China’s View of Acid Rain in Northeast Asia and Regional Cooperation Strategies for Mitigation

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Abstract

China's central government recognizes acid precipitation from coal-related sulfur emissions as a serious and growing problem. The government has gradually raised the priority accorded to this key environmental problem, and now devotes substantial resources to mitigation efforts. Officials and others in China are very open to international exchanges to address the problem, and actively seek technical and financial assistance. China is less interested in joint international efforts to address the larger problem of acid precipitation in Northeast Asia, but has shown a willingness to participate in joint research efforts. The government would likely be unwilling to consider an agreement to control transboundary pollutants, but would probably support joint research projects that could lay the foundation for discussions. At least initially, officials would probably prefer to discuss acid precipitation issues with other Northeast Asian countries on a bilateral basis, or through existing multilateral fora, rather than through a newly created organization.

Executive Summary

OVERVIEW

In the early 1980s, China's central government recognized acid precipitation resulting from coal-related sulfur emissions as a serious and growing problem. Sulfur dioxide emissions from power plants and other sources have risen quickly along with the expansion of economic activity, and some parts of southern China experience damages from acid rain similar to those found in the most severely affected regions of Europe and North America. The government has gradually raised the priority accorded to this key environmental problem, and now devotes substantial economic and political resources to mitigation efforts. Officials and others in China are very open to international exchanges to address the problem, and actively seek technical and financial assistance.

Although it is the largest contributor to regional acid precursor emissions, China has not shown great interest in joint international efforts to mitigate acid precipitation in Northeast Asia. The government would likely be unwilling to consider an agreement controlling transboundary pollutants in Northeast Asia. Some in China may not even see the need for such an agreement, since domestic incentives to control sulfur emissions-both to reduce acid precipitation and human health impacts-are already very strong. On the other hand, China is willing to participate in joint research efforts, and would probably support monitoring and research projects that could lay the foundation for discussions.

CHINA'S DOMESTIC ACID PRECIPITATION

Sulfur dioxide is the most important acid precursor in China, and coal combustion accounts for 94% of all atmospheric sulfur emissions. Total emissions have been rising nearly as fast as coal use, since mitigation efforts have been weak. Power plant boilers are collectively the single largest contributor, industrial boilers the second, and residential stoves and boilers third. Power plants are the largest contributors to pollutant emissions that are transported long distances, and thus to regional acid precipitation. Industrial and residential sources contribute mainly to local, particularly urban acid precipitation

Areas affected by acid precipitation are principally in southern China, with some areas experiencing precipitation with average pH below 3.5. The affected area has gradually expanded to include eastern and northern coastal areas. Until recently, acid precipitation was mostly restricted to cities, but it has been spreading to rural areas. Direct acid-rain damages in the worst affected areas were 16 billion yuan (US $2 billion at present exchange rates) annually by the end of the 1980s.

CHINA'S CONTRIBUTION TO ACID PRECIPITATION IN NORTHEAST ASIA

China officially recognizes that acid precipitation is a problem with regional dimensions, and that there is substantial transboundary transportation of acid precursors. The government remains noncommittal, however, on the relative contribution of each country's emissions to the severity of acid precipitation in other countries. A crucial gap in understanding of regional acid precipitation is the lack of empirical research on transboundary transport. Privately, some Chinese researchers may say they believe that China contributes more to other countries' acid precipitation burdens than those other countries do to China's, but this does not represent an official position. Whatever damage China's emissions may cause in other countries, it is far less than the damage China does to itself, since most emissions remain with the country's boundaries.

LEGISLATION TO CONTROL ACID PRECIPITATION

In August 1995, the National People's Congress (NPC) passed a new version of the Atmospheric Pollution Control Law, and it is expected to approve and issue regulations-drafted by the National Environmental Protection Agency (NEPA)- for implementation in the first half of 1997. Major provisions of the Law call for creating "acid rain control regions" and "sulfur dioxide control regions" in China. Power plants and other large coal users will be required to adopt measures to reduce emissions. Production of high-sulfur coal will be limited and new coal-washing facilities will be encouraged. A sulfur dioxide emissions permitting system will be extended to cover all major coal users, and emissions fees will be gradually raised to a level above the cost of control. The system for using emissions fees will also be reformed. The Ministry of Electric Power's plans call for desulfurization equipment to be installed at power plants totaling 10 GW (out of a projected total of about 200 GW of fossil fuel-fired generating capacity) by 2000. In addition, NEPA is releasing new standards for power plant emissions rates.

PARTICIPANTS IN CONTROLLING ACID PRECIPITATION IN CHINA

Setting and implementing China's policies to control acid precipitation involves a wide array of actors with divergent interests. Most deeply concerned are those involved with environmental protection: the State Council's Environmental Protection Leading Group, the NPC's National Committee on Environmental Protection, and NEPA, including all its local branches down to the county and township level. This set of organizations, however, is relatively weak compared to the others that also have a say in policy formulation. The State Planing Commission and the State Economic and Trade Commission, which have responsibility for coordinating activities in different sectors, try to integrate environmental goals with other crucial objectives, such as overall economic growth and poverty alleviation. Line ministries are powerful, and vigorously defend enterprises within their jurisdictions against regulation. Provincial and lower-level administrations are crucial to implementation. Local environmental protection bureaus (EPBs) that carry out regulatory activities report both to NEPA and to local administrations, which are typically concerned mainly with local economic development, and often restrain EPBs' activities.

REGIONAL AND INTERNATIONAL COOPERATION TO CONTROL ACID PRECIPITATION

China is far from ready to consider an international agreement on limiting transboundary pollution, but there are some positions that China would likely take. Since coal will continue to dominate the primary energy consumption mix for many decades, and since coal consumption will likely continue to grow by several percent annually, China's sulfur dioxide and other coal-related pollutant emissions sources will keep growing. So long as control of emissions remains expensive, China will likely maintain that, given its relative poverty, sulfur dioxide emissions controls can only be phased in slowly. China may be willing to discuss limits to the rate of growth of emissions, or limits to per capita emissions, but talks about reducing total emissions would be unlikely. At least initially, officials would probably prefer to discuss acid precipitation issues with other Northeast Asian countries on a bilateral basis, or through existing multilateral fora, rather than through a newly created organization.

For the time being, China is likely to reject any calls to begin drawing up a framework for joint action on transboundary pollution in Northeast Asia. It's willingness to cooperate on joint research efforts and on technology transfer and development projects in support of domestic efforts to mitigate acid precipitation, however, indicate that China could be slowly drawn into such a process.

1. Overview

In the early 1980s, China's central government recognized acid precipitation resulting from coal-related sulfur emissions as a serious and growing problem. Sulfur dioxide emissions from power plants and other sources have risen quickly along with the expansion of economic activity, and some parts of southern China are experiencing damages from acid rain similar to those found in the most severely affected regions of Europe and North America. The government established monitoring networks to study trends in emissions and acidity of precipitation, and supported numerous empirical and analytical studies designed to deepen understanding of the causes and effects of acid rain. The government has gradually raised the priority accorded to this key environmental problem, and is now devoting substantial economic and political resources to mitigation efforts. Officials and others in China are very open to international exchanges to address the problem, and actively seek technical and financial assistance for controlling sulfur dioxide emissions.

Although it is the largest contributor to regional acid precursor emission, China has not shown great interest in joint international efforts to address the larger problem of acid precipitation in Northeast Asia. The government would likely be unwilling to consider an agreement on control of transboundary pollutants in Northeast Asia. Some in China may not even see the need for such an agreement, since the domestic incentives to control sulfur emissions-both to reduce acid precipitation and human health impacts-are already very strong. On the other hand, China has shown a willingness to participate in joint research efforts, and would probably support joint monitoring and research projects that could lay the foundation for discussions.

In the next section of this paper, I describe the current state of acid precipitation in China, including emissions sources, regions affected, and severity. Then I briefly examine China's view of its contribution to the acid precipitation problem in Northeast Asia. I follow that with discussions of current efforts in China to mitigate acid precipitation, and the main actors involved in setting and implementing policy. Finally, I consider China's likely attitude towards an agreement on control of transboundary pollution in Northeast Asia, and the terms on which China would be willing to engage with other countries.

2. China's Domestic Acid Precipitation

SOURCES OF ACID PRECURSOR EMISSIONS

Sulfur dioxide is by far the most important acid precursor in China (although nitrogen oxides are rising in relative significance), and coal combustion provides 94% of all atmospheric sulfur emissions. Basically, then, those sectors and equipment categories that use the most coal also contribute the most to sulfur emissions. Power plant boilers are collectively the single largest contributor, and industrial boilers the second. Furnaces and kilns are also important contributors. Less than half a dozen of the country's hundreds of power plants is equipped with desulfurization equipment, and virtually no industrial boilers are. Only 20% of coal is washed, and nearly all of that in coking for the metallurgical industry. Thus, almost none of the coal used in utility and industrial boilers is washed, sorted, or matched to improve efficiency and remove sulfur and ash.

Residential stoves and boilers are also important, mainly in terms of locally transported pollutants, but total coal use in the household sector has been declining since 1990. Many households have switched partially or completely to gas and electricity for cooking and water heating. Those households that continue to use coal increasingly use honeycomb briquettes in specially designed stoves, increasing the efficiency of coal use. Moreover, many briquettes incorporate sulfur-fixing additives, further reducing emissions.

While particulate emissions from fuel combustion in China have been rising much more slowly than fuel use (mainly because air pollution control efforts to date have focused on controlling particulates), sulfur dioxide emissions are rising, and in 1994 reportedly stood at nearly 19 Mt (Figure 1). Official reports of sulfur dioxide emissions understate the total, however, because they do not include rural industry, which consumes a growing share of China's energy. Actual emissions rates may be about 20% higher. Chinese estimates of total emissions are due to be published soon.

FIGURE 1. SULFUR DIOXIDE AND PARTICULATE EMISSIONS IN CHINA* [available in hard-copy version only]

* Figures exclude rural industry, but do include estimates for the household sector.

Source: Sinton *et al.*, 1996; State Statistical Bureau, 1996.

Besides efforts to control sulfur emissions in combustion chambers and smoke stacks, two trends will fundamentally affect China's sulfur dioxide emissions. Most important is the continued growth of coal use, from 1.2 billion metric tons (Gt) currently, to about 1.5 Mt in 2000, and up to 2 Mt in 2010. Absolute consumption of coal will continue to rise in industry, and especially in the utility sector, since electricity is the fastest growing form of energy in the end-use mix. Utility boilers will take an increasing share of coal use, and much of that rise in use will be at plants located near coal mines and major coal transfer facilities.

The other major trend is the change in average sulfur content of coal. Despite little change in the rate of washing, the sulfur content of coal is declining; in the early 1990s, delivered coal contained over 1.1% sulfur, whereas the average is now about 1.0%. One reason has been the Ministry of Coal's policy of conserving coking coal to restrain non-metallurgical use of this relatively less plentiful resource. Since coking coal has a higher average sulfur content than steam coal, this has reduced the sulfur content of coal available on the market. The recent greater availability of low-sulfur (0.5%), low-ash coals from large surface in Shanxi, Shaanxi, and Inner Mongolia has also been important. The economic reforms that have pushed mines to become more financially independent may also have played a part. Underground mines, in order to reduce mining costs, have begun to exploit shallower resources, which tend to have lower sulfur content.

AFFECTED AREAS AND SEVERITY

According to the National Environmental Protection Agency (NEPA), the main affected areas include the area to the south of the Yangtze River and to the East of the Tibetan Plateau, and the Sichuan Basin (see map in appendix). Until recently, acid precipitation was mostly restricted to urban areas, but it has been spreading to rural areas. Southern central China (Guizhou, Hunan, and Jiangxi) is afflicted with the country's worst acid rain, experiencing precipitation with an average pH of under 4.0, with more than four-fifths of precipitation episodes considered acid (i.e., below pH 5.0). Some areas regularly experience precipitation with pH under 3.5, and episodes of rain with pH as low as 2.8 have been recorded. The Southwest is also seriously affected, with areas of Sichuan receiving precipitation with an average pH of under 5.0. In 1993, most major municipal areas in Guizhou received precipitation with average pH

under 4.0, with some as low as 3.2.

The problem is less acute in eastern China, but the affected area is large, covering the heavily populated lower reaches of the Yangtze River and coastal areas as far south as Xiamen in Fujian. Some cities in southern China, particularly in the Pearl River Delta (the area surrounding Guangzhou) and in eastern Guangxi, have very acid precipitation (ranging from 4.5 to 5.0 pH), and rural areas are increasingly affected. Only a few cities in the North and Northeast-notably Qingdao in Shandong, Shijiazhuang in Hebei, Taiyuan in Shanxi, and Tumen in Jilin-regularly experience acid precipitation. Acid rain in the north is likely to intensify, especially if construction of mine-mouth power plants accelerates as planned.

An assessment of acid-rain damages in the four most affected provinces (Guangdong, Guangxi, Guizhou, and Sichuan) concluded that, in the latter half of the 1980s, direct damages were 16 billion yuan (about US $2 billion at present exchange rates) per year. Another source places the annual damage to forests alone near 1 billion yuan or more. Certainly, damages are likely to be near levels experienced in very acidified regions in Europe and North America, since many areas of southern China experience similar precipitation pH levels.

Dry deposition is also a large source of damage. Ambient levels of sulfur dioxide give an idea of the severity of this problem, as well as the direct health problems resulting from this pollutant. Figure 2 shows the range of annual average sulfur dioxide levels for nearly 90 Chinese cities. The average level for all cities regularly exceeds the U.S. annual standard of 80 µg/m3, and for some cities the annual average is many times that. Despite increases in total sulfur emissions, ambient level have remained stable, in part thanks to efforts to switch away from coal and to introduce low-sulfur briquettes to households and the food service industry, which typically account for a large fraction of emissions to ambient urban environments.

FIGURE 2. AMBIENT LEVELS OF SULFUR DIOXIDE (µG/M3) IN CHINA'S MAJOR CITIES (ANNUAL AVERAGES) [available in hard-copy version only]

Source: Editorial Board of the *China Environmental Yearbook*, 1995; Sinton *et al*., 1996.

3. China's Contribution to Acid Precipitation in Northeast Asia

China officially recognizes that acid precipitation in Northeast Asia is a problem with regional dimensions, and that there is substantial transboundary transportation of acid precursors. The government remains noncommittal, however, on the relative contribution of each country's emissions to the severity of acid precipitation in other countries, noting that further study is needed to develop a more quantitative understanding. Modeling exercises to date suggest that a substantial fraction of the acidity of precipitation in Japan and the Korean Peninsula is attributable to emissions from China. Research on acid aerosols found on mountains in Japan seems to confirm that some acid precipitation in that country originates in the East Asian continent. Privately, some Chinese researchers may say they believe that China contributes more to other countries' acid precipitation burdens than those other countries do to China's, but this does not represent an official position. Whatever damage China's emissions may cause in other countries, it is far less than the damage China does to its own southern central and southwestern regions, since most of China's emissions remain with the country's boundaries.

A crucial gap in understanding of regional acid precipitation is the lack of empirical research on transboundary transport. Since the second half of the 1980s, China has expended considerable effort to characterize weather and atmospheric transport patterns within its borders, but has not done similar work on the Northeast Asia region (which would have to be conducted in collaboration with other countries). Such research, along with more work on source analysis of acid precipitation in the countries of Northeast Asia, is needed to complement the extensive computer modeling of regional weather patterns and pollutant transport that has already been done. Officials at NEPA reportedly have discussed with Japanese counterparts the possibility of mounting a joint empirical study of regional pollutant transport, but the political sensitivity of the issue has prevented any action to date.

4. Legislation to Control Acid Precipitation

In August 1995, the National People's Congress (NPC) passed a new version of the Atmospheric Pollution Control Law (*Daqi Wuran Fangzhi Fa*), originally passed in 1987. Implementation regulations for the Law have already been drafted by an expert group appointed by the National Environmental Protection Agency. State commissions, line ministries, and local administrations are

currently commenting on the regulations. The NPC is expected to approve and issue revised versions of the draft regulations in the first half of 1997.

Major provisions of the Law call for creating "acid rain control regions" and "sulfur dioxide control regions" in China. Power plants and other large coal users in these regions will be required to gradually adopt measures to reduce sulfur emissions. Coal mines are also covered; production of high-sulfur coal will be limited and construction of new coal-washing facilities will be encouraged. Other provisions require that a sulfur dioxide emissions permitting system be extended to cover all major coal users, and that emissions fees gradually be raised to a level above the cost of emissions control. In addition, NEPA is releasing new standards (in three classes) for power plant emissions rates, based on stack height.

Within the "acid rain control regions", regulations will be designed to address long-range transport of acid precursors, and will therefore focus on large end-use facilities like power plants, as well as coal mining and processing facilities. Standards will be set for sulfur content of coal used. Those facilities that use coal that exceeds the standard will be required to adopt flue-gas desulfurization and other measures to reduce emissions. New mines that produce high-sulfur coal will be required to invest simultaneously in coal-washing facilities, and existing mines will be required to build washeries within a limited time. Overall levels of production of high-sulfur coal will be limited in some districts, based on an overall evaluation of all emissions sources and coal characteristics. In the "sulfur dioxide control regions" the focus will be more on local transport of pollutants and on controlling impacts to human health. In these areas, measures to control sulfur emissions from household and restaurant stoves (e.g., coal briquettes with sulfur-fixing additives) and residential boilers will receive more attention.

Provincial and municipal governments will be allowed to set rules that are more stringent than the ones applied to their jurisdictions by national authorities. Guangdong, for instance, is implementing special rules for the Pearl River Delta area. Like the national regulations now being drawn up, Guangdong's rules require coal-fired power plants to adopt measures to reduce sulfur emissions, but the timetable for implementation is more rapid than the national rules are likely to require.

The boundaries of acid rain control regions will be set according to average acidity of precipitation. The threshold level is likely to be set at pH 4.5, although it may be as low as 4.0. A threshold level of pH 5.0 has been discussed, but is not likely to be adopted, in part because the area subject to precipitation with that average level of acidity is quite large and would strain already limited resources for implementation.

China has had an emissions fee system in place for many years, but air pollution fees were levied only on particulate emissions, and collection has been uneven. The new legislation calls for phasing in fees on other pollutants as well, beginning with sulfur dioxide. China has already implemented a sulfur dioxide emissions fee system on a trial basis since 1992. Major coal consumers in two provinces (Guizhou and Guangdong) and nine cities (Chongqing and Yibin in Sichuan; Nanning, Guilin and Liuzhou in Guangxi; Changsha in Hunan, Yichang in Hubei, Hangzhou in Zhejiang; and Qingdao in Shandong) were required to pay emissions fees of 150 to 200 yuan per ton of sulfur dioxide emitted. The new law requires that the emissions fee system be extended to the rest of the country, and that the fee be gradually raised to a level higher than the cost of emissions control. The regulations currently under consideration will lay out a timetable for phasing in the higher fees and means for enforcing collection.

The disposition of funds from emissions fees will also change under the new air pollution control law. Formerly, up to 80% of emissions fees were returned to the same enterprises from which they were collected, often in the form of direct subsidies. The new system will no longer guarantee that the fees revert to polluting enterprises. Instead, the money will be used to fund a credit facility that will provide loans to all enterprises for environmental protection projects. Those enterprises that "contribute" more to the fund will not necessarily be entitled to greater amounts of credit.

Aside from the recent legislative activity, NEPA has worked jointly with the Ministry of Electric Power (MOEP) to address sulfur dioxide emissions from power plants. MOEP is involved in desulfurization technology development and demonstration projects (including the foreign-funded projects mentioned below). The Ministry's plans for the Ninth Five-Year Plan call for flue-gas desulfurization equipment to be installed at power plants totaling 10 GW (out of a projected total of about 200 GW of fossil fuel-fired generating capacity) by 2000. Sulfur dioxide emissions from power plants alone would be near 11 Mt per year.

5. Participants in Controlling Acid Precipitation in China

Setting and implementing policy for addressing acid precipitation involves first the bureaucratic apparatus for environmental protection. The State Council, the Chinese government's highest administrative body, is home to the Environmental Protection Leading Group, which sets the general direction for environmental policy and coordinates overall activities. NEPA is under the direct authority of the State Council (as are all other state agencies, ministries, and bureaus), and NEPA in turn has branches at each lower level of government, including provinces, cities, most counties, and some townships.

The NPC is the country's highest legislative body, and has responsibility for considering and passing environmental legislation. Until recently, the NPC largely signed off on legislation passed to it through the State Council, but has begun to take a more active role. The NPC has a National Committee on Environmental Protection (headed by former NEPA administrator Qu Geping), which has a brief to develop new laws and to formulate effective implementation mechanisms.

In practice, the NPC does not have the wherewithal to formulate environmental policies, and typically provides guidance to NEPA for drafting policies and rules. Like most organs of the central government, NEPA has a relatively small staff given its responsibilities, and it usually creates an expert committee, with many members drawn from research and academic organizations, to draft legislation. The scientific basis for NEPA's policy recommendations generally comes from work (including joint international projects) done by NEPA, its research arm, the Chinese Research Academy of Environmental Sciences, the Chinese Academy of Sciences, and the China Energy Research Society. Research projects directly related to policy also involve staff of state commissions and line ministries.

Since environmental policy touches on so many spheres of activity, policy formulation and implementation is coordinated with other parts of government. Those national organs with economic and financial responsibilities-the State Planning Commission (SPC), the State Economic and Trade Commission (SETC), the Ministry of Finance, and the major banks-have input into the process. If, as is often the case, policies and rules involve requirements for developing new technologies, the State Science and Technology Commission will become involved. Particularly for environmental issues that arise primarily from energy use, such a acid precipitation, ministries and state corporations in the energy sector will be involved. They include especially the Ministry of Electric Power and the Ministry of Coal, and in some cases the China National Petroleum Corporation and regional coal and electricity authorities. For legislation affecting major energy-using sectors (e.g., the metallurgical, building materials, and machine-building industries) the relevant line ministries will have a say as well. Should policy involve agreements with other countries or multilateral organizations, the Ministry of Foreign Affairs will play a part, and participation by the state commissions will be stronger.

Most of the actors just mentioned are relatively more powerful than NEPA and can therefore have considerable influence on the content and strength of environmental regulations as they are written and implemented. They can be expected to work hard to protect their respective spheres of influence from perceived intrusion by environmental regulators. The SPC and the SETC have responsibility for coordinating activities in different sectors, try to integrate environmental goals with other crucial objectives, such as overall economic growth and poverty alleviation. Those organs responsible for energy and industrial sectors often resist new and more stringent environmental control requirements as an undue burden on sectoral economic performance.

Just as important as the national actors, in many ways, are the local actors, particularly in view of the continuing process of decentralizing authority that has been a key feature of economic system reforms. Provincial and some municipal administrations, whose top priority is typically local economic development, have direct input into drafting of environmental legislation, and have primary responsibility for carrying out monitoring and regulation. They also have considerable influence on how monitoring and regulatory activities are carried out. Local environmental protection bureaus have difficulty functioning as regulators because, in addition to their responsibility to the national environmental protection system, they are also subject to the authority of local administrations, which allocate their funding. There is considerable variation among localities, with some vigorously pursuing environmental protection objectives. In some areas, there is a virtual vacuum in implementation, with only one or two part-time staff in country environmental protection offices, and sometimes no staff whatsoever. On the other hand, local administrations that are supportive of environmental protection efforts can be crucial to the success of regulatory actions. Zhangjiagang in southern Jiangsu, for instance, is an extremely clean city by Chinese standards, mainly due to the support of the mayor, who has taken Singapore as a model.

6. Regional and International Cooperation to Control Acid Precipitation

TERMS OF ENGAGEMENT

The Chinese government currently views the problem of transboundary acid precipitation as a subject for scientific research rather than for a binding international agreement. While willing to admit that the problem exists, and that acid precursors move between countries, China remains unwilling to discuss relative contributions, let alone targets and methods for emissions controls.

On the other hand, China is very willing to engage in many of the kinds of aid and trade activities that would be adopted under almost any regional agreement to control acid precipitation-so long as the rationale for such activities does not include statements about responsibility for transboundary pollutants and targets for control. For instance, China's Agenda 21 Office actively seeks foreign participation in projects oriented towards sustainable development, but does not tie the projects to any specific commitments to meet targets that would measure progress towards sustainability. China has been very responsive to Japan's Green Aid Program, which has included demonstration and design of utility and industrial boiler desulfurization equipment and transfer of energy-efficient equipment. Table 1 lists the Sino-Japanese desulfurization projects announced to date. Some Japanese-funded research projects conducted by Chinese organizations have been aimed (both directly and indirectly) at characterizing the markets in China for Japan's clean-coal and energy-efficient technologies. These have been characterized as aid and trade promotion programs with multiple benefits for all parties, including unquantified contributions to controlling emissions of acid precursors and greenhouse gases.

TABLE 1. DEMONSTRATIONS OF JAPANESE DESULFURIZATION TECHNOLOGY IN CHINA

Location	Facility	Demonstrated Technology	Status
Chongqing, Sichuan	Luohuang Power Plant(2 x 360 MW)	wet lime injection(Mitsubishi)	in operationsince 1991
Qingdao, Shandong	Huangdao Power Plant	semi-dry lime injection	in operation
Taiyuan, Shanxi	Taiyi Power Plant	simplified wet lime injection	in operation
Chengdu, Sichuan	power plant	electrostatic removal	under construction
Weifang, Shandong	industrial boiler	unknown	in operation
Chongqing, Sichuan	industrial boiler	unknown	in operation
Nanning, Guangxi	industrial boiler	unknown	in operation

Source: Shu, 1995; expert interviews, October 1996.

The only other countries with flue-gas desulfurization demonstration projects in China are Germany and Finland. China's State Council recently approved a project, partially funded by a $300 million loan from Germany, to install desulfurization units on two 200 MW generating units in Chongqing. The terms of the project will allow the power plant to charge a higher rate for its electricity to cover operating costs and depreciation of the scrubbers. Since the region is short of generating capacity, customers are willing to absorb the increased cost of electricity. Lack of similar provisions have hampered operation at the Japanese-funded demonstration plant in Chonqing; that plant reportedly runs its desulfurization equipment only during the day in order to reduce its high operating costs.

In general, China is very interested in technical cooperation projects aimed at adapting flue-gas desulfurization technologies. In particular, researchers and officials feel that Japanese and American wet lime injection technologies are well-suited to Chinese conditions, and would like to find ways to develop cheaper, perhaps marginally less effective, and smaller-scale versions of Japanese and American equipment. Technical cooperation of this sort-with no more than vague mention of its relevance to regional acid precipitation-would be ideal, from China's point of view.

As with any other area that touches on development, China is very keen to attract foreign financial support for environmental protection. China simply does not currently have the capital to finance its own, very rapid growth, nor the production capacity. Approximately one-third of the investment funds for power projects in China, for instance, already comes from overseas, and by 1998 China will probably have exceeded the capacity of its equipment

manufacturers to fill orders for utility boilers and generating sets. China would probably be very receptive to finding ways to tie funding for sulfur emissions controls to funding for power projects.

China has also shown a good deal of willingness to conduct joint research projects (except in certain sensitive areas, as noted above). The participation of Chinese government organs and research organizations in numerous bilateral and multilateral studies of greenhouse gas emissions sources and mitigation strategies provides ample evidence. Chinese researchers have been involved in studies of Asia's regional acid rain problems (both in multinational studies like the RAINS-ASIA modeling study and in internally financed and conducted studies) since the early 1980s. Most of the joint research projects have been done in collaboration with Japanese and South Korean researchers. China very likely would view expanded joint research efforts as a prerequisite to any official discussions on a framework for controlling transboundary air pollution.

REGIONAL VS. SUBREGIONAL (BILATERAL) FORA

Chinese researchers and officials recognize that there are a number of important transboundary environmental problems, including acid precipitation, that would be best solved through joint regional approaches. China already participates in some regional fora that address environmental problems in Northeast Asia, setting a precedent for possible future participation in a regional organization to address acid precipitation. China would probably prefer to deal with acid rain through an existing regional forum, like APEC, rather than through a newly created organization.

On the other hand, China has given some signals that it prefers to deal with regional issues on a bilateral basis. In the dispute over the Spratley and Paracel Islands in the South China Sea, for instance, China has preferred to deal directly with the parties to the dispute in bilateral talks rather than through a multilateral forum like the Association of Southeast Asian Nations (ASEAN). Bilateral negotiations give the parties much greater control over the process of negotiation, and agreements, once reached, can be used a precedents when dealing with other parties regarding similar issues.

CONVENTION TO CONTROL TRANSBOUNDARY POLLUTION

China is far from ready to consider an international agreement on limiting transboundary pollution, but there are some positions that China would likely take. Since coal will continue to dominate the primary energy consumption mix for many decades, and since coal consumption will likely continue to grow by several percent annually (even if the energy consumption elasticity of economic growth remains under 0.5, as it has for years), China's sulfur dioxide and other coal-related pollutant emissions sources will keep growing. So long as control of emissions remains expensive, China will likely maintain that, given its relative poverty, sulfur dioxide emissions controls can only be phased in slowly, and that absolute levels of acid precursor emissions will rise. China may be willing to discuss limits to the rate of growth of total sulfur dioxide emissions, but talks about reducing total emissions would be unlikely in the near future. China may be willing to consider limits to or reductions in per capita sulfur dioxide emissions, particularly if such limits allowed total emissions to grow.

Many of the issues that would be dealt with in a transboundary pollution control agreement (and many of the mitigation measures) would be similar to those contained in a regime for limiting greenhouse gas emissions, but China would probably find the latter easier to agree to. One reason is that acid rain is already viewed as a serious domestic problem, and substantial resources are being devoted to its mitigation. Concern about global climate change is far weaker. Another reason is that, compared to carbon dioxide, sulfur dioxide is somewhat easier to deal with: available technologies can reduce sulfur content at any stage of fuel extraction and use, while this is simply not possible for carbon (except through switching to non-carbon-based energy sources and measures that raise energy efficiency). Limiting sulfur dioxide emissions could be very expensive indeed and possibly affect economic growth, but hard limits to greenhouse gas emissions could deprive China of its cheapest form of energy and severely hamper the rapid economic growth China so strongly desires.

For the time being, China is likely to reject any calls to begin drawing up a framework for joint action on transboundary pollution in Northeast Asia. It's willingness to cooperate on joint research efforts and on technology transfer and development projects in support of domestic efforts to mitigate acid precipitation, however, indicate that China could be slowly drawn into such a process.

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Appendix: Map

Notes
