more recent change involved reform of the system so that it now bases charges on mass flow rather than on concentrations. With these changes, the volume as well as all pollutants in the waste stream are covered (and not just those in greatest violation). Water pollution charges are generally higher than air pollution charges (Vermeer 1991), which encourages transfer of pollution to less regulated media (World Bank 1992). For example, burning “dirty coal” is favored over coal washing by the existing pollution charge structure.

An efficient discharge fee system provides incentives to reduce discharges beyond the levels specified in the standards when the marginal costs of control are relatively small. Furthermore, an efficient charge system provides a dynamic incentive for development of more efficient pollution control technology.

The discharge fee system as established in 1982 provides no incentive to reduce discharges beyond the levels specified in the standards no matter how low the incremental costs. To remedy this problem, a volume-based industrial wastewater discharge fee of 0.05 Yuan per ton was introduced in 1993, but enterprises are not required to pay both this fee and the over-standard charge, since when the standard is violated the firm is required to pay only the over-standard charge. In practice, revenues from the within-standard pollution charge in 1993 have been minimal, accounting for only 10% of the over-the-standard collections (State Statistical Bureau 1993).

A combination of lack of incentives to do better than the set standard and mandated technologies (treatment plants), or mandated levels of environmental investments (7% of total investment cost of a project), removes any incentive for innovation and development of more efficient production and pollution control technologies. This not only reduces the economic efficiency but also discourages growth in the environmental technology and services industries.

A cost-effective pollution control system allows treats enterprises differently.

In design, the Chinese pollution control system makes little differentiation between industries of different size and type of ownership, but considerable is made in implementation. For instance, while TVEs are subject to the same levy system as large urban enterprises, little effort is made to collect levies from them in recognition of the high administrative costs of collecting fees from a large number of small and scattered enterprises. For example, in Chongqing less than 2% of TVEs paid levies compared to over 50% for the larger urban enterprises (Zhong *et al.* 1994). This pragmatic difference improves the administrative efficiency (and hence the cost effectiveness of the system) but lowers its environmental effectiveness by leaving a large number of enterprises totally unregulated. Recognition of differences in administrative efficiency (monitoring and collection costs relative to collected revenues) and the incorporation at the design stage of differentiated instruments would ensure both higher administrative efficiency and higher environmental effectiveness. For example, while direct regulations and economic instruments such as effluent standards and pollution charges are used for larger urban-based and easy-to-monitor enterprises, input taxes, production charges, deposit refund systems, and waste delivery incentive can more appropriately and effectively be used for smaller and scattered town and village enterprises.

Cost-effectiveness calls for treating new and old investments differently because it is far less costly to incorporate changes in plant design, technology, and equipment during the investment planning stage than to retrofit existing plants. Therefore, a certain degree of grandfathering (i.e. lower standards or charges or, preferably more gradual compliance, for old plants) is required to minimize overall compliance cost as well as to obtain acceptance by industry. The degree of such grandfathering, however, must be carefully defined (optimized) to avoid institutionalizing inefficiency and giving undue advantage to existing enterprises. The Chinese pollution control system does take some of these considerations into account. For instance, facilities that have been established after the introduction of the 1979 Environmental Protection Law are assessed double pollution charges; similarly, old enterprises that fail to operate existing treatment facilities are also assessed double fees. Furthermore, new investment projects are required to allocate 7% of their total capital cost to environmental investments and to incorporate environmental protection in design, construction and operation (“three simultaneous” policies).

Ownership and control also needs to be treated differently for environmental reasons. State-owned enterprises working on the basis of budget constraints that are very stringent do not respond to economic instruments such as pollution charges and fines for non-compliance because they can pass them through painlessly to their consumers or to the state which covers their deficits. In such cases, the preferable policy would be direct controls or privatization before the use of economic instruments. The current pollution control systems (levies and standards) make no differentiation between privately and state-owned enterprises in the design of instruments. In practice, however, the state enterprises are frequently exempted from pollution charges due to their poor economic health or the need to keep their activity going to maintain employment; this tends to further weaken the environmental effectiveness of these charging instruments.

While the flexibility of economic instruments is critical to achieve cost-effectiveness, when the environmental danger is high (as in the case of hazardous or highly toxic wastes which in small quantities can do a large amount of damage), flexible systems such as pollution charges may not be the appropriate instruments. Strict regulations, manifest systems, performance bonds and central treatment facilities may be more appropriate. (For a mixed regulatory and economic instrument system for controlling hazardous waste, see Panayotou 1993b). The existing systems, designed at a time when China produced little hazardous waste, would benefit from different use of regulatory instruments according to the composition of industrial pollution. Efforts are currently underway to introduce hazardous waste legislation and instruments to implement it.

Finally, pollution abatement processes such as treatment and disposal of hazardous waste and wastewater offer significant "economies of scale" that can be exploited through (privately- or state-operated) central treatment facilities. "Economies of scale" are when the treatment becomes cheaper as more of the pollution is treated. The regulations requiring that each enterprise, regardless of size and treatment costs, establish and operate its own waste treatment facility and the lack of flexibility ignore the significant potential cost savings through larger operations. In general, the "three sychronizations" policy and the 7% environmental investment requirement has led to building end-of-the-pipe treatment facilities factory by factory, with significant loss of economies of scale in both construction and operation. Zhong *et al.* (1994) report that only about half of wastewater treatment facilities in Chongqing are actually operated.

Financial Considerations: Revenues and Expenditures in China's Environmental Policy

To induce a change of behavior, pollution charges must not be reimbursed to an enterprise through tax deductions, outright exemptions, or rebates linked to the level of charges paid. Treating state and non-state enterprises differently by giving exemptions or more lax compliance schedules to financially troubled firms reduces the environmental effectiveness and efficiency of regulations. State enterprises tend to be less efficient and more polluting. As a result, a larger pollution reduction by more efficient, non-state enterprises becomes necessary to compensate for the state firms.

The state-owned enterprises, which have been the main target of the pollution discharge fee system, continue to enjoy a budget constraint which is very soft, and which thereby diminishes the effectiveness of pollution charges. State enterprises, two-thirds of which are reported to be unprofitable (Reuters World Service,

*To induce a change of behavior, **pollution charges must not be reimbursed to an enterprise** through tax deductions, outright exemptions, or rebates linked to the level of charges paid.*

March 29, 1995), are often exempted from pollution charges due to their poor economic health. For example, the Chongqing municipality exempted 82 "difficult enterprises" from pollution discharge fees in 1989 and exempted all textile enterprises in 1993 due to poor economic health (Zhong *et al.*, 1994). Even enterprises that do pay pollution discharge fees (called "normal fees" in contrast to the "four small pieces") are allowed to count these fees as part of their production cost and hence deduct them from their before-tax income.

Because the use of the environment for the disposal of waste is simply another factor of production, it is appropriate to allow enterprises to treat pollution levies as production costs. However, in the case of non-market-regulated sales from state enterprises, all of the pollution charges are passed directly on to the consumer and taxpayer. This diminishes the incentive for enterprises to control their pollution. In fact, it creates a perverse incentive for some enterprises to shield their profits from taxes by paying into the levy system from which 80% of their payment can be recovered under the rebate system (Florig *et al.* 1995). State enterprises that incur losses as a result of pollution levies pass on these losses to the state budget, resulting in no incentive to minimize pollution in these firms either.

Such actions contradict the "polluter pays" principle, endorsed by Chinese law, which requires that the producers and consumers of polluting products pay the levies, not the taxpayer or the society at large. As noted above, polluters actually pay less than a fifth of the overall pollution control expenditures. In 1993, the revenues from levies accounted for only 12% of China's environmental expenditures. Since the most inefficiently operated enterprises are often excused from paying pollution levies, the well-run enterprises are indirectly being forced to subsidize the former by enduring stricter standards and higher levies for any desired level of environmental quality. A separate issue, which has important effects on the system of environmental protection, is the lack of a clear economic policy that determines when enterprises should be left to go bankrupt.

Efficiency requires that public environmental expenditures maximize aggregate social return.

The total revenues collected from discharge fees in 1994 was 3 billion Yuan, of which about 2 billion Yuan was actually used for pollution abatement, compared to a SEPA estimate of 12 billion Yuan needed to meet effluent and emission standards by the year 2000[2]. Twenty percent of the fee revenues plus all the revenues from fines are used by local Environmental Protection Bureaus (EPBs) to finance their operations while the rest (eighty percent of the fee revenues) is returned to the fee paying enterprises to subsidize pollution control investments. This revenue allocation approach has resulted in a number of unintended negative consequences:

a) Enterprises tend to treat these funds as entitlements, reducing their incentive to alter behavior;

b) The returned fees are not always used by enterprises as intended (the recent change that puts the return payments into the form of competitive grants and loans has removed part of this distortion);

[2] These are not the only expenditures on pollution abatement but the part that comes from discharge fees.

c) The returned funds (and even the loans) for environmental investments bias pollution control in favor of capital-intensive solutions and against other, often low-cost alternatives such as input changes or improved waste management;

d) The allocation of grants and loans only to fee-paying enterprises ignores other, possibly higher-return investments, while it provides a perverse non-compliance incentive to enterprises;

e) The system tends to ensure the artificial survival of inefficient firms and to act as a subsidy that may encourage entry into inefficient industries over the long run;

f) The reliance of EPBs for survival on revenues from pollution charges has become an incentive for EPBs to better monitor and collect charges, but also an incentive to tolerate non-compliance with standards to maintain income from pollution fees and fines; at the same time it weakens the government's financial responsibility for environmental protection.

Indeed, the levy system has been caught in a number of vicious circles. First, as more pollution is abated, fewer revenues from pollution levies are collected by the local EPBs; therefore, it becomes more difficult for them to continue operating. This lowers the effectiveness of the levy system and distorts its goals. Second, increasing levy funds requires more monitoring and equipment which in turn requires more levy funds to purchase them. Moreover, the higher the levy, the higher the monitoring needs because the incentives for evasion increase. Third, EPBs are reluctant to enforce standards or induce relocation of pollution industries outside of populated areas for fear of losing their revenue base (see Zhong *et al.* 1994).

In 1997, total government revenue reached RMB 820 billion (approximately $100 billion) or about twelve percent of the China's GDP. Of relevance here, all consumption taxes go to the central government but all environmental taxes go to the local government. The proceeds of charges and fees are incorporated only partly into the national budget, a point of major importance.

Institutional Arrangements for Administration of Key Market-based Instruments

Market-based instruments (MBIs) are only effective when the appropriate institutions are in place. Today in China, there is a complex interplay among institutions at the national and local levels in administering economic instruments for environmental management. Some of the instruments are authorized in national legislation and regulations and approved by the **State Council**. Others have originated from the laws and regulations of the **National People's Congress** or government at the provincial level. In most cases, the central government initiates the instrument/charge regulation and the provincial governments adopt the regulation in order to make it effective in the province. Where there is no central government regulation, the provincial government can adopt its own regulation based on authority from the National People's Congress, the State Council, and other sources.

Market-based instruments (MBIs) are only effective when the appropriate institutions are in place.

The **State Environmental Protection Administration (SEPA) has the responsibility for setting national policy related to the environment**, implementing the policies and regulations approved by the State Council, and supervising and coordinating all environmental

management activities within the government. SEPA's functions, established by the Law on Environmental Protection, include preparing policies, legislation and regulations on environmental protection; organizing implementation of environmental laws and regulations; monitoring effects on the ecological environment; addressing trans-boundary environmental problems; formulating environmental quality criteria and pollutant discharge standards; and organizing scientific research and development. Recent institutional reforms elevated SEPA to ministerial status and conferred on it additional responsibilities. SEPA is organized into ten functional departments, three of which have the most responsibility: the Department of Pollution Control, Department of Natural Protection and the Department of Supervision and Management. SEPA has a staff of 200 people.

China has created an extensive network of environmental institutions at the provincial, municipal, county, and town levels. China has literally thousands of local organizations and tens of thousands of personnel carrying out environmental protection work. At the provincial level, each government has established an **Environmental Protection Bureau (EPB)** which is the primary executing arm of SEPA and therefore has the responsibility for implementation and enforcement.

Many of the market-based instruments are administered in other governmental bodies. The key national institutions responsible for policy for economic instruments for environmental management are the SEPA, Ministry of Finance and the State Development and Planning Commission (SDPC). In addition, the State Economic and Trade Commission (SETC) plays an important role. Most of the environmental charges (i.e. pollution levies) are administered by the Department of Price in the SDPC and its counterparts at sub-national levels. SEPA is responsible for implementing some of the charges while other ministries may have implementation responsibilities for others (i.e. Ministry of Water for water resource charges). Environmental taxes are administered by the Ministry of Finance's Department of Taxation System and Tariff and are administered by the State Administration of Taxation. The Department of Price of the SDPC generally manages market instruments such as pricing systems, regulatory permits and trading programs. Regulatory permits are usually administered by the EPBs. Deposit bonds and subsidies are directed by the Ministry of Finance or by the relevant economic sector institution.

Current Environmental Policies

Discharge standards form the core of environmental regulation in China. They are differentiated according to pollutant, industrial source and are often differentiated within a particular industry by age of facility or height of smokestack. Most other environmental regulations are linked to this system of standards. Unfortunately, the total volume is not considered under the system of discharge standards in China which means that total pollution can increase even when discharge standards are being met simply because the volume of waste is increasing. This problem led to two other types of policies in China: pollution permits and the Total Amount Control policy.

Pollution permits were first introduced in China in 1989 for water as an administrative method, but they have never become law. Generally, a national goal is set for the total pollution load (standard

Comparing Different Kinds of Chinese Policies

*The **discharge standard system** limits the amount of pollution one can discharge into the air, land or water. The **pollution permit system** allocates permits to individual firms to discharge pollution. **The Total Amount Cap (TAC)** system sets a discharge standard and then allocates pollution permits to meet that goal.*

multiplied by the volume of waste) and then permits are allocated for individual enterprises that will meet that goal. In its favor, the permit system provides better control over environmental impacts than standards alone because volume of waste is taken into effect. The system also gives the EPBs authority to inspect enterprises to verify if pollution control is taking place. Finally, the system is good in that it provides some flexibility by requiring some firms to reduce more than others so the policy is not uniform. This could reduce costs for those firms where pollution control is very expensive and demand more reductions from those firms where pollution control is less expensive. It has not been very effective because the EPBs do not impose stringent enough fines to discourage firms from breaking the regulations. The system does not relate very well to the ecological goal and there are discrepancies between pollution loads in the permit system and the overall national goals.

The **Total Amount Control (TAC)** system is a reform of the pollution permit system. The TAC system ensures that the quotas allowed under the permit system add up to meet the national target. First, the national target is set and then these targets are allocated among the provinces and then the provinces eventually allocate their assigned amounts to firms. The EPBs develop annual plans and conduct inspections of the enterprises. The degree of implementation at the local level is unclear. It is the study team's impression that the relationship between emissions and environmental ambient quality is poorly understood in many parts of the country, which will make it difficult to ensure implementation. It clearly does not replace the discharge standard system and the TAC system is probably not very cost-effective.

IMPROVING THE CURRENT SYSTEM

Overview of the Recommended Market-Based Instruments

The set of market-based instruments for environmental management identified in this study was selected by the team of experts from the wealth of international experience with market-based instruments in environmental protection. Although the major focus is on market-based instruments, **the Policy Action Plan emphasizes "problem solving" and not simply the demonstration of instruments**. Thus, where appropriate, strengthening of existing command-and-control instruments or the introduction of new regulatory approaches is recommended. This set of instruments were determined by:

- Identifying the most promising of existing instruments currently in use in China and proposing reforms for improving them.
- Introducing a limited number of new instruments considered to be the best based on international experience ("best practice"), and,
- Suggesting further refinements to environmental financing mechanisms in order to enhance China's environmental investment in the future.

China has as much, if not more, practical experience with market-based instruments for environmental management as any developing nation in the world.

Reforming existing instruments and pricing

China has as much, if not more, practical experience with market-based instruments for environmental management as any developing nation in the world. The team of international experts

recognizes and applauds this fact and bases several of its recommendations on the accumulated experience with these instruments. For example, China is in the process of its main market-based instrument, the pollution levy system (PLS). In addition to those reforms currently being undertaken, the team of experts recommends increasing the air pollution rates of the PLS and integrating municipal wastewater charges into it. These reforms would further increase the effectiveness of the PLS as an economic incentive for reducing air and water pollution and address the institutional disconnect that exists between industrial and municipal waste-water management. Further, the team recognizes the SO_2 charge as a potentially effective market-based instrument for reducing air pollution from energy sources and recommends increasing the SO_2 charge rates in order to maximize the incentive. Finally, the team recommends removing existing subsidies for water and energy consumption. These measures would help China to optimize the use of its water and energy resources.

Introducing new instruments

To complement the existing market-based instruments for environmental management, the team of experts also recommends the introduction of a number of new instruments for China taken from the best examples of international experience. For example, while the team recognizes the regulatory value of the total amount control (TAC) system, it also sees the inherent inflexibility and inefficiency of this tool as it is applied in China. In order to increase flexibility and efficiency in the TAC system, the team suggests expanding the use of trading programs among point sources of air and water pollution. Also, China should consider introducing a "banking" program to promote more creative investments. In this case, "banking" means to set aside a portion of the revenues generated from point sources in the pollution levy system and apply the revenue to finance cost-effective investment in non-point source pollution abatement. To address the difficulties in dealing with mobile sources of air pollution in particular, the team identifies a number of emissions-based, fuel content-based, and congestion-regulating instruments designed to complement traditional regulatory controls for mobile sources.

Figure 1. Overview of Market-Based Instruments for Environmental Management

Reforming Existing Instruments and Pricing:

- Reform the pollution levy system by increasing the air pollution rates and integrating municipal waste-water charges
- Increase the SO_2 charge
- Collect fuel taxes to replace the consumption tax on gasoline
- Increase water tariffs to reflect full costs of water production
- Continue to liberalize energy markets so that energy prices reflect the full costs of energy production

Introducing New Instruments:

- Expand trading programs among point sources of air and water pollution within the Total Amount Control system
- Promote "banking" programs for making point source pollution levy system revenues available for more cost-effective treatment by non-point sources of water pollution
- Establish an emissions charge to reduce emissions from mobile sources of air pollution
- Establish a product charge on sulfur content of diesel fuels to encourage production and use of cleaner fuels
- Establish congestion tolls to reduce congestion in the use of discrete road segments, bridges, tunnels

Improving Environmental Investment:

- Augment the Total Amount Control system by adapting environmental funds to allocate basin-wide or air-shed investment
- Introduce cost-effectiveness criteria into evaluation of public/private investments in air pollution control and wastewater treatment technologies

Improving environmental investment

In addition to promoting the use of market-based instruments for environmental management, the team recommends a number of measures for improving public and private investment in environmental management and control. The team's review of current investment practices, particularly with respect to allocation of PLS revenues for industrial pollution control, identifies a number of areas with potential for improvement. In particular, the team recommends introducing cost-effectiveness criteria into the evaluation of both public and private investments in environmental protection, thereby promoting the most efficient use of limited financial resources for environmental investment. Along these same lines, the team also suggests adapting existing environmental funds to augment the current Total Amount Control system by allocating cost-effective investment on a basin-wide or air shed basis**.**

Case Study: Water Pollution Management in the Minjiang Basin, Fujian Province

The Min (or Minjiang) is the largest river in the Fujian province with three main tributaries. Its average annual runoff in the lower reaches is about 55 billion cubic meters and the average flow rate is 1750 cubic meters per second. The main sources of industrial and municipal discharges are the towns of Yongan, Sanming, Shaxie, Nanping, Shuncheng and Fuzhou City on all three tributaries. The river water quality varies but is worst in some middle segments, especially between Yongan and Nanping on the Sha tributary.

Pollution Levy in Fujian: The record of water pollution control in the Minjiang basin is mixed. Certain improvements are noticeable, in part due to the pollution levy system. The system has not been very efficient but it has resulted in some closures of highly polluting TVEs.

Better knowledge of polluters' responses: If the authorities are to be creative, they need to know more about the polluters through monitoring and observation. Information needs to be shared among polluters to maximize pollution control technological adoption. Trading of ideas is essential to the adoption of the best technologies.

Total Amount Control (TAC) policy: This vital policy has been applied conservatively in Fujian province. The Chinese authorities need to begin debating the mechanisms of its application, but not the fundamentals of the TAC policy. There are potential gains from measures that allow greater "trading" among different classes and types of polluters.

Discharge Permit Trading: The existing institutions in Fujian make it unlikely that genuine trading in wastewater discharge permits could be introduced any time soon. An exploration of the obstacles to emissions trading is warranted, though, to assess its viability.

Pricing of wastewater or pricing of water? The environmental cost of water provision needs to include the cost of avoiding the deterioration of water resource quality. The price of water should include the cost of maintaining water quality for other users within the basin. Any unpaid environmental cost ultimately translates into higher water production cost as deteriorating water quality results in increasingly expensive cost of delivering uncontaminated supplies or in the need to pre-treat existing supplies.

Non-tax and non-trading approaches: Training of staff in provincial EPBs in flexible and collaborative ways. Upgrading municipal wastewater infrastructure in the basin in ways that improve institutional arrangements that integrate industrial and municipal pollution control approaches. Introduction of more market-based approaches toward wastewater control needs to be integrated with estimates of demand for pollution control facilities.

The entire case study is available in the final project report.

Policy Measures

China recognizes the need to sustain and strengthen its network of environmental institutions, as evidenced by the goals and plans in the "Ninth National Five-Year Plan" (1996-2000) and the projections for subsequent plans. In addition, a great deal of recent work by SEPA and the Chinese Research Academy for Environmental Science has focused on reforms in the management institutions in general and in the pollution levy system in particular. What follows is a discussion of a number of policy measures for carrying out the recommendations for improvements.

- *Continue to make investments in building the personnel, technical, and financial capabilities of local environmental institutions.*

Clearly China has committed itself to building the capabilities of its network of environmental institutions at the provincial, municipal, country, and town level of government. The "Ninth National Five-Year Plan" (1996-2000) documents the substantial efforts that China plans to invest in building the personnel, technical, and financial capabilities of these institutions. Particular emphasis will have to be directed to strengthening the institutional capabilities of the weakest institutions, those at the

county and town levels of government. This strengthening can be done through education, training, study tours (domestic and international), workshops soliciting international experience and "best practices." Further, while China should institute reforms in the institutional management of the pollution levy system, various other charges and economic instruments deserve substantial investment as well.

Case Study: SO_2 Air Pollution in Shaanxi Province

Shaanxi Province is a medium-sized interior province located in northwest China. Its economy is based on a mix of industries and its per capita GDP was only 60 percent of the average for China in 1996. The Wei He basin is where the capital, Xi'an is located and most of the province's population, industry and pollution sources. Shaanxi has already implemented an SO_2 charge in an effort to reduce emissions. Benefits of reducing SO_2 concentrations in the air include reduced ecosystem damage (freshwater, forests, farms), reduced damage to structures and reduced damage to human health (disease and premature deaths).

This study concludes that a command and control approach to reducing emissions is more expensive than using market-based instruments. A pilot SO_2 emissions trading program is recommended for industrial sources, with a cap that declines over time at a rate consistent with the emissions targets in the TAC system. The objective, therefore, is to reduce emissions, not just prevent them from increasing. New sources would have to purchase allowances from existing sources.

The reduction in pollution control costs from trading must exceed the costs of administering the program. A technical system of standardized measurement for emissions monitoring would be needed. In addition, duplicate data sets are essential. The EPB would need to compile data, reconcile and review it and detect violations. A strict enforcement of violations is needed to create the incentive for polluters to fully participate in the program.

The entire case study is available in the final project report.

- *Reduce the number and types of charges in order to reduce administrative burdens, improve efficiency, and avoid confusion.*

The administrative burdens, inefficiency, and confusion caused by the proliferation of environmental charges needs to be addressed. The Ministry of Finance has recognized the problems presented by this web of overlapping charges and has expressed interest in reducing the number of charges and raising the rates of the remaining ones. SEPA should undertake a complete rationalization of the environmental charges currently imposed as a second stage to its proposed reforms for the pollution levy system. This will require inter-ministerial collaboration, since sector ministries administer many of the other charges. It may well involve placing legal limitations on the authority to impose independent charges at the local level of government.

- *Clarify the relationships among provincial and local governments in administering charges and accessing charge revenues.*

The emerging inter-institutional conflicts in administering environmental charges, particularly the pollution levy system, suggest the need to clarify relationships and re-establish the lines of authority in collection and management of environmental charges. SEPA recognizes that the pollution levy system needs reform and has committed to reforms in the collection and management of the charge, as well as the use of revenues from the charge. SEPA's proposed creation of "environmental funds" at the national, provincial, and local levels and the use of charge revenues for soft loans, instead of grants, for environmental pollution investments should address many of these inter-institutional issues.

- *Establish independent, market-oriented institutions to manage trading programs.*

China's experience with environmental regulatory institutions directing permit trading has proved to be more of a regulatory than a market-based brokering of tradable permits. Unfortunately, this regulatory allocation of tradable permits is seen as simply another regulatory function. The new emphasis in the fiscal reforms on mechanisms for promoting the socialist market system should encourage China to experiment with more market-oriented institutions for managing the trading programs.

Case Study: Mobile Source Emissions in Beijing

Beijing has experienced a doubling of the city's vehicle fleet since the beginning of the decade. As a result, Beijing is the most congested city in China and the rapid increase in the number of vehicles has negated all efforts to reduce emissions from mobile sources. Air pollution in Beijing represents a serious health threat and impairs visibility. Pollutant concentrations for SO_2 and total suspended particulate matter in Beijing are more than two times the World Health Organization guidelines.

The number of motor vehicles in Beijing has been rising at more than 10 percent per year. Despite the growth in motor vehicles, Beijing ranks far behind other international cities in terms of vehicles per 1000 persons. Trucks, vans and buses comprise more than one-half of the vehicle fleet and there are very few vehicles of any type that are more than 10 years old. Investment in public transportation has lagged significantly behind road infrastructure in China.

Past and current policies have included emissions standards for new and used vehicles, inspection programs, a mandatory vehicle retirement program, and restrictions on the use of high emission vehicles during times of high air pollution.

Fuel switching, congestion fees, fuel taxes, parking fees, tradable licenses, increased public transportation infrastructure, public transportation subsidies, privatization of transit, and piloting activities for air pollution and congestion are all recommended. The inspection and maintenance program needs to be enhanced and the vehicle retirement program needs to be modified. Emissions charges/taxes could be levied on vehicles and fuel modifications during the winter could reduce CO emissions. Area permits and licenses could reduce congestion, as could expanded use of congestion tolls.

The entire case study is available in the final project report.

Implementation Arrangements

As with any major policy reform program, the institutional arrangements established for promotion of the market-based instruments for environmental management identified in the Policy Action Plan will play a critical role in their success. The study team worked closely through the complex of state, provincial, and local institutions responsible for environmental policy and its implementation. Based on this experience with the institutional framework in China, the team suggests the following institutional arrangements for implementation of the action plan:

- Overall management of implementation of the Policy Action Plan – the State Environmental Protection Administration (SEPA)
- Policy formulation with respect to market-based instruments at the state level – SEPA in collaboration with the Ministry of Finance (MOF), the State Development and Planning Commission (SDPC), the State Council, and in some cases, the National People's Congress

- Policy execution with respect to market-based instruments at the provincial and local levels -- Provincial Environmental Protection Bureaus (EPBs), Water Resource Bureaus, Construction Bureaus, and their counterparts at the local level of government.

A brief discussion of these institutional arrangements follows.

Directing implementation of the Policy Action Plan.

As the principal state agency with responsibility for environmental policy and its implementation, **SEPA should assume overall responsibility for directing implementation of the action plan**. In this role, SEPA will set the priorities among market-based instruments to pursue and determine the scheduling of actions required for implementation. Needless to say, an important part of SEPA's direction will be coordinating the other policy-making institutions at the state level to take the actions necessary to advance implementation of the Action Plan. For example, many of the reforms and new instruments proposed will require action by the State Council, approval by the MOF or the SDPC, or, in the case of legislative amendment, action by the National People's Congress. Furthermore, SEPA will also have to oversee the policy-executing institutions at the provincial and local levels, enhancing capacity where necessary to implement new instruments and ensuring consistency in application nationwide.

Formulating policy at the state level

SEPA is not alone, however, in formulating policy at the state level, particularly with respect to market-based instruments that may be used for environmental management. As noted above, many of the reforms and new instruments proposed by the experts in this action plan will require SEPA's collaboration with other authorities at the state level, particularly the MOF and the SPDC, the State Council, and ultimately the National People's Congress. Recognizing this fact, SEPA will have to review its priorities among the market-based instruments with the relevant policy-making institutions and come to agreement on which instruments to pursue and what schedule of actions to follow. For example, fuel taxes will have to originate in the MOF, which may have a separate agenda with respect to environmental taxes. Reforms in the area of water tariffs and energy prices will require action by the relevant sector ministry. And, new instruments such as emissions trading and banking programs may require amendment to the underlying legislation by the National People's Congress.

Executing policy at the provincial and local levels

As noted above, **SEPA has responsibility not only for formulating environmental policy but also for ensuring its implementation nationwide**. In this regard, SEPA should set its priorities for promoting the market-based instruments contained in the action plan in consultation with key provincial and local authorities in order to determine which agencies are politically willing and technically able to execute recommended reforms or new instruments. This is critically important in deciding where to conduct pilot activities, for example.

The execution of the market-based instruments recommended in the Policy Action Plan will ultimately rest on the local policy-executing institutions, e.g., the Provincial Environmental Protection Bureaus (EPBs), Taxation Administrations, Water Resource Bureaus, Construction Bureaus, and their

counterparts at the local level of government. In some instances, these institutions will face constraints in national laws or regulations (e.g., in adopting congestion tolls or area permits for controlling mobile sources of air pollution). SEPA will have a critical role in overcoming these constraints in national policy in order to encourage local initiative in environmental control.

Furthermore, SEPA has a role in promoting the collection and analysis of data necessary for decision-making at the local level of government. To this end, SEPA should undertake a collaborative effort with selected provincial EPBs to improve data collection and integrate environmental information systems into local management programs. Along the same lines, SEPA has a role in helping local agencies in identifying and disseminating information on the most cost-effective treatment options within and across industries. In this respect, SEPA and its local executing institutions need to become more informed about the structure of the pollution control costs of its regulated executing institutions at the local level, enhancing their capacity to implement the reforms and new instruments adopted, and ensuring equitable and consistent application of the instruments nationwide.

POLICY ACTION PLAN

This section details the Policy Action Plan for promotion of market-based instruments in specific sectors that the team proposes for implementing the set of reforms of existing instruments, new instruments, and improvements in environmental investment discussed above. The instruments and their corresponding actions are organized according to the environmental sectors that were the principal focus of the study. These sectors are:

- Air pollution from stationary sources – examined in detail in the Shaanxi Province case study
- Air pollution from mobile sources – examined in detail in the Beijing Municipality case study
- Water resources management – examined in detail in the Fujian Province case study

For presentation purposes, each of the environmental sectors contains a detailed table displaying the essential information of the action plan, i.e., the market-based instruments, their corresponding actions, and pertinent information on their application. In each matrix, the market-based instruments are presented in separate rows, the first column providing a brief description of the instrument, followed by a detailed itemization of the actions necessary to implement the instrument. The rest of the columns provide pertinent information on the following:

- the sources targeted by the instrument (i.e., pollution sources identified)
- the geographical focus of the instrument (e.g., provincial pilots, river basins, air sheds, nationwide application)
- the projected timing of implementation (i.e., the scheduling of various steps)
- the institutional roles in implementation (e.g., SEPA approval, EPB execution)
- the institutional/legal changes required for implementation (e.g., capacity building, regulatory revisions, legislative amendments)
- the projected approximate costs of implementation and sources of financing (e.g., cost increases to polluters/consumers) and

- the expected impacts and benefits from implementing the instrument (e.g., projected savings, reductions in health costs).

Water Resources Management

Sound water pricing is seen as an essential complement of policies designed to manage water pollution. Underpriced water encourages wasteful use and misallocation of investment resources. It also leads to increased volume of wastewater generated and to dilution of effluent by polluters attempting to circumvent more costly effluent discharge fees.

The widely acknowledged interdependence of water and wastewater pricing needs to be translated into specific measures that can overcome the existing separation between institutions and decision-making bodies. Without this integration, problems will continue to be inefficiently exported across institutional boundaries. The low price of water pollution charged to municipal or industrial customers will continue to increase the cost of water supply (because of contamination of sources) and low water tariffs will continue to increase the cost of water pollution control. In a situation where prices are regulated by the government, it is particularly important to minimize price distortions caused by institutional separation. Price signals need to be made more reliable by internalizing any spillover effects; institutional integration is an elegant way of achieving this.

The team endorses the emerging policy of fuller pricing of water in China, but recommends several improvements of the policy and accelerated implementation. The improvements involve: (1) amendments of water supply companies' financial reporting that would make it easier to estimate the full cost of supply and institute cost control measures; (2) elimination of most non-tariff charges accompanying tariff increases; (3) simplification of tariff adjustment procedures and (4) greater synergy between the activities of MWR (Water Conservation Offices) and the water supply companies. The team recognizes that most of these subjects are under discussion in China and that interesting experiments are under way in several cities (Shenzen, Chengdu, etc.). The point is that SEPA and its provincial bodies have a stake in the outcome of the reforms of water pricing and need to play a more active role in the process. In particular, both SEPA and the water providers need to continually guard against possible combinations of water tariffs and water pollution levies that could provide incentives for dilution. This is despite the desirable inclusion of a volumetric component in the calculation of water effluent levy that will normally make dilution unprofitable.

The team identified municipal wastewater management as a major area requiring policy attention. Given the recent success in controlling water effluents of larger industrial polluters, municipal discharges are more clearly recognized as a major water pollution problem. This is not only because of limited coverage (less than 20 per cent of urban households being connected to wastewater treatment plants (WWTPs) but also because of the lack of integration of municipal wastewater treatment with the rest of the country's efforts to control water pollution. This is true even in areas where residents *are* connected, or about to be connected. The team noted the following:

- Residential polluters are treated differently from non-residential polluters even though they account for about the same amount of organic pollution load as industrial polluters. The latter are subject to the provision of the pollution levy system, and a focus of SEPA's efforts, the former are not. More than eighty percent of residential polluters are de facto exempt from payment or control.

- The rationale for undertaking municipal wastewater control has typically been affordability, municipal governments' concern over competitiveness in attracting foreign investment and impact of water pollution on the local population. Construction Commissions initiating the decisions regarding centralized wastewater treatment have different objectives from those of EPBs whose responsibility is the quality of receiving bodies within and outside municipal boundaries.

- Until now, the prices of municipal wastewater discharges have been set independently of those levied on industrial polluters and have been dictated largely by financing and affordability considerations.

- Partly because the experience with the operation of municipal wastewater treatment plants in China is still short, and because of the traditional emphasis in SEPA's work on industrial pollution control, the role of SEPA and EPBs in dealing with residential water pollution lacks a firm institutional and operational basis, and is typically dominated by concerns over the impact of possible institutional realignment on the distribution of pollution-related charges. A number of unresolved issues exist including: (1) the manner and justification of EPBs' regulation of industrial influent into WWTPs; (2) the liability of WWTPs to the provisions of the pollution levy system; (3) the mechanism of EPBs' control of WWTPs' discharges and collection of any pollution levies involving WWTPs; (4) the setting of rates charged by municipal operators of WWTPs to industrial customers.

- The design of municipal wastewater treatment plants has until now been based on the assumption of mandated, rather than negotiated, connections of industrial clients to centralized treatment facilities. Industrial polluters do not easily cross the EPB/municipal regulatory boundary and their insufficient involvement in the design of centralized treatment solutions may lead to needlessly expensive technical solutions. Absence of a clear policy on pricing of industrial influent fails to provide industrial polluters with firm parameters on which they could base their cost-minimizing responses.

The project team recommends that several pilot locations be selected where an integrated approach to controlling all water pollutants regardless of their origin would be put into operation. The essentials of the arrangement would be (1) for WWTPs to be placed under a PLS regime; (2) for industrial polluters connected (and remaining connected) to WWTP no longer to be liable to pollution levies but charged instead rates negotiated from time to time with WWTP managers; (3) industrial polluters to have maximum opportunity to affect the design of WWTPs in areas where WWTPs are yet to be constructed; (4) a revised system of financing of provincial and local EPBs resulting from a changed pattern of pollution levy collection inherent in the proposal.

The team members find a strong case, based on urban residents' willingness to pay and the balance of economic costs and benefits, for accelerating the municipal wastewater plants installation and for making wastewater treatment charge the principal means of their financing. The existing practice of combined billing for residential water and wastewater treatment is both sensible and efficient.

The current application of the TAC system, still in its formative stage, provides an important opportunity to steer the policy in a more market-based direction. While in strong agreement with the policy of capping the total pollutant load, the team suggests that formulation of more detailed TAC targets be used to introduce more flexibility into the pattern of compliance in water pollution. to engage in a negotiated (polluter-to-polluter) re-distribution of the additional pollution reduction load in line with each company's comparative advantage in pollution abatement. A range of conditions can be attached to such a modified TAC to satisfy various concerns of the regulator while unleashing the potential for a substantially reduced cost of compliance.

In the team's opinion, now is the right time to begin testing different variants of such a "TAC opening". It is suggested that the existing limited experience with controlled trading by water polluters in China (Shanghai) be re-evaluated and the experience made better known to SEPA and local EPB staff. It is proposed that suitably chosen administrative areas within at least three water basins be selected to design modified TAC formulation and implementation schemes. The areas should be chosen on the basis of several criteria described in more detail in the final project report. The schemes should include industrial polluters as well as municipal wastewater treatment plants.

The team also noted the growing seriousness of non-point sources of water pollution in China. Unlike the previous case, a market-based (negotiated) redistribution of pollution reductions from high-cost industrial or municipal sources towards lower cost non-point sources cannot be done directly. Instead, an intermediate vehicle, such as a fund which accumulates contributions from the former group of polluters and subsequently finances pollution reduction activities by non-point sources would be ideal. The team considers that such "banking" of PLS obligations and the use of the proceeds for environmental purposes outside the sector of origin may not be as revolutionary as it first appears if the experience of recycling of the proceeds of pollution levy in China is a good precedent. Once more, a pilot testing is recommended.

By their nature, *most* environmental funds are intermediary vehicles of one kind or another. The need to break away from the common practice of returning the proceeds of any pollution tax to the original contributors is strong in water resource management where pollution control needs to be ecologically based rather than depending on the administrative boundaries or sectoral considerations. The team has noted the growing recognition of this need among Chinese policy makers and proposes that the TAC system currently being introduced be augmented by a provision allowing for payments collected from violators of TAC targets to be deposited into an environmental fund designated for water basin-wide investments. Allocation of the funds would be on the basis of how efficiently a proposed investment would contribute to the environmental status of the water basin.

Increased cost-effectiveness of investment in water pollution control was identified by the team as a major crosscutting theme. There are several ways in which this objective should be pursued. First, the PLS implementing regulations should explicitly encourage the industry and municipalities to seek joint (industry-industry, industry-municipality) solutions, instead of facility-by-facility compliance. This idea has already featured in our recommendations concerning greater integration of municipal wastewater control into the overall pattern of water quality management. Second, industrial associations must be incorporated into SEPA's pollution control efforts. SEPA's role should be to encourage a flow of information about cost-effective treatment within industries as well as across industries. Flexible, low-cost, joint solutions to water pollution problems are helped by a better flow

of information. Third, therefore, SEPA itself needs to become more knowledgeable about the structure, and development over time, of pollution control costs of those who are being regulated. Mere cost summaries of end-of-the-pipe technologies are no longer adequate. Better knowledge of the abatement options and costs under greater flexibility of compliance is essential to ensuring that PLS revenues are channeled towards the most cost-effective options.

The experts agreed that in the understandable emphasis on the pollution levy system and its further improvements, the Chinese policy makers may have given less attention to other market-based instruments. Some of these may well be in the nature of "niche" instruments, suitable for selected areas rather than the entire nation, but still offering considerable potential for a low-cost improvement of the environmental status. The team considers that one such instrument is a deposit-refund scheme applied to used motor lubricants in areas where petroleum-based pollution to surface waters is particularly acute.

Market-Based Instruments for Controlling Air Pollution from Stationary Sources

China has already made substantial progress toward liberalizing energy markets so that energy prices reflect full *production* costs. It has done this by phasing out price controls and subsidies, rationalizing pricing among various types of consumers, and to a certain extent, promoting competition in energy production. The project team did not analyze these reforms, which have been covered by many previous projects. It nevertheless endorses them as important means of encouraging more efficient use of energy resources and thus reducing the amount of pollution per unit of energy consumed.

Important as energy sector reforms are, they are only a partial step toward full-cost pricing of fossil fuel combustion. Industrial and non-industrial consumers should pay for not only the production costs of fossil fuels but also the damage that combustion-related pollution emissions cause. China has, of course, long implemented the "**polluter pays principle**," through both the PLS and SO_2 charge. In both cases the levy and charge rates are too low to have a significant incentive effect. Analyses by CRAES and other organizations, as well as by the project team, make a convincing case that charge rates should be raised. In the case of the SO_2 charge, the current charge of 0.2 Yuan/kg should be increased by 4-5 times. Moreover, the charge should be extended to cover emissions by the power and heating sectors, which are currently exempt in most parts of China.

Industrial sources of air pollution other than fuel combustion are significant in some provinces. For example, production processes in the metallurgical, chemical, and cement industries also release significant amounts of particular pollutants (e.g., particulate in the case of cement). Increased levy and charge rates will also create an incentive for these sources to reduce emissions.

The current procedures for allocating revenues among the EPBs and pollution sources do not promote cost-effective pollution abatement. This defect is especially serious in the case of pollution from fossil fuel combustion, as unduly high abatement costs ripple throughout the economy due to their direct and indirect impacts on energy prices. Abatement options related to fossil fuel combustion vary greatly across sources and include not only end-of-pipe technologies like flue-gas desulfurization but also coal washing, fuel switching, and process modifications. China needs to

develop and implement improved procedures for evaluating pollution abatement projects that recognize the full range of available options and direct available levy and charge revenues toward the most cost-effective options.

The third category of actions represents an opportunity to introduce a market element into the existing command-and-control approach. China is in the process of implementing the total amount control (TAC) system. This system involves the determination of quotas on the total amount of pollution emitted at various levels (national, provincial, etc.) and the allocation of these quotas among individual pollution sources. Although the TAC is intended as a command-and-control approach, two features of it – determining aggregate quotas and allocating assigned amounts to sources – are the foundations of an emission trading program. Emission trading offers the same incentives and advantages of levy and charge systems without imposing as great a financial burden on enterprises. China has already experimented with emission trading programs, with mixed results. The introduction of the TAC system increases the probability that these programs can be implemented successfully in China. Indeed, in the absence of trading, the ambitious pollution reduction targets of the TAC system might be impossible to attain except at an extraordinarily high cost. Our estimates indicate that trading can reduce the amount industries must spend on SO2 pollution control by 20-40 percent. Moving from the TAC to trading is not automatic, however. Some legal reforms are needed, and the monitoring and enforcement capabilities of the EPBs must be upgraded substantially. The Shaanxi case study published in the final project report for Market-Based Instruments for Environmental Management in China (HIID, 1999) discusses these issues and associated action items for the case of a pilot SO2 trading program.

Market-Based Instruments for Controlling Air Pollution from Mobile Sources

China's mobile source policies have developed more slowly than in other environmental sectors, reflecting the more recent growth in the vehicle fleet and the more limited impact of mobile sources on health and environment outside of the largest cities. Not surprisingly, economic instruments, which have been featured prominently in water and stationary air, have not played a role in addressing the dual problems of mobile source emissions and traffic. Principally, revenue-generating mechanisms such as charges and taxes on vehicles and fuels and tolls on limited access roads represent the only applications of economic instruments to mobile source problems. These mechanisms have strictly served to generate revenue and have had little incentive effect. Nevertheless, the policies that characterize China's mobile source strategy are not inconsistent with international practices, although their implementation lags far behind most developed countries.

The actions described in Table 3 in this summary include both economic instruments and regulatory approaches, divided into four groups. The first group of actions is designed to encourage reductions in vehicle emissions and include two regulatory instruments and one economic instrument. The rapid phase-in of more stringent emission standards for all categories of vehicles should be the highest national priority. With an annual growth rate in vehicles of more than ten percent, additional delays in requiring stricter emission controls will undermine China's efforts to bring emissions per vehicle down to acceptable levels. If standards are to be phased in, **large urban areas, where health damages are greatest, should be targeted for earlier implementation**. While China already has emission testing capabilities, we propose that these be upgraded by switching from idle tests to vehicle testing under loads. **Vehicle testing is an essential complement to emission standards and a cost-**

effective instrument to ensure control systems and engines are maintained properly. Adoption of enhanced testing systems should follow the introduction of stricter emission standards in the large urban areas. Finally, emission charges provide a complementary instrument to the regulatory approaches that would encourage high emission vehicle retirement and purchase of low emission vehicles and provide modest incentives to maintain emission control systems and reduce driving. Emission charges can be justified in terms of the polluter pays principle and are analogous to charges for other types of pollution.

The second group of actions represents options for accelerating fleet turnover and retiring high emission vehicles. International experience suggests that a **small share of the vehicle fleet account for a disproportional amount of total emissions**. Thus, policies targeted at retiring these older, high emission vehicles, may be very cost-effective. These options are most appropriate for large cities with high levels of pollution and a large proportion of vehicles without effective emission controls. Two approaches are proposed and could both be undertaken on a pilot basis. The first approach would be similar to Beijing's mandatory retirement program, but would give greater importance to emissions than to age or the number of kilometers the vehicle has traveled. Alternatively, both positive and negative incentives for voluntary retirement could be implemented. While their impact on retirement is more difficult to predict in advance, they could potentially complement and improve the effectiveness of mandatory retirement programs. Adoption of mandatory retirement programs should not be contemplated at the national level. These programs should be implemented locally after careful assessment of fleet characteristics, air pollution problems, differences in emissions for older vehicles versus new vehicles, and anticipated growth rates for new vehicles.

The third set of options concerns the use of low emission fuels and reformulation of gasoline and diesel. China has made a commitment to switch to unleaded gasoline by the year 2000. Thus, none of the options described addresses lead phase-out through either regulatory or economic instrument approaches. As discussed previously, retrofit options involving the switch to LPG or CNG that are both financially attractive and effective in reducing emissions. These options are most suited to large public or private fleets, particularly where refueling stations can be constructed on the premises of fleet maintenance facilities and the vehicles are used for short trips. Of the fuel options described in the Policy Action Plan, **fuel switching is the only option proposed for immediate implementation**. Beijing already has made some conversions, more are planned, and retrofits should be an attractive option in other large cities. All options to reduce emissions through reformulation of gasoline or diesel fuels should be medium term priorities. Product charge on sulfur content in diesel fuel could provide incentives to develop low sulfur diesel fuels on a national level. Reformulation of gasoline to reduce volatility is recommended on a national level, although introduction on a pilot basis may be useful to better assess the potential benefits and costs. Oxygenation of gasoline is a cost-effective strategy for addressing CO emissions during the winter in colder regions. For China's large northern cities, oxygenates could reduce mobile source emissions of CO by more than 25%.

The final set of options are proposed to address congestion and, to a lesser extent, vehicle emissions. With the exception of fuel taxes, all options are expected to be most appropriate for large cities with chronic congestion problems. As discussed in the final project report, China has proposed a new tax on gasoline to replace the current consumption tax. While tentative tax rates are nearly six times the consumption tax rate, the increase is not likely to result in significant short run reductions in gasoline consumption due to inelastic demand, although the gasoline tax can be expected to provide

incentives for long run adjustments in vehicle selection and use. **China should consider the option of even higher gasoline taxes to enhance incentives for public transit and as well as vehicle choice and use**, possibly with incremental increases in line with GDP growth. **The recycling of tax revenues to improve roads or public transportation alternatives may make tax increases more palatable** among vehicle owners. The remaining three options are designed to address the congestion problems by increasing the costs of travel during peak travel times (area permits and congestion tolls) and improving the quality of public transportation options.

The action plan measures involve a diverse set of institutional players, with SEPA and provincial EPBs taking a prominent role in options to reduce vehicle emissions. The key constraints to introducing stricter emission standards and enhanced emission testing systems are both technical and financial. Since the domestic vehicle manufacturers are already working to supply vehicles to meet Beijing standards, the major issue is the pace at which production can be shifted to vehicles with advanced control equipment. Improvements in the system of emission testing would require significant capital expenditures and would necessitate analysis of optimal number of testing stations to ensure the program is cost-effective and the additional costs per vehicle of the improved tests are not prohibitively costly. Changes to the gasoline tax, introduction of an emission tax or charge, and a product charge on sulfur would require the involvement of the Ministry of Finance and necessitate new or amended legislation.

Most action items to be implemented on the local level require participation of a variety of municipal or provincial bureaus. The key constraint to the adoption of programs such as congestion tolls and area permits is likely to be their consistency with national laws or regulations. If these national provisions must be altered before local actions may be implemented, there may be significant delays.

To improve China's ability to design and implement mobile source options, particularly at the local level, the scope of data collection needs to be expanded. Even for Beijing, which has received considerable attention relative to other urban areas, data on vehicles, emissions, vehicle kilometers traveled, and traffic flow rates are not collected on a regular basis. The most reliable data are those developed for specific projects, such as the World Bank project in Beijing. It is recommended that a project be undertaken as a collaborative effort between SEPA and selected provincial EPBs to develop proposals for improving data collection and integrating information systems into management programs. In addition, collaboration between provincial EPBs and traffic management agencies for selected provinces could focus on improvement in data collection on traffic and congestion.

It is also proposed that China adopt ambient standards for ground level ozone and PM-10 and/or PM-2.5. In terms of health impacts of mobile source emissions, these pollutants account for the major proportion of damages and should provide the basis for management of mobile sources of air pollution.

Table 8.1: Policy Action Plan—Water Resources Management

A. PROMOTE FULL-COST PRICING OF WATER AND WASTE-WATER ⇒ OPTIMIZE USE OF WATER RESOURCES							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Continue to increase **water tariffs** to reflect full costs of water production: 1. Determine full costs of water production incorporating, inter alia, appropriate charges for raw water 2. Rationalize pricing among various types of consumers and regions 3. ELIMINATE OTHER WATER RESOURCE DISTORTIONS/CHARGES 4. Let rising water tariffs replace industrial water quotas	All household, commercial, industrial and agricultural consumers	Concentrate efforts in selected water supply companies in water-short provinces, then introduce common elements nationwide. Allow for local variations in tariff structure	Phase tariff increases in medium term	State Development Planning Commission, Ministry of Construction and Ministry of Water Resources set water tariff guidelines- PROVINCIAL CONSTRUCTION COMMISSION AND PRICE COMISSIONS EXECUTE SEPA to advise on the effect of water prices on possible dilution by industrial and municipal polluters.	Amend water tariff regulations and simplify tariff adjustment procedures Water supply companies to amend financial system to more reliably estimate the full cost of supply Redefine the role of municipal Water Conservation Offices Set up a mechanism to deal with possible conflicts between pricing of water and that of water effluent discharges.	Potentially significant costs in some industrial sectors WTP estimates by households support 30-40 per cent tariff increases over current levels (averaging Y0.6/cu m in 1996). No financing necessary. An average 30per cent increase in tariff would generate about $3 mil/day at old consumption levels.	Increased efficiency in water use. Removal of wastewater dilution incentives. With full-cost water pricing, wastewater volume reduction of about 10 mil cu m per day likely, equivalent to about $0.5-1.0 million per day in wastewater treatment cost.
ACCOMPANY TARIFF INCREASES BY **COST CONTROL MEASURES** BY WATER SUPPLY COMPANIES (WSC)	Water supply companies	As above	Initiate immediate ly	SDPC, MOW and MOC to set the rules.	Guidelines required to define allowable costs and rate of retrun in water tariff calculations. All costs incurred by other government agencies to be transferred to WSCs	No financing necessary.	Improved efficiency of water supply operators. Protection of consumers against possible abuse of tariff increases.
Integrate pollution levy system (PLS) and **municipal waste-water charges**: 1. Determine full costs of municipal wastewater treatment 2. Allocate charges among household and industrial dischargers 3. Incorporate municipal waste-water charges into PLS 4. Re-calibrate industrial discharge rates, wastewater tariffs and water tariffs to ensure no perverse (dilution) outcomes occur.	Industrial dischargers and municipal waste-water treatment plants	Pilot in several cities, water basins and provinces, then nationwide	Phase integratio n with reform of PLS	State Environmental Protection Admin., State Development and Planning Commission, Ministry of Construction approve – Provincial, City, County EPBs execute Municipal discharges to be supervised by local EPBs .	Extend EPB authority over municipal treatment plant discharges; enhance supervision capacity Amend PLS implementing regulations to cover municipal wastewater discharges. Provide municipal wastewater plants with autonomy in accepting industrial effluent for treatment and setting corresponding charges.	Minor administrative cost of more active involvement of EPB in monitoring centralised wastewater treatment plants. Some diversion of PLS revenue of connected industrial polluters, now still collected by EPB, towards municipal managers of wastewater treatment plants.	In conjunction with full cost pricing of water, improved wastewater management. More flexibility given to industry to choose the least cost method of compliance. Improved design of centralized wastewater plants
Price **all** municipal wastewater discharges	Municipal households at present unserved by centralised wastewater treatment facilities	Priority water basins and heavily polluted sections of these basins. Then nartionwide.	Speed up existing policy of extending national coverage.	As above. Encourage consultation with local industries in the design of centralised treatment facilities to achieve maximun compatibility and lower combined unit treatment cost.	Wastewater tariff regulations to be enacted in cities currently not having them.	Total annualized investment to treat the municipal effluent at present untreated (about 8 billion tons p.a.) of about $0.6-1.2 billion. Financing by discharging households and the connected industry via municipal budgets.	Major improvement in surface water quality. Some improvement in groundwater quality. Associated health and productivity benefits of at least $2.5-3.0 billion p.a. Lower cost of compliance by connected industry that avoids higher *insitu* treatment cost.

Table 8.1: Policy Action Plan—Water Resources Management

B. PROMOTE FLEXIBILITY WITHIN TOTAL AMOUNT CONTROL SYSTEM ⇒ INCREASE EFFICIENCY IN WATER POLLUTION CONTROL							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Discourage facility-specific and **uniform allocation of TAC targets** and favor instead more aggregate targets. Accompany by voluntary exchange/trading programs (see below)	All polluters currently targeted by TAC policy	Nationwide, with initial focus on regions where TAC policy is operational	Begin in short term	State Environmental Protection Admin./ State Council approves – Provincial, City, County EPBs execute	Existing TAC implemetation guidelines to be amended	Possibly lower administrative cost as much detailed planning is eliminated. This could be partly offset by greater cost of "arbitrating" compliance within aggregate TAC targets.	Depending on the extent of aggregation adopted under a modified TAC program, major or smaller (but still significant) reduction in the total compliance cost.
Expand **voluntary exchange/ trading programs** among point sources of water pollution within the total amount control (TAC) system: 1. Determine marginal treatment costs for point sources within a basin 2. ALLOW VOLUNTARY TRADING AMONG SOURCES AS LONG AS TOTAL AMOUNTS DO NOT EXCEED SPECIFIED LIMITS FOR THOSE SOURCES. 3. REQUIRE MONITORING AND REPORTING TO ENSURE COMPLIANCE WITH TAC	Most significant point sources	Most polluted river basins or provinces	Begin in short term.	As above	Enhance EPB capacity for directing voluntary exchange/trading programs Amend water law to authorize trading; issue implementing regulations	The cost of EPB staff training and administrative re-tooling among the EPBs involved. Additional cost of improved (and easier-to-verify) self-monitoring by participating sources. Significant potential savings/Financing through administrative budgets	Increased flexibility/ efficiency; reduced costs in achieving TAC goals. 50 per cent or greater reduction in average unit compliance cost by the regulated industry compared with a uniformly applied, facility-by-facility, TAC reduction targets
Promote **banking programs** for making point source PLS revenues available for more cost-effective treatment by non-point sources of water pollution (NC model): 1. Determine marginal treatment costs for point and non-point sources within a basin 2. Set aside a portion of PLS revenues from point sources 3. Identify pollutant of concern among point and non-point sources 4. Finance cost-effective investment by non-point sources	Most significant point and non-point sources	Most polluted river basins or provinces, especially those with significant non-point pollution sources, such as Danchi and Chaohu lakes	Phase in medium term	State Environmental Protection Admin./ State Council approves – Provincial, City, County EPBs execute	Enhance EPB capacity for directing trading programs Amend water law to authorize banking; issue implementing regulations	Minor administrative costs; significant potential savings/Financing through administrative budgets	Increased flexibility/ efficiency, reduced costs in achieving TAC goals. Extent of reduced cost of compliance uncertain as patern of pollution reduction cost by non-point sources little documented in China. Based on experience elsewhere, reduction of aggregate compliance cost of at least 25 per cent is likely.
Augment TAC system by adapting **environmental funds** to allocate basin-wide investment: 1. Collect PLS revenues from sources exceeding TAC limits 2. Determine most cost-effective treatment options available (point and non-point sources) 3. Allocate PLS revenues to most cost-effective treatment	Most significant sources	Pilot in several provinces, then nationwide	Begin in short term	State Environmental Protection Admin. approves – Provincial, City, County EPBs execute	Modify local environmental funds/ enhance EPB capacity to allocate investment/ Amend fund regulations	Minor administrative costs/ Financing through administrative budgets	Increased efficiency in investments.

Table 8.1: Policy Action Plan—Water Resources Management

C. MAXIMIZE INVESTMENT IN COST-EFFECTIVE TREATMENT ⇒ *PROMOTE EFFICIENCY IN WASTE-WATER MANAGEMENT*							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Introduce **cost-effectiveness criteria** into evaluation of public/private waste-water treatment investments: 1.Institutionalize cost-effectiveness considerations in all municipal waste-water treatment investments 2. Institutionalize cost-effectiveness considerations in all PLS investments 3. Disseminate information on most cost-effective treatment options	All industrial and municipal waste-water investments	Nationwide	Begin in short term	State Environmental Protection Admin., Ministry of Construction approve – Provincial, City, County EPBs execute. Industrial associations to be co-opted by SEPA and given fuller access to information about cost-effective treatment (same industry as well as cross-industry information)	Revise EPB/Construction Bureau procedures/ enhance capacity for revenue allocation. Amend PLS implementing regulations to explicitly encourage the industry and municipalities to seek joint (industry-industry, industry-municipality) solutions, instead of facility-by-facility compliance.	Minor administrative costs; significant potential savings/Financing through adminisktrative budgets	Increased efficiency in wastewater investments. More appropriately designed centralised treatment plants facilitating cost recovery and encouraging connenctions by the industry. Potential for reduction of average unit treatment cost of 20 per cent and up.
D. OTHER							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Introduce **deposit-refund schemes for petroleum-based products** (especially motor lubricants) **t**o reduce the problem of unsafe disposal of used lubricants and consequent pollution of water sources and bodies	All users of vehicle lubricants	Pilot in several water basins where oil pollution of surface water is serious, then nationwide	Begin in short term	Provincial and municipal EPBs to design the scheme, and select an appropriate level of deposit. State Petroleum Corporation to organise collection and re-processing of used lubricants against agreed fee, deducted form the deposit amount.	Ministry of Finance to assign administrative powers to levy the deposit and approve the management of the deposit amounts.	Initial cost of collection infrastructure (special containers) and sampling equipment to be recovered from the deposit anmount. (Twenty per cent of a suggested deposit of RMB 2-5/liter considered suitable) Re-processing of used lubricant should be self-financing.	Significant reduction of unsafe disposal of used lubricants. Economic benefits of reduced petroleum contanimation not quantified in China but agreed to be substantial. Inherent fairness of the system suggests acceptability of the scheme to the public.

Table 8.2: Policy Action Plan—Controlling Air Pollution from Stationary Sources

A. PROMOTE FULL-COST PRICING OF ENERGY ⇒ *OPTIMIZE USE OF ENERGY RESOURCES*							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Continue to liberalize energy markets so that **energy prices** reflect the full costs of energy production: 1. Promote competition in the production of energy resources (e.g., coal, oil, gas) and energy products (e.g., electricity) 2. Phase out price controls and subsidies 3. Rationalize pricing among various types of consumers	All household, commercial, and industrial consumers of energy resources and energy products	Pilot in several provinces, then nationwide	Liberalization of China's energy market is already well underway. Additional reforms are needed mainly in the state sector.			Higher energy prices will impose potentially significant short-run costs on energy-intensive sectors. Financing will be needed for investments in more energy-efficient technologies (the private sector should be main the source of financing) and social programs to assist displaced workers (the government should fund these programs).	Increased efficiency in energy use will make industries more competitive in the long run and will reduce air pollution emissions per unit of GDP.
Increase air pollution levy rates in the **pollution levy system** (PLS): 1. Continue studies of pollution abatement costs by CRAES and other organizations 2. Based on results of these studies, determine levy rates necessary to achieve desired emissions reductions for particulates and other key pollutants (see discussion below for SO_2 charge)	Power and other industrial sources (both fuel combustion and industrial processes)	Pilot in several provinces, then nationwide	Suggested measures are already part of reform process for PLS	State Environmental Protection Admin., State Development and Planning Commission, Ministry of Finance approve – Provincial, City, County EPBs execute			Increased use of cleaner fuels and cleaner production technologies in the power and other industrial sectors, increased investment in air pollution abatement, reduced emissions of air pollutants.
Increase rate for **SO_2 charge**: 1. Continue studies of pollution abatement costs by CRAES and other organizations 2. Based on results of these studies, determine charge rates necessary to achieve desired emissions reductions (most likely, rate should be at least RMB 1.0-1.2/kg, at 1994 price levels) 3. Phase-in the increase according to a pre-announced schedule 4. Impose energy taxes on fuel based on the sulfur content, in cases where it is not feasible to levy a charge on SO_2 emissions.	Power, heating, and other industrial sources (both fuel combustion and industrial processes). Charge is currently targeted at industrial sectors other than power and heating.	Pilot in SO_2 pollution control and acid rain control areas or several provinces, then nationwide	Suggested measures are already part of reform process for SO_2 charge	State Environmental Protection Admin., State Development and Planning Commission, Ministry of Finance approve – Provincial, City, County EPBs execute	Add provision to Air Pollution Prevention Act authorizing charges based on the total quantity of pollution emitted. Shift charge base from imputed emissions derived from fuel consumption to direct measurement of emissions, and shift responsibility for administering the charge toward county and municipal EPBs (provincial EPBs are currently primarily responsible)	Higher charge rates will impose potentially significant costs in sectors using high-sulfur coal and will reduce sales revenues for mines producing high-sulfur coal. Financing will be needed for investments in coal washing, fuel switching (e.g., gasification), FGD and other forms of SO_2 control, emissions monitoring, and social programs to assist displaced mine workers, and also for strengthening environmental inspection teams in EPBs.	Increased use of low sulfur fuels and cleaner production technologies in the power and other industrial sectors, increased investment in air pollution abatement, reduced emissions of SO_2.

Table 8.2: Policy Action Plan—Controlling Air Pollution from Stationary Sources

B. PROMOTE TRADING WITHIN TOTAL AMOUNT CONTROL SYSTEM ⇒ INCREASE FLEXIBILITY/EFFICIENCY IN AIR POLLUTION CONTROL							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Expand **trading programs** among point sources of air pollution within the total amount control (TAC) system: 1. Use TAC guidelines to allocate marketable rights ("allowances") among sources 2. Design trading rules 3. Design procedures for monitoring emissions, recording trades, reconciling emissions and allowance holdings, and penalizing sources that are out of compliance 4. Allow trading among sources as long as total amounts discharged do not exceed specified limits for those sources, to protect local air quality. These limits should not necessarily correspond to existing emissions standards, which might be too stringent for pollutants that disperse over large areas and might constrain trading possibilities so severely that few trades will occur. Limits should be explicitly linked to local ambient conditions.	Most significant point sources, especially (but not only) power plants	Pilot in SO_2 pollution control and acid rain control areas or heavily polluted provinces or groups of provinces first, then nationwide	Begin in short term	State Environmental Protection Admin./ State Council approves – Provincial, City, County EPBs execute	Enhance EPB capacity for directing trading programs Amend air law to authorize trading; amend other supporting legislation as necessary (e.g., commercial law); issue implementing regulations Review existing emissions standards, with the intention of making them more consistent with the attainment of ambient air quality standards. This will require the development of enhanced air pollution dispersionn modeling capacity and improved integration of air modeling with monitoring and enforcing activities (e.g., to determine maximum permissible emissions by individual facilities).	Human resource costs for EPBs will be high during design phase but should decline during implementation (though will still be higher than under TAC, due to more stringent monitoring and enforcement activities). Pollution sources will need to invest in improved self-monitoring capability. Financing for EPBs through administrative budgets; for sources, through private funds or revenue from PLS or SO_2charge.	Increased flexibility in selection of emissions reduction measures, leading to substantial (20-40%) reduction in industry's expenditure on pollution control and thus reduced costs in achieving TAC goals.
C. MAXIMIZE INVESTMENT IN COST-EFFECTIVE TREATMENT ⇒ PROMOTE EFFICIENCY IN TREATMENT OF WASTE AIR							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Introduce **cost-effectiveness criteria** into evaluation of waste air treatment investments funded by the PLS and SO_2 charge revenues: 1. Institutionalize cost-effectiveness considerations in evaluating proposals for use of PLS/SO_2 charge revenues 2. Disseminate information on most cost-effective treatment options	All industrial air pollution sources subject to the PLS or SO_2 charge	Nationwide	Begin in short term	State Environmental Protection Admin. approve – Provincial, City, County EPBs execute	Revise EPB procedures/ enhance capacity for revenue allocation Amend implementing regulations for PLS and SO_2 charge	Minor administrative costs; significant potential savings/Financing through administrative budgets	Increased efficiency in air treatment investments: greater reductions in health and productivity damages per yuan spent on treatment

Table 8.3 Policy Action Plan—Controlling Pollution from Mobile Sources

A. ENCOURAGE REDUCTIONS IN VEHICLE EMISSIONS							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
A1. Emission standards – upgrading of national standards. With plans to phase out leaded gasoline, emission standards for new vehicles should be set according to levels achievable by catalysts. Phasing recommended with urban areas prioritized.	New and used gasoline powered light, medium, and heavy duty vehicles, diesel fueled cars, trucks, and buses	Country-wide but phased in standards with more populated provinces targeted first	Provide two to three years lead time, phase in over 5-8 years	SEPA develops and issues regulation; if phase-in not reflected in SEPA regulation, EPBs may issue more stringent standards for province; EPB conducts vehicle inspections and emission testing.	Introduction of regulation. EPBs must be empowered to conduct vehicle inspections and test emissions to ensure compliance	For new cars, additional cost of emission controls to meet EU/US standards is 700 to 1100 USD per vehicle. Emission control retrofit kits available in China for 100 USD, but less effective than new systems. Development and staffing of inspection and testing capabilities financed by provincial or local EPBs, with inspection fees levied to cover O&M and depreciation.	Depending on standards, emission reductions in major combustion products of over 80% per kilometer attainable by meeting 1999 Beijing standards. Given fleet characteristics, 10% reductions in average emissions per vehicle obtainable, higher if combined with I&M, repair programs, retrofitting, or retirement programs
A2. Vehicle emissions testing – components: (1) upgrade I&M program capabilities, principally by adopting better testing procedures involving emission tests under load and simulated driving conditions (e.g., IM-240 or equivalent); (2) expand road test capabilities to detect control system failures and tampering; (3) use of green labels for vehicles meeting standards, bulding on Beijing program	All gasoline and diesel fueled road vehicles	Initial focus on piloting in large cities, expansion to other areas according to implementation schedule	Pilots in near term, full adoption in medium term	SEPA responsible for developing emission standards and testing procedures; provincial and local EPBs implement I&M, road testing, may issue local regulation in advance of SEPA action	Local regulation if piloting activites precede adoption of national regulations; promulgation of national regulations.	IM-240 dynamometer, sampling and measuring equipment cost approximately 120,000 USD compared to 5-12,000 USD for idle test equipment, although costs reduced by ½ if large market. Road tests require test equipment (usually smoke opacity) at modest cost; costs of test for IM-240 less than 20 USD, road tests free unless fail tests.	Effective I&M program capable of CO and HC reductions of 25% and NO_x reductions of 10%. Benefits increase over time, since control failures more likely as vehicles age.
A3. Emission charge – two variants: (1) annual charge on estimated emissions determined from annual emission test and vehicle kilometers traveled during year – higher charge rate for urban vehicles to reflect higher emissions/km in congested areas. (2) emission charge determined according to vehicle emissions rating and vehicle kilometers, but provides less incentive for maintaining engine performance and emissions control equipment	New and used gasoline powered vehicles	Country-wide or for selected mobile source "hot spots"	Medium term	SEPA to design basic charge system, with opt-in provision for provinces; EPB role if emission testing results used to determine annual charge	Replace modest vehicle charge with emission charge; SEPA promulgates regulation; all adminstrative mechanisms in place in provinces including annual inspection and registration (at which time kilometers traveled and emissions can be determined). Roadside testing capability may be required to discourage tampering with emission controls	For EPBs, modest increase in administration costs, I&M systems already in place. Vehicle owners may incur costs to service vehicles prior to annual test, presumably justified by potential to reduce amount of charge	Increase awareness of emissions, incentives to maintain emissions control systems (if charge based on tested emissions), potential emission reductions a function of emission charge

Table 8.3 Policy Action Plan—Controlling Pollution from Mobile Sources

B. ACCELERATE VEHICLE FLEET TURNOVER							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Mandatory retirement program based on emissions and age – expands on Beijing retirement program, added flexibility by considering vehicle emissions as major criterion, thereby providing more flexibility for well-maintained vehicles, especially for medium and heavy duty vehicles designed for extended use, more attractive for government and corporate fleets	Older, high emission vehicles	Urban areas	Near term	Provincial and local EPBs, linked to inspection and registration process	Adoption of local regulation	Minimal for EPB implementation; two cost elements for vehicle owners: higher costs/km for replacement vehicle (function of markets for used and new vehicles) and initial upfront capital costs (which are reflected in costs/km) to replace retired vehicle.	Various studies indicate 15% of vehicles account for 43% of emissions. Targeting of high emission vehicles cost-effective strategy
Incentive package to retire high emission vehicles – related components designed to attain "full cost" pricing of vehicle use or make replacement more attractive including: (1) more frequent I&M inspections for older vehicles; (2) repair and retrofit provisions; (3) higher registration fees or emission charges; (4) buy-back program	Older, high emission vehicles	Urban areas, with piloting in one or more cities	Near term	Provincial and local EPBs, municipal authorities design overall program, promulgation of local regulations, I&M, SEPA, if emission charges (see A3)	Adoption of local regulation, adapt environmental fund to support buyback (if used to finance program).	Minimal for EPB implementation, identify source of financing for buyback program; for vehicle owners, time and cost of more frequent I&M, higher likelihood of repairs, retrofit, plus payment of emission charges, with retirement and cost of replacement reduced by buyback.	Similar to B1. Focus more on personal vehicles rather than institutional fleets.
C. ENCOURAGE USE OF LOW EMISSION FUELS							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Product charge on sulfur content of diesel fuels - in terms of percentage of sulfur. Product charge would be levied on refiners and reflected in diesel fuel prices. Could be combined with new tax on diesel as differential rate surcharge on higher sulfur fuels	Diesel trucks, buses, and vans	All regions	Near or medium term	MoF, SEPA, **Ministry or agency involved in setting standards for fuels used in China**	Determination and monitoring of sulfur content, collection of product charge from refineries. Requires change in tax law if general revenues	Presumably, refineries will respond to shifts in demand and develop lower sulfur diesel fuels. Subsidies to petroleum sector for development of low sulfur fuels would accelerate introduction and lower the production costs.	Reduced sulfur dioxide emissions, fine sulfate PM
Reformulation of gasoline – two major efforts would focus on reducing volatility and blending oxygenates for winter driving in northern cities	Gasoline-fuels vehicles	For addressing volatility, initial focus in urban areas, later in all regions;	Phased, medium term to develop refining	SEPA, **Ministry or agency involved in setting standards for fuels used in China**, provincial EPBs	May require amendment to fuel quality regulations at national level, for provinces opting for oxygenate program, local	Net costs of reducing Reid Vapor Pressure by 1 psi are approximately $0.12 per liter while additional cost of oxygenates such as	Reduced volatility may decrease evaporative emissions by more than 30 percent, HC emissions by 4 percent, and CO by 9

Table 8.3 Policy Action Plan—Controlling Pollution from Mobile Sources

		oxygenates targeted in northern regions	capacity	opting in to oxygenate program	ordinances and changes to monitoring of gasoline sold in the province	MTBE is 1-3 cents per liter; Cost to reformulate fuels to be passed along to consumenr; processes demonstrated in the West.	percent with no increases in NO_x; oxygenates can reduce CO by 43% and HC by 14% for cars w/o catalysts and by 10% and 6% rspectively for cars with catalysts
Retrofit medium and heavy duty vehicles with CNG or LPG - for large public and private sector fleets, retrofit to use cleaner fuels.	Medium and heavy duty trucks, buses and vans	Large urban cities	Near term	Municipal authorities to develop investment programs	None required	Investments can be justified financially, provided alternative fuels less costly. Overall costs reduced if fleet size large enough to justify design and testing of prototypes, construction of refueling stations at maintenance facilities; only problem of securing capital an impediment.	Substantial reductions in HC and CO, potentially some increase in NO_x for some fuels.
D. ENCOURAGE REDUCTIONS IN NUMBER AND TIMING OF TRIPS							
Policy Instrument/ Description	**Sources Targeted**	**Geographical Focus**	**Timing**	**Institutional Roles**	**Institutional/Legal Changes**	**Approximate Costs/ Financing**	**Expected Impacts/ Benefits**
Fuel taxes – collect tax on fuel (gas and diesel). Tentatively, proposed fuel tax rates for gasoline and diesel of RMB 1.15 and RMB 0.95, respectively. Inelastic demand for gasoline suggests much higher tax needed to reduce or slow growth in consumption.	All gasoline purchases, although farmers using these fuels for irrigation may require compensation	All regions	Proposed fuel tax slated for 1999, additional tax rate changes in medium term	Ministry of Finance, design and overall adminstration	Adoption of tax law, additional modification to increase rates; revision of revenue sharing plan for regions adopting higher tax rates.	Minimal additional costs to implement; higher costs of fuel for vehicle owners. Major issues are the allocation of revenues between central and local governments and priotities for using these revenues for infrastructure investments in roads or public transportation	Incentives to reduce fuel consumption per owner and hence emissions and traffic (not targeted to congestion); benefits may be dampened by anticipated growth in vehicle ownership; potentially large source of revenue for Ministry of Finance
Congestion tolls – charges imposed on the use of discrete road segments, bridges, tunnels, differentiated by time of day, controlled or limited access necessary as self-enforcing mechanism	Vehicles using limited access highways	Urban cities, interurban, suburban corridors	Timed with introduction of new roads, roads converted to limited access	Highway Administration under Municipal Communications, Finance, and Price Bureaus participate in design, approval and implementation	Toll roads have been established in cities such as Beijing, each new toll requires municipality approval	Toll administration including facilities and staff financed out of toll revenues	Shift trips to off-peak times, other modes of transportation, encourage higher occupancy trips, potentially could exacerbate congestion on free roads
Area permits and special licenses – permits or licenses issued for vehicles to enter congested areas at peak an off-peak times; two complementary approaches: (1) permits to travel in designated areas during	Vehicles traveling in congested areas during peak travel times	Large cities	Pilot in one or more large cities	Various municipal authorities (need more information)	Municipal regulations covering permit program, permit rates, penalties for violations of the regulations	Administration costs to issue permits, added enforcement by traffic department, costs expected to be covered by permit revenues	Alleviate congestion and reduce air pollution by reducing vehicular travel during peak hours; small increases in average travel time represent substantial economic savings in

Table 8.3 Policy Action Plan—Controlling Pollution from Mobile Sources

prescribed times with costs increasing for access during peak travel hours and days and vehicle emissions; permits issued on monthly basis with daily permit purchases; (2) special license plates limiting access to off-peak times (available at lower cost							terms of reducing number of vehicles required to provide services, increase in productivity. May encourage higher occupancy vehicle use.
Public transportation initiatives – primary focus on improving quality and convenience as well as coverage of public modes of travel; design of routes to reduce travel time during peak travel periods.	Personal vehicle owners (less opportunity to switch from commercial vehicles to public transportation	Large cities	Pilot in one or more large cities	Various municipal bureaus responsible for designing, financing, and implementing public infrastructure projects, municipal pricing bureauss in setting public transportation prices	None	Costs depend on type of public transport network, subway systems more costly than public buses; financing from budget, earmarked charges, support from IFIs	Alleviate congestion and reduce air pollution by reducing vehicular travel during peak hours; small increases in average travel time represent substantial economic savings in terms of reducing number of vehicles required to provide services, increase in productivity.