TAMING THE DRAGON HEADS: CONTROLLING AIR EMISSIONS FROM POWER PLANTS IN CHINA

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Coal-fired power plants are the leading source of industrial air pollution in China today, contributing up to one-half of total sulfur dioxide emissions and over 96 percent of carbon dioxide emissions.[1] These emissions in turn contribute heavily to acid rain, smog and climate change both within China and around the world, causing severe damage to human health and natural ecosystems.[2] China is now the world's second largest emitter of greenhouse gases, and is expected to surpass the United States within the next two or three decades.[3] Acid rain falls over 30% of China's landmass and in 1995 was responsible for 110 billion yuan RMB in economic losses – nearly 2 percent of GNP.[4] The World Bank estimates that outdoor air pollution in excess of national standards is responsible for 178,000 premature deaths a year in China.[5]

China's electric power industry has played a fundamental role in its national economic development. Local governments have traditionally viewed power plants as "dragon heads" that, if properly fed and protected from reforms, would continue to yield substantial tax revenues and other benefits.[6] For many years, the central government focused on policies to facilitate the rapid development of the power sector, in some cases exempting power plants from environmental regulations that might hinder such development. China's oldest power plants, typically the most highly polluting and inefficient, were kept in service as long as possible to help meet China's burgeoning demand for electricity.

In recent years, however, as the gap between power supply and demand has closed, some of China's top leaders have begun to seek ways to improve the power sector's energy efficiency and combat its severe environmental impacts. These efforts, however, must compete for attention with other national priorities that are equally urgent, deserving and under-funded. Even if consensus is reached at the central government level, translating national programs into action by local government and individual plants poses major challenges. Yet as China begins to restructure its electricity utility industry, it has an important opportunity to put into place environmental and efficiency requirements that will encourage a long-term shift in investment towards cleaner generation resources.

This paper will review and analyze China's current efforts to improve the environmental performance and energy efficiency of its power sector. The focus will be on sulfur

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[1] Chen Fu. "The SO_2 Control Strategy in China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China*. Beijing, Nov. 15-18, 1999:6; Research Team of China Climate Change Country Study. *China Climate Change Country Study.* Tsinghua University Press, 1999: 56.

[2] *See* McElroy, Michael. "Industrial Growth, Air Pollution, and Environmental Damage." In *Energizing China: Reconciling Environmental Protection and Economic Growth.* Cambridge MA: Harvard University Press, 1997: 241-26; Xu Xiping, "Air Pollution and Health Effects in Urban China". *Id.* at 268-285.

[3] Nielson, Chris P. and Michael B. McElroy. "Introduction and Overview." In *Energizing China: Reconciling Environmental Protection and Economic Growth.* Cambridge MA: Harvard University Press, 1997:27.

[4] Chen, *supra* note 1, at 1.

[5] *Clear Water, Blue Skies: China's Environment in the New Century (CWBS).* Washington, D.C.: The World Bank, 1997: 19.

[6] Remarks of Michael Oxsenberg, *Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy* (Beijing, Nov. 8, 1999).

dioxide emissions, because controlling acid rain is one of China's top environmental priorities, as well as its primary air quality goal.

CHINA'S POWER SECTOR

Coal-fired power plants have generated about three-quarters of China's energy for at least the past two decades. There are approximately 3,000 thermal plants in China today with a capacity of at least 6,000 kW, and together they consume around one-third of China's coal**.** About half of these plants are fully funded and owned or held with majority shares by the State Power Corporation (SPC).[7] Others belong to provincial power corporations, foreign investors, joint ventures, or communes.[8] China plans to gradually restructure its electric power industry in order to create a market for independent and competitive power generation open to all investors.[9]

Efficiency: During the initial stages of power development in China, owing to limitations in technology, funding and equipment, many power plants were small in scale (under 50,000 kW) with ordinary coal burning generators. These small-sized units, which supplied about 30 M kW in 1998, are highly inefficient, consuming over 200 grams more coal per kilowatt-hour than 300,000 kW plants.[10]

These plants have driven down China's overall thermal power plant energy efficiency to 30%, much lower than that of developed countries.[11] According to the Chinese Research Academy of Environmental Sciences, the average coal consumption in coal-fired power plants is 412 grams of standard coal/kWh, 25 percent higher than the world average of 317 grams of standard coal/kWh).[12]

The International Energy Agency calculates that the average thermal efficiency of coal-fired plants in China ranges from 27% to 29%, compared to around 38% in OECD countries. It estimates that raising the efficiency of boilers and other coal-fired plant by

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[7] The State Power Corporation, one of the largest state-owned corporations in China, was formed in 1997 to take over the business management of China's electric utilities from the former Ministry of Electric Power (MOEP). MOEP was disbanded and its governmental functions transferred to the State Economic and Trade Commission. This change was part of China's widespread institutional reforms in 1997 to separate business management from the administrative and regulatory functions of government institutions. Zu Chengzhang, Li Weizheng and Yang Fuquaing. "Overview of Institutional and Market Reforms and Future Prospects in China's Utility Sector." July 21, 1999. Commissioned by the China Sustainable Energy Program.

[8] Ge Chazhong, Yang Jintian and Wang Jinnan. "SO_2 Control Measures in Power Sector in China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China*. Beijing, Nov. 15-18, 1999: 3,22.

[9] Zu *et al.*, *supra* note 7, at 31-33.

[10] *Id.* at 9.

[11] Research Team of China Climate Change Country Study. *China Climate Change Country Study.* Tsinghua University Press, 1999: 227.

[12] Tang Dagang, Atmospheric Environment Institute, Chinese Research Academy of Environmental Sciences. "Emission Standard of Air Pollutants for Power Plant. *Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy* (Beijing, Nov. 8, 1999): 9.

30-35% could save some 300 million tons of coal. Potential savings could be as high as 400 million tons.[13]

Sulfur Dioxide Emissions: Power plants were responsible for 7 million tons of SO_2 emissions in 1995, or 35% of China's total emissions, and the percentage is rising.[14] Some estimates place 1998 power plant SO_2 emissions at over 40% of the total, although complete figures are not yet available.[15] According to some experts, power plant SO_2 emissions could rise to one-half of total emissions by the end of this year and two-thirds of total emissions by the year 2010.[16] This pattern resembles that experienced in the U.S., when the percentage of power plant SO_2 emissions rose from 10% to 67% of total emissions over the last fifty years as households and transportation systems switched away from coal.[17] In Shanghai, power plants are already responsible for 72% of SO_2 emissions.[18]

Very few power plants have installed desulfurization equipment in China because of its high cost, although virtually every type of desulfurization technology has been demonstrated.[19] About ten plants in China have installed continuous emission monitoring systems, but only a few of them are in operation, because of the high cost of operation and the ambiguous role of monitoring in China's environmental regulatory system.[20] Many of the plants built before 1980 have relatively low smokestacks and are located near cities, contributing greatly to local air pollution.[21] Newer plants often rely on tall smokestacks to meet SO_2 emission limits, exacerbating regional and transboundary pollution problems that are difficult to address under China's existing system of environmental regulation.[22]

SO_2 EMISSIONS CONTROL AND POWER PLANT EFFICIENCY

The State Council, China's top executive body, declared last year that the control of sulfur dioxide emissions and acid rain is one of China's top environmental priorities (the others are the cleanup of three rivers, three lakes and the city of Beijing).[23] China is developing an integrated approach to the control of sulfur dioxide and acid rain, including

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[13] International Energy Agency. *Coal in the Energy Supply of China: Report of the CIAB Asia Committee.* Paris: OECD/IEA, 1999: 25.
[14] Chen Fu, *supra* note 1, at 2.; Ge et al., *supra* note 8, at 4.
[15] Chen, *supra* note 1, at 6.
[16] *Id.*
[17] Workshop discussion. *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China*. Beijing, Nov. 15-18, 1999.
[18] *CWBS*, supra note 5, at 52.
[19] *Id.* at 50; Chen, *supra* note 1, at 6.
[20] Meng Fan, Cai Fahe, Yang Jianxiang and Pu Yifen. "Management and Monitoring of SO2 Emission Sources in China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China*. Beijing, Nov. 15-18, 1999: 16-17.
[21] *CWBS*, *supra* note 5, at 50.
[22] Chandler, William, Guo Yuan, Jeffrey Logan, Shi Yingyi and Zhou Dadi. *China's Electric Power Options: An Analysis of Economic and Environmental Costs.* Draft Final. Washington, D.C.: Battelle Memorial Institute, 1998: 16.
[23] U.S. Embassy Beijing. "China EPA Head Discuses Challenges, Priorities." Oct.1999: 1.

the demarcation of SO_2 emission and acid rain control zones, plant closures and relocations, limitations on the mining of high-sulfur coal, SO_2 emission limits, technology and monitoring requirements, capacity building and a variety of enforcement mechanisms and market-based instruments.

China's official policy for the power sector stresses both energy development and energy conservation, but places greater emphasis on energy conservation.[24] China is working to improve power plant efficiency primarily through technological renovation and the closure of older small-scale plants.

This section describes the relevant environmental and efficiency policies of key Chinese organizations, including the State Council, the State Power Company, the State Economic and Trade Commission (SETC), the State Development and Planning Commission (SDPC), the Ministry of Finance (MOF) and the State Environmental Protection Administration (SEPA).

I. THE STATE COUNCIL

A. Two Control Zone Plan

In January 1998, the State Council unveiled an ambitious plan for the control of acid rain and sulfur dioxide emissions in two major regions, or "control zones," of China. The acid rain and sulfur dioxide control zones together cover 11 percent of China's territory (1.1 million square kilometers) and are responsible for 60 percent of China's total SO_2 emissions (14 million tons).[25] The regions with the largest SO_2 emissions are mainly those with high sulfur coal and large energy production and consumption, including Sichuan, Guizhou, Henan, Hebei, Liaoning, Jiangsu and Shandong provinces.[26] The areas most seriously polluted by sulfur dioxide emissions include the provinces of Guizhou, Sichuan, Guangxi, Shanxi, Shandong, Hebei, Shaanxi, and Gansu, and the municipalities of Chongqing and Beijing.[27]

The 1995 Law on Air Pollution Prevention and Control specifically authorizes the demarcation of acid rain and sulfur dioxide control zones and the development of SO_2 control measures in those zones.[28] China's overall goals for these regions for the year 2010 are to: (1) hold SO_2 emissions to year 2000 levels, (2) bring all cities into

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[24] Sun, Jiaping and Liu Chunsheng, ed. *Electric Power Industry in China.* Epoch Printing Co., Ltd., 1998: 3.

[25] Chen, *supra* note 1, at 3-4. The acid rain control zone consists of regions while the SO_2 control zone consists of individual cities. *Id.*

[26] Lixin Jung, Jianping Zhu, Deqian Fu and Fan Meng. "SO_2 Pollution and Acid Rain Monitoring in China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China*. Beijing, Nov. 15-18, 1999: 4.

[27] *Id.* at 6.

[28] *Decision of the Standing Committee of the National People's Congress Concerning the Amendment of the "Air Pollution Prevention and Control Law of the People's Republic of China"*: Article 7 (adding a new Article 27)(Chadbourne & Parke LLP translation).

compliance with ambient air quality standards, and (3) significantly reduce the area of land with rainfall pH levels below 4.5.[29]

The State Council has developed a comprehensive set of requirements for achieving these goals, mainly focusing on command-and-control measures such as plant closures and relocations, limits on the mining of high sulfur coal, and mandated installation of desulfurization technology. Thermal power plants are key targets, since they comprise 70 percent of the major SO_2 polluting enterprises controlled by the government within the two zones. About half of total SO_2 emissions from the power sector come from plants located within these zones.[30]

Under the State Council's plan, no new thermal power plants (except for combined heat and power plants) will be approved for construction in or around large and medium cities or their surrounding suburbs. Newly built and renovated plants fueled by coal with a sulfur content above one percent must install desulfurization equipment before 2010. Existing power plants using high sulfur coal must also adopt desulfurization facilities and other effective emission reduction measures before 2010 according to a specified timetable.[31]

The plan allocates target quotas for SO_2 emissions within the two zones on a sectoral basis. Surprisingly, there is no quota of allowable SO_2 emissions for the power sector. Shanxi province has reportedly developed an SO_2 emissions quota for the Northwest Power Administration, but the power company has not yet allocated this quota on an individual plant basis.[32]

The plan forbids the construction of new mines with sulfur content in coal seams above three percent. Existing coalfields that produce coal with a sulfur content above three percent will be gradually phased out. Existing coalmines producing 1.5 percent sulfur coal or above must install appropriate coal washing and selecting facilities.[33]

The plan includes measures to strengthen enforcement, increase pollution levies and improve monitoring, research, development and training.[34] It also recognizes that much emphasis will need to be placed on energy efficiency in order to meet its ambitious goals, but does not contain any specifics. All 175 cities in the two control zones have finished drafting implementing programs, and local governments have already approved nearly 100 of them.[35]

B. Power Plant Closures

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[29] Chen, *supra* note 1, at 3-4.
[30] Ge et al., *supra* note 8, at 5, 23.
[31] *Id.* at 4.
[32] *Id.* at 23.
[33] Chen, *supra* note 1, at 4-5.
[34] Meng et al., *supra* note 20, at 3.
[35] Chen, *supra* note 1, at 4; "Acid Rain Control Plans Finalized", *Environmental Health & Safety Review*, Vol. 3, No. 5, May 1999.

In addition to The Two Control Zone Plan, the State Council last year ordered all local governments to speed up the closure of inefficient and highly polluting small power plants. Single unit plants with a capacity below 25 MW were to be shut down by December 31, 1999, and all plants with a capacity of less than 50 MW must be closed by 2003. About 41 percent (12.24 MW) of the targeted plants belong to the State Power Company. Over three quarters of these SPC plants are below 25 MW and located within the two control zones, therefore slated for immediate closure.[36]

In order to strengthen its closure orders, the State Council has forbidden power grid enterprises to buy electricity from plants due to be closed and directed banks not to lend to them. It also ordered all small-scale plants within the two zones to burn fuel with less than one percent sulfur or take other SO_2 control measures before they are shut down.[37]

II. STATE POWER COMPANY

A. Sulfur Dioxide Emission Control Goals

The former Ministry of Electric Power (MOEP) published its first report on the environmental performance of China's power sector in 1997. The report indicated progress in controlling most air emissions, except for sulfur dioxide.[38]

The Ninth Five-Year Plan (FYP) for the power sector, which was unveiled in 1996, does not contain any targets or emission control limits for sulfur dioxide, although it does include a plan for total emission control of nitrogen oxides. The Ninth FYP instead calls for the installation of desulfurization equipment in five demonstration plants, and expanding the installed capacity of generators with desulfurization equipment to 10 million kilowatts by the year 2000.[39]

The State Power Company has just published its development strategy for the Tenth Five-Year Plan period (200-2004), including the following environmental protection goals:

- During the Tenth Five-Year Plan, all pollutant discharges will meet State standards;
- The desulfurization industry will achieve a new level of development with commercial operation of domestically made 300 MW and above wet desulfurization units;

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[36] Ge et al., *supra* note 8, at 10-11. There is some evidence that the plant closure plan has been less than successful. Sinton, Jonathan, Mark Levine, David Fridley, Fuqiang Yang and Jiang Lin. *Status Report on Energy Efficiency Policy and Programs in China.* Lawrence Berkeley National Laboratory, Energy Analysis Department, 1999: 3.

[37] *Id.* at 10.

[38] "The Ninth People's Congress: Five Year Plans Announced: Electric Power Sector." *China Environmental Review,* Vol. 1, Issue 4, April-May 1998: 3.

[39] *Id.;* Ge et al., *supra* note 8, at 8; National Environmental Protection Agency, State Planning Commission, State Economic and Trade Commission. *The National Ninth Five-Year Plan and the Long-Term Targets for the Year 2010 for Environmental Protection.* Beijing: China Environmental Science Press, 1997: 22.

- By 2015, environmental protection enterprises within the State Power system will have independent intellectual property rights, and achieve a new level in terms of scale, variety and completeness.[40]

SPC's focus in terms of SO_2 emission reduction, therefore, is still on the development of domestic end-of-pipe desulfurization technologies. Although its goals include compliance with all national emission control standards, it also plans to increase total capacity by an average of 5% annually;[41] so total SO_2 emissions could rise even if all plants meet emission standards**.**

In the absence of official targets for controlling SO_2 emissions in the power sector, a group of Chinese analysts have developed their own proposed targets, based upon the State Council's Two Control Zone Plan. This proposal, which does not represent the official position of the State Power Company, demonstrates the views of some experts that total SO_2 emission control, even for one category of power plants, will take at least a decade and even then can only be achieved with great effort. The proposed plan provides that:

- By 2000, thermal power plants owned by SPC and located within the two control zones should comply with SO_2 emission standards;
- By 2000, all thermal power plants in China should reduce SO_2 emissions by a total of 1.25 tons;
- By 2000, total SO_2 emissions from SPC plants within the two control zones should be returned to 1997 levels (around 4 million tons);
- By 2005, total SO_2 emissions from thermal power plants fully funded by or held with majority shares by SPC and located within the two control zones should be controlled and limited to 4.8 million tons; and
- By 2010, total SO_2 emissions from thermal power plants fully funded by or held with majority shares by SPC and located within the two control zones should remain at 2005 levels (i.e., 4.8 million tons) with great efforts.[42]

B. Power Plant Efficiency Goals

SPC's goals for the Tenth Five-Year Plan period do not include any targets for improving the energy efficiency of power generation, although a number of initiatives, including the closure of small-scale plants, are designed to improve overall efficiency.[43] Interestingly, China's Agenda 21, which was adopted as official State policy in 1994, does contain such a target. Chapter 13, Sustainable Energy Production and Consumption, which presumably was drafted by the Ministry of Electric Power, includes the goal of upgrading old coal-fired power plants to reduce coal consumption at coal-fired power plants from

[40] "SP's Development Strategy in the 10th Five-Year-Plan." *Energy: China Market Series (CMS),* Vol. 4, No. 2, Feb. 2000: 6 <http://www.songbin.com>.
[41] *Id.* at 5.
[42] Ge et al., *supra* note 8, at 8-9.
[43] CMS, *supra* note 40, at 4-7;

427 g/kWh in 1990 to 365 g/kWh in 2000.[44] This goal might provide a useful starting point for discussions with SPC on policy mechanisms for improving power plant efficiency.

C. Environmental Management and Supervision

The former Ministry of Electric Power (MOEP) in 1996 issued a series of *Measures for Administration of Environmental Protection in Power Sector* based upon the Environmental Protection and Electric Power Laws. These measures cover (1) the duties and responsibilities of various institutions regarding environmental protection in the power sector; (2) the administration of environmental protection in construction projects and the production process; (3) scientific research, teaching, training, and international exchanges; and (4) enforcement of environmental requirements. MOEP also issued *Regulations on Environmental Monitoring in Thermal Power Industry* and *Designing Rules for Environmental Protection in Thermal Power Plants.*[45] The extent to which these requirements still apply and are being enforced following the transfer of governmental functions from MOEP to the State Economic and Trade Commission is unclear.

SPC's Department of Science, Technology and Environmental Protection plays an important role in carrying out the power sector's own environmental management systems, which include annual examinations and evaluations, environmental technology supervision and whole process management by designated institutions.[46]

III. STATE ECONOMIC AND TRADE COMMISSION

Following the 1998 restructuring of the Chinese government, the State Economic and Trade Commission has been given regulatory authority on issues relating to power plant efficiency and environmental performance.

A. Law on Electric Power

The new SETC Department of Electricity and Power has taken over a range of power sector regulatory functions from MOEP.[47] Among other responsibilities, this department is presumably responsible for supervising the implementation of China's Electric Power Law. The Electric Power Law was enacted in 1995 to cover all activities in connection with electric power construction, production, supply and consumption. Like most Chinese legislation, it is written in vague language that does not clearly delineate the

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[44] *China's Agenda 21: White Paper on China's Population, Environment and Development in the 21st Century.* Beijing: China Environment Science Press, 1994: 129.
[45] Ge et al., *supra* note 8, at 6.
[46] *Id.* at 7.
[47] *Id.*

roles of various government agencies in its implementation and enforcement.[48] Nonetheless, several provisions contain general language that could serve as legal authorization for SETC to improve power plant efficiency and environmental performance.[49] Without legislative authorization, any new standards that were developed would be voluntary rather than mandatory.[50]

The State Council issued *Rules on Electric Power Supply and Use* in 1996, pursuant to the Law on Electric Power, in order to regulate the management of electric power supply and use, protect the legitimate rights and interests of electric power suppliers and users, maintain the order of electric power supply and use and ensure a safe, economic and reasonable power supply.[51] These rules also provide general support for measures to improve power plant efficiency. Article 5 states that "the State [government] will implement, for electric power supply and use, the management principle of using electric power in a safe, saving and planned way. Power enterprises and users shall obey the relevant regulations, take effective measures and make the works in respect of using electric power in a safe, saving and planned way to be well done." Article 15 states that "the design, construction, test and operation of electric power supply and receiving facilities shall meet the national or power industry standards."

B. Law on Energy Conservation

The SETC Department of Resources Conservation and Comprehensive Utilization has primary responsibility for implementing the 1998 Law on Energy Conservation. A number of provisions of this law could also be interpreted as authorizing the development and implementation of power plant efficiency standards, although the language is fairly general. Article 39 encourages the Chinese government to promote comprehensive efficiency in thermal energy applications and increase the efficiency of electric power utilization. Article 14 authorizes the development of national energy conservation standards, either on the national or sectoral level. Article 12 requires the design and construction of all fixed capital investment projects to comply with these standards, and further requires all feasibility studies (a required step in government project approval) to include information on energy consumption. Article 12 also provides that regulatory and

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[48] Alford, William P., and Shen Yuanyuan. "Limits of the Law in Addressing China's Environmental Dilemma." In *Energizing China: Reconciling Environmental Protection and Economic Growth.* Cambridge MA: Harvard University Press, 1997: 411-412.

[49] Article 5 under "General Principles" provides that "[e]lectric power construction, production, supply, and consumption should protect the environment, adopt new technology, reduce emissions of hazardous substances, as well as prevent and control pollution and other public hazards, as provided by law." According to Article 9, "The State shall encourage the adoption of advanced technology and management techniques in the course of electric power construction, production, supply and consumption…." Article 10, under "Electric Power Construction," states that "[p]lanning for electric power development should reflect the principles of reasonably exploiting complementary development among energy resources, electric power resources and the electric grid [concerned], improving economic effectiveness and benefiting environmental protection."

[50] Zhang Hongjun and Richard Ferris, Jr. "Shaping an Environmental Protection Regime for the New Century: China's Environmental Legal Framework." *Sinosphere* Vol. 1, Issue 1 (1998): 8. <http:www.chinaenvironment.net/sino/sino1/page6.html>.

[51] *Rules on Electric Power Supply and Use,* State Council Order No. 196, April 17, 1996.

supervisory authorities may not approve the construction or completion of projects that do not meet energy efficiency standards or include an analysis of energy consumption in their feasibility studies.[52]

Article 20 contains measures to improve the efficiency of key energy-consuming corporations, defined as those with an overall annual energy consumption of at least 10,000 tons of standard coal (or those with consumption of between 5,000-10,000 tons that are identified by provincial level governments). SETC has already begun to implement Article 20.[53] Although this article is presumably aimed at improving industrial energy efficiency, it might also be interpreted to cover power generation facilities. Including power generation facilities within the category of key energy-consumption corporations could provide a powerful tool for SETC to monitor, report and perhaps disclose power plant energy utilization efficiency.

A number of provinces have already enacted regulations to implement the Law on Energy Conservation, and others are in the process of completing these regulations.[54]

IV. STATE DEVELOPMENT AND PLANNING COMMISSION

The State Development and Planning Commission (SDPC) is responsible for devising strategies and plans for national economic and social development, setting targets and developing regulatory policies to coordinate the development plans of major industries, including the power sector. SDPC maps out plans for the development of the energy sector and determines all major infrastructure investments in China, giving it tremendous influence on whether new power plants are fired by coal or other energy sources.[55]

A March 1999 study by the SDPC's Energy Research Institute proposes that China sharply limit the growth of coal production and move towards higher energy efficiency, oil and natural gas. The report also estimated that a 2.8 percent annual increase in energy efficiency in the two control zones during the next ten years would cut coal consumption by 250 million tons – the equivalent of a SO_2 emissions cut of 5.54 million tons.[56]

SDPC issued a circular in May 1999 stating that the focus of power plant construction will be shifted away from the expansion of power generation capacity and more towards newer and more efficient technologies. High priority will be placed on the development

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[52] The Law on Energy Conservation of the People's Republic of China, approved Nov. 1, 1997.
[53] Sinton et al., *supra* note 36, at 7.
[54] Wang, Alex L. *A Comparative Analysis of the 1997 Energy Conservation Law of China and the Implementing Regulations of Shandong, Zhejiang and Shanghai.* Prepared for the Natural Resources Defense Council, 1999.
[55] State Development Planning Commission (SDPC) "PRC Ministry/Commission Profile: In-Depth Version," China Online 1999: 1-2 <http://www.chinaonline.com/refer/ministry_profiles/SDPCL3.asp>.
[56] Zhou Fenqi and Zhou Dadi, eds. *Studies on Long Term Energy Development Strategies of China.* Beijing: China Planning Publishing House, March 1999.

and use of locally produced equipment in all power generation projects, and projects that help curb pollution and improve air quality.[57]

The SDPC Department of Pricing is responsible for formulating pricing policies and regulating the general price level and the prices of major state-controlled commodities.[58] Current energy prices are distorted and do not reflect the full cost of energy, making it difficult to use market-based instruments for SO_2 emission reduction.[59] SDPC is gradually deregulating the price of coal, and has drafted a plan to readjust its electricity supply pricing mechanism to bring it into line with market-oriented principles.[60] SDPC does not, however, currently allow power plants to pass along to consumers the cost of installing desulfurization or other pollution control equipment. This policy is inconsistent with full cost energy pricing and does not give enterprises an incentive to install or operate such equipment.[61]

V. STATE ENVIRONMENTAL PROTECTION ADMINISTRATION

The State Environmental Protection Administration is working actively to control SO_2 emissions in China.[62] SEPA was primarily responsible for drafting the State Council's acid rain and sulfur dioxide control zone plan, and is now overseeing the implementation process. SEPA has promulgated national SO_2 emission standards for thermal power plants, and a plan for total emission control of sulfur dioxide emissions. SEPA is working to strengthen enforcement mechanisms, develop new approaches to pollution control, and increase public awareness. It has also developed a Trans-Century Green Project aimed at implementing China's environmental goals over the next decade.[63]

SEPA has drafted a series of amendments to the 1995 Law on Air Pollution Prevention and Control that are now under consideration by the National People's Congress (NPC).[64]

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[57] "Energy Pricing Reform Initiatives." *Environmental Health & Safety Review (ESH Review),* Vol. 3, No. 5 (May 1999).

[58] SDPC, *supra* note 55, at 1-2.

[59] Zhang Shiqiu and Duan Yanxin, "Coal, Costs, and Consequences: Improving China's Energy Pricing System," Oct. 25, 1999 <http://www.idrc.org.sg/eepsea/publications/policy/PBSusanZ.htm>.

[60] ESH Review, *supra* note 57; *CWBS, supra* note 5, at 51- 55.

[61] *CWBS, supra* note 5, at 54; Ge et al., *supra* note 8, at 16.

[62] For a detailed description of the responsibilities of various SEPA departments, *see China Environmental Review*, Aug-Sept. 98: 5, and <http://www.chinaonline.com/refer/ministry_profiles/SEPAL3.asp>.

[63] SEPA's Trans-Century Green Project contains a series of projects designed to implement the environmental strategies of the Ninth, Tenth and Eleventh Five-Year Plans and the Long Term 2010 Plan. The first stage includes over one hundred projects in the two control zones, over two hundred other air pollution control projects, and several capacity building projects for national environmental supervision and management. SEPA hopes to attract foreign capital for many of these projects. Chen, *supra* note 1, at 3; "China's Environmental Law: A Comprehensive System on Paper," *China Environmental Review* Vol. I Issue 1, Oct. 1997: 6-7; National Environmental Protection Agency, State Planning Commission and State Economic and Trade Commission. *China Trans-Century Green Project Phase I (1996-2000),* Beijing: China Environmental Science Press, 1997.

[64] The interagency State Environmental Protection Commission, which once reviewed all proposed environmental legislation before its submittal to the National People's Congress, was abolished in 1998, enabling SEPA's legislative proposals to be enacted more quickly. "The New SEPA…" *China Environmental Review,* Vol. I, Issue 4, April-May 1998: 3. The establishment of the NPC's Environmental

These amendments would provide legal authorization for many of new initiatives that are described below. Other proposed amendments would set up clean energy programs, establish coal-free areas, and replace coal combustion with clean energy resources such as renewables and natural gas. The amendments reportedly include an outright ban on the discharge of air pollutants above a certain level and increase the level of emission fees and fines. They also appropriate 180 billion yuan (US$ 21.7 billion) to curb acid rain and sulfur dioxide emissions, with the majority of the funds allocated to Beijing, Shanghai, Fuzhou, Shantou, Zhanjiang and Suzhou.[65]

As described below, SEPA has established or is developing a wide range of environmental management tools, including environmental impact assessments, emissions monitoring and reporting, public disclosure, the pollution levy system, emission permits, total emission control and emission trading. Actual enforcement, however, is carried out by local Environmental Protection Bureaus, which are often more responsive to local needs and priorities than to SEPA's directives.

A. Environmental Impact Assessments

Environmental impact assessments (EIAs) specifying pollution and environmental impacts and requisite control measures must be prepared for construction projects and submitted to the department in charge and the responsible environmental protection department. The planning department may not approve the construction design until the environmental protection department has approved the EIA (Environmental Protection Law, Art. 13). SEPA itself is responsible for approving EIAs for major construction projects, including large power plants.[66]

In November 1998, SEPA enacted a set of new Construction Project Environmental Protection Management Regulations. The new regulations create a legal framework for liability if the environmental conditions of the surrounding area worsen following project completion, enhance the penalties for noncompliance, and provide guidelines for the types of projects requiring environmental impact assessments or less stringent environmental reviews.[67]

SEPA is drafting a new Environmental Impact Assessment law that would improve public participation, call for closer inspection of projects at the conception stage, and require EIAs to analyze regional impacts. The EIA mechanism itself may eventually be expanded into a "sustainability impact assessment" that will consider a much wider range

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Protection and Natural Resources Conservation Committee has also sped up the passage of environmental legislation. Zhang Hongjun and Richard Ferris, Jr., "China's Evolving Environmental Regulatory System." *China Environmental Review,* Vol. II Issue 3, Feb.-March 1999: 5-6 <http://www.asianenviro.com>.

[65] Chen, *supra* note 1, at 5; "State Stepping Up Air Pollution Battle." *Sinosphere* Vol. 2, Issue 4, Fall 1999: 5 <http: www.chinaenvironment.net/sino>; CCICED, *supra* note 50, at 3-4.

[66] Zhang Hongjun and Richard Ferris, Jr. "Shaping an Environmental Protection Regime for the New Century: China's Environmental Legal Framework." *Sinosphere* Vol. 2, Issue 3 (Summer 1999): 50 <http:www.chinaenvironment.net/sino/>.

[67] *"*Developments in EIA Law in China.*" China Environmental Review* Vol. II, Issue 4, April-May 1999: 2.

of impacts. This proposal was scheduled to be submitted to the National People's Congress by the end of 1999, and may be promulgated within the next two or three years.[68]

B. Emission Standards for Thermal Power Plants

SEPA and the State Bureau of Quality and Technical Supervision in 1996 promulgated revised national emission standards for thermal power plants in 1996.[69] These standards are based upon the age and size of the plant, and generally apply only to thermal power plants with boilers whose capacity is greater than 65 tons per hour.[70] The emission standards cover smoke and dust, sulfur dioxide and nitrogen oxides, but do not include particulate emissions. There are no time limits for compliance in the standards or the Air Pollution law itself. Instead, the government relies either on general compliance targets (such as those found in five-year plans or the Two Control Zone Plan), or else directives setting compliance deadlines for individual plants or cities.[71] Although these standards are mandatory, emissions exceeding the standards are not considered a legal violation under current law.[72]

Thermal power plants are divided into three age categories for purposes of the standards. Phase I standards are generally applicable to plants built and put into production before August 1, 1992. Phase II standards apply to new, extended and reconstructed plants whose EIAs or initial design were approved between August 1, 1992 and December 31, 1996. Phase III standards, which were added in 1996, apply to new, extended and reconstructed thermal power plants whose EIAs or initial design were approved after January 1, 1997.

Sulfur Dioxide Maximum Emission Standards: All thermal power plants must comply with maximum total sulfur dioxide emission limits. These limits are calculated according to a formula that takes into account the age and location of the plant, its stack height (with a maximum allowable stack height of 240m), and meteorological conditions. Phase III plants that exceed these limits must reduce their SO_2 emissions as necessary to meet the standards, even if it means reducing production to 90% of previous levels.

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[68] *Id.; "*Strategic Environmental Assessment Law Proposed." *China Environmental Review* Vol. II, Issue 2, Dec. 1998-Jan. 1999:3 <http://www.asianenviro.com>.

[69] State Environmental Protection Administration, "Emission Standard of Air Pollutants for Coal Fired Power Plants (GB 13223-1996)." *Selected Environmental Standards of the People's Republic of China* (1979-1997), 1998.

[70] The standards also apply to layer combustion boiler spreaders, stoker boilers and pulverized fuel boilers whose capacity is 65 tons per hour or less. *Id.*

[71] For example, the State Council ordered 47 key cities to ensure that by 2000, all industrial pollution sources meet national emission standards and air quality meets ambient air quality standards for SO_2, NOx and total suspended particulates. SEPA is developing "Management Methods for Deadline Setting" to standardize the process of deadline setting. Chen, *supra* note 1, at 8-9; Meng et al., *supra* note 20, at 6.

[72] Dasgupta, Susmita, Mainul Huq and David Wheeler, "Bending the Rules: Discretionary Pollution Control in China." *World Bank Policy Research Department Working Paper,* Feb. 1997: 3.

Sulfur Dioxide Maximum Emission Concentration Standards: In addition to these maximum total emission limits, Phase III plants in the two control zones must also comply with limits on SO_2 emission concentrations. The SO_2 concentration limits are 2100 mg/m^3 if the fuel sulfur content is below 1 percent, and 1200 mg/m^3 if the fuel sulfur content is above 1 percent. This dual standard was designed to force plants using high sulfur coal to install desulfurization equipment. In practice, however, the dual standard encourages power plants to use low sulfur coal because it costs less than installing desulfurization equipment. Plants often mix fuels with different sulfur content in order to lower the total sulfur content to below 1 percent and therefore avoid the more stringent emission standard.[73]

Such an approach is economically efficient because it allows flexibility in choosing the lowest cost option, although it does not allow power plants to meet the standards through increased efficiency or cleaner production methods. SPC and others, however, would prefer to have power plants use high sulfur coal and reserve low sulfur coal for boilers and other smaller sources whose emissions are much more difficult to control.[74]

For power plants outside the two control zones that use coal with a sulfur content of one percent or less but exceed applicable standards, a decision on whether to require desulfurization equipment will be made on the basis of the environmental impact assessment in light of the plant's total allowable SO_2 emissions, the regional SO_2 control target, and local environmental quality requirements.[75]

Monitoring and Enforcement Requirements: SO_2 continuous emissions monitoring equipment is required for all plants built in acid rain and SO_2 pollution control zones, as well as all plants using flue gas desulfurization equipment. Local environmental protection bureaus are responsible for enforcing the emissions standards, while SEPA and other national departments are responsible for enforcing the monitoring equipment requirements through the certification of monitoring equipment.

Ambient Air Quality Standards: SEPA has also promulgated ambient air quality standards for SO_2 and nine other pollutants. The standards include annual, daily and one-hour concentration limits for three different types of regions. Type I regions are specially protected areas such as natural conservation areas, scenic spots and historical sites. Type II regions are residential areas, mixed commercial/residential areas, cultural, industrial and rural areas. Type III regions are special industrial areas. The average annual SO_2 ambient air quality limits are 0.02 mg/m^3 for Type I regions, 0.06 mg/m^3 for Type II regions, and 0.10 mg/m^3 for Type III regions.[76]

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[73] Workshop discussion, *Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy* (Beijing, Nov. 8, 1999). 60 percent of the coal used in China's power plants has a sulfur content of less than 1 percent, thirty percent has a sulfur content between 1 and 2 percent, and ten percent has a sulfur content above 2 percent. Tang, *supra* note 12, at 10.

[74] Workshop discussion, *Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy* (Beijing, Nov. 8, 1999).

[75] Ge et al., *supra* note 8, at 6.

[76] State Environmental Protection Administration, "Ambient Air Quality Standard (GB 3095-96), *Selected Environmental Standards of the People's Republic of China* (1979-1997), 1998.

New Authority to Issue Standards: In April 1999, SEPA enhanced its authority to issue environmental standards by issuing new Environmental Standards Management Measures. These measures provide that SEPA may issue standards where no national environmental standards governing the target subject matter exist. Previously all environmental standards had to be issued jointly by SEPA and the State Bureau of Quality and Technical Supervision. This new authority covers pollutant emission or control standards, environmental quality standards, environmental monitoring method standards, and national fundamental environmental standards. Any unilateral standards promulgated by SEPA must be repealed if and when national environmental protection standards are issued that govern the same matter as the SEPA standards. Local governments may enact environmental standards governing a particular topic if the national government has not already issued such a standard, and may issue standards that are more stringent than existing national standards.[77]

C. Emissions Monitoring

A small but increasing number of thermal power plants in China have installed automatic SO_2 emissions monitoring equipment in the last few years. The type and quality of the monitoring instruments used, however, vary greatly from plant to plant. China needs to develop a unified standard for automatic monitoring equipment, including a certification process for imported instruments, technical standards for equipment installation, specific requirements for operational management, and a checking process for installation and operation of monitoring equipment.[78] It would also be helpful to develop a clear regulatory role for automatic monitoring in China's regulatory system, especially as the regulatory system develops to include a strengthened pollution levy system, permits and perhaps emission trading.[79]

Since most thermal power plants in China still lack automatic monitoring equipment, most SO_2 charges are calculated on the basis of estimated data derived from coal consumption. The dominant method of calculating emissions is the material balance method, which theoretically should provide satisfactory estimates, but only when no treatment methods are in use.[80] Some cities in China are unable to develop this estimated data since they lack the means to measure the sulfur content of coal.[81] SEPA and CRAES believe that automatic monitoring equipment should be required for all large power plants with sufficient technical capabilities and capital for monitoring equipment.[82]

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[77] "China Moves to Further Clarify Its Complex Environmental Standards Regime." *China Environmental Review*, Summer 1999: 1,3 <http://www.asianenviro.com>.
[78] Ge et al., *supra* note 8, at 24.
[79] Yang Jintian, Cao Dong, Wang Jinnan and Tian Weiyong. "SO_2 Charge in China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China,* Nov. 15-18, 1999: 9.
[80] *Id.* at 6.
[81] Wang Hangchen and Liu Bingjiang. "Policymaking for Environmental Protection in China." In *Energizing China: Reconciling Environmental Protection and Economic Growth.* Cambridge, MA: Harvard University Press, 1997: 399.
[82] Meng et al., *supra* note 20, at 18.

D. Emissions Reporting

SEPA's 1991 Enforcement Regulations for the Law on Prevention of Air Pollution require facilities to report (1) any major changes in the type, quantity and concentration of discharged pollutants, (2) any dismantling or idling of air pollutant treatment installations, (3) accidents, and (4) progress in complying with orders to handle pollution problems by a prescribed time. The regulations also set penalty levels for different violations, all of which are paid into the national treasury.[83] These regulations, which apparently were not revised following the 1995 amendments to the Air Pollution Law, do not appear to require regular emissions monitoring.

In 1992, SEPA directed all enterprises directly or indirectly emitting SO_2 (except small industrial sources and households) to report their discharges on a special registration form. Local EPBs are responsible for supervising the reporting process.[84] More information is needed to determine whether this SO_2 emission reporting is required an annual, monthly, or one-time basis.

E. Public Disclosure and Participation

SEPA is taking a number of steps to increase public awareness of environmental issues. A total of 27 cities in 1997 began to broadcast weekly readings of their local air quality. The cities monitor SO_2, NOx, and total suspended particulates (TSP) and combine the three readings into a weekly air pollution index (API). The program is successful and homebuyers in Shanghai reportedly consider API readings when deciding where to live. SEPA plans to extend the API reporting system to 47 cities and to develop a daily reporting system.[85] The Beijing city government began to publish daily air quality reports in 1999.[86]

Under the Environmental Protection Law, municipalities are required to publish periodic reports on local environmental standards and pollution control measures. In 1997, SEPA pressed Beijing and Shanghai to disclose the details of their environmental violations to the public.[87] In August 1997, Beijing held its first public press conference, in which it discussed the state of the city's environment.[88]

SEPA and the NPC Committee on Environmental Protection and Natural Resources Conservation have developed an "All-China Trans-Century Environmental Tour," a four-

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[83] "Enforcement Regulations for Law on Prevention Of Air Pollution of the People's Republic of China." <http://www.qis.net/chinalaw/prclaw33.htm>.
[84] Meng et al., *supra* note 20, at 8.
[85] "National Activity: Air Pollution Index." *China Environmental Review,* Vol. I, Issue 3 Feb.-March 1998: 3-4 <http://www.asianenviro.com>.
[86] "Air Pollution Blocks Beijing's Blue Sky." *Environment News Service,* 1 Sept. 1999.
[87] "Publicizing Pollution Data." *China Environment Reporter,* Vol. 1, No. 1, April 30, 1997:5.
[88] News in Brief." *China Environmental Review,* Vol. 1, Issue 2, Dec. 1997: 4.

year program aimed at exposing polluters to the public through TV, newspapers and other media.[89]

SEPA is also working to enhance citizen involvement in environmental activities. The 1996 amendments to the Water Pollution Prevention and Control Law provide for the consideration of public comments related to construction, reconstruction or demolition projects that will impact water quality.[90] As mentioned above, SEPA is developing a new environmental impact assessment law that may increase public participation in EIAs on all types of projects. It is unclear whether the amendments to the Air Pollution Prevention and Control Law will include similar provisions.

Desmond Connor, an expert in public consultation, suggests that China may be ready to experiment with a limited form of public consultation, in which the government provides information to the public and solicits feedback on several possible solutions. A number of Chinese managers who have considered this approach appear to believe that public consultation is feasible and even necessary to increase understand and support for the myriad reforms being introduced. They indicate that the traditional decisionmaking approach of "Decide-Announce-Defend" is coming under increasing pressure.[91]

F. Pollution Levy System

China's primary mechanism for enforcing pollution emission standards at thermal power plants has been the pollution levy system, also known as the emission fee system. The pollution levy system was formally instituted in China in 1982 under the authority of the Environmental Protection Law.[92] Under the original pollution levy system, charges were based upon:

- The amount of emissions exceeding the standards (which does not provide any incentive to lower emissions below the level of the standards);
- The concentration of emissions, rather than the total amount emitted (which encourages the construction of tall stacks rather than control of total emissions);
- The pollutant with the highest concentration, rather than all emissions; and
- A low charge rate (which encourages plant owners to view pollution levies as a cost of doing business rather than an incentive to install pollution control equipment).[93]

New emission sources that exceed the standards are subject to double levying, and the rate increases even further after two years of double levying.[94] Eighty percent of the pollution levy is available to the polluting enterprise in soft loans for the purchase of

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[89] "Qu Geping's Seminar: Progress Made, More Challenges Ahead." *China Environment Reporter*, Vol. 1, No. 2, May 30, 1997: 10.
[90] Zhang et al., *supra* note 64, at 47.
[91] Connor, Desmond M. "Public Consultation for China's Environment." *Sinosphere* Vol. 2, Issue 2, Spring 1999: 42 <http://www.chinaenvironment.net/sino/sino4/>.
[92] Yang et al., *supra* note 79, at 1.
[93] *Id.* at 6.
[94] Meng et al., *supra* note 20, at 8.

pollution control equipment. The remaining 20 percent is allocated to the local Environmental Protection Bureau to cover administrative expenses.[95]

SEPA is now revising and expanding the overall pollution levy system. The new system will be based upon both emission concentration and total loads, and will cover all pollutants, not just the one with the highest concentration. SEPA is also working to increase the pollution levy charge rate. Proposed amendments to the Air Pollution Law will provide legal authorization for these changes.[96]

SO_2 Pollution Levy: The original 1982 pollution levy system included an SO_2 charge rate of 0.04 yuan RMB/kg. This levy, however, did not apply to boilers for power plants and heating, but only targeted emissions from industrial processes. In any case, problems with monitoring and measurement of SO_2 emissions prevented it from being applied anywhere for over a decade, except on a limited basis in some individual provinces.[97]

In September 1992, China instituted a two-year trial SO_2 pollution levy system in nine cities and two provinces, including the cities of Chongqing, Yiben, Nanning, Guilin, Liuzhou, Yichang, Qingdao, Hangzhou and Changsha, as well as Guangdong and Guizhou provinces. The program was jointly developed by SEPA, the State Pricing Bureau (now renamed the Department of Pricing under the State Development and Planning Commission), the Ministry of Finance and the State Council Economic and Trade Office.[98]

This trial SO_2 pollution levy system strengthened the original system in several respects. Power plant emissions were covered for the first time. The charge rate was higher (0.2 yuan RMB/kg) and applied to all SO_2 emissions, not just those above the standards. Ninety percent of the levy was returned to the polluting enterprise for the purpose of purchasing pollution control equipment.[99]

SEPA reported in 1994 that the trial SO_2 pollution levy system was successful in reducing emissions from existing pollution sources, controlling new pollution sources, accelerating SO_2 pollution control, controlling acid rain and generating pollution mitigation revenues. One recent analysis[100], however, found that the implementation of this pilot program encountered a number of obstacles. Several of the nine pilot cities had difficulties in carrying out the trial program because they lacked the means to measure the sulfur content in coal (the typical measure used for applying the SO_2 levy). The total amount of revenue generated varied greatly amount cities, both in the amount levied and the percentage of levies actually collected. Guangdong and Guizhou provinces never actually imposed SO_2 pollution levies because of resistance from local governments, who:

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[95] "China's Environmental Law: A Comprehensive System on Paper." *China Environmental Review,* Vol. 1, Issue 1, Oct. 1997: 6 <http://www.asianenviro.com>.
[96] Yang et al., *supra* note 93, at 2.
[97] *Id.*
[98] *Id.* at 7; Wang et al., *supra* note 81, at 398.
[99] Yang et al., *supra* note 79, at 3; Wang et al., *supra* note 81, at 398-99.
[100] Wang et al., *supra* note 81, at 399.

- Attributed their acid deposition to emissions from other provinces (reflecting the difficulties in addressing regional pollution issues in China);
- Considered the amount of the levies set aside for administrative expenses (ten percent) insufficient to cover their expenses in measuring emissions and applying the levies;
- Perceived the levies as only a two-year pilot project, which could be ignored, rather than a compulsory policy.

Despite these difficulties, Hebei Province began implementing a trial SO_2 pollution levy system in 1995, followed by Shaanxi Province in 1996. In 1998, the State Council decided to extended the SO_2 pollution levy system to all localities within the acid rain and SO_2 pollution control zones. With this extension, the total amount of revenue generated increased significantly, to a total of 508 million yuan RMB in 1998. The Chinese Research Academy of Environmental Sciences (CRAES) credits the extended SO_2 pollution levy system with a decrease in national SO_2 emissions, and found a direct correlation between the amount of emission decrease and the effective SO_2 charge intensity (the actual amount of the charge for unit SO_2 emissions).[101] A number of problems with the SO_2 pollution levy system, however, still need to be resolved.

SO_2 Pollution Levy Charge Rate: After conducting an extensive study of China's pollution levy system, the World Bank concluded that a pollution control strategy in China targeting large sources of SO_2 emissions and inducing at least a 70 percent abatement of SO_2 would be cost-effective and yield large benefits in terms of human health.[102] However, the current SO_2 pollution levy charge rate of 0.2 yuan RMB/kg is still much lower than the marginal cost for SO_2 reduction or the average cost of SO_2 mitigation.[103] Therefore coal-fired power plants, which are key targets for SO_2 pollution levies, would still prefer to pay the levy than install pollution control equipment.

CRAES has proposed an optimal rate of 1.2 yuan RMB/kg (1,200 yuan RMB/ton) for SO_2 emissions from large coal-burning power plants. This rate is slightly higher than the average SO_2 treatment cost for these plants (800 yuan RMB/ton), and would also provide sufficient revenue to cover administrative expenses. If the charge were based upon coal production or consumption rather than SO_2 emissions, this rate would correspond to a level of 8-65 yuan RMB per ton of coal, depending on its sulfur level.[104]

In June 1999, the State Council approved a SO_2 emission rate increase of 1.2 yuan RMB/kg for Beijing, effective November 1999. This is the same rate proposed by CRAES, and corresponds to approximately 7% of the price of coal in Beijing. Beijing

[101] Yang et al., *supra* note 79, at 3-5.
[102] Dasgupta, Susmita, Hua Wang and David Wheeler. "Surviving Success: Policy Reform and the Future of Industrial Pollution in China." World Bank, March 1997: § 5.3, chap. 7-8.
[103] Yang et al., *supra* note 79, at 6.
[104] *Id.* at 7-8.

hopes that this higher rate will stimulate polluters to reduce SO_2 emissions or substitute high sulfur coal with low sulfur coal or cleaner energy generation resources.[105]

Utilization of Pollution Levy Revenues: Since ninety percent of SO_2 levy revenues are returned to the polluting enterprise for use in plant-specific mitigation projects, the government cannot pool funds in order to invest in large capital projects or address regional pollution problems. Many analysts in China are calling for reform of the current system of revenue utilization, including the establishment of a national Environmental Protection Fund to use SO_2 pollution levies to address regional transboundary acid rain problems and establish SO_2 treatment facilities for large coal-burning equipment.[106]

G. Emission Permits

In addition to the pollution levy system, China is also developing an emission permit system in order to control air emissions from power plants and other facilities. The basic parameters of the permit system are enunciated in Article 27 of the Environmental Protection Law. Unlike the pollution levy system, emission permits set absolute limits on the emissions of various pollutants from each enterprise or industrial sites. Local EPBs determine the permit conditions (level of emissions allowed, period of validity, covered pollutants) based upon local conditions, but under current law do not consider regional or nationwide environmental goals. Plants subject to the emission permit system must pay licensing fees in addition to emission fees under the pollution levy system.[107]

In 1994, NEPA initiated a trial air emissions permit program in sixteen cities, including Shanghai, Tianjin, Shenyang, Guangzhou, Guiyang, Chongqing, Liuzhou, Yichang, Jilin, Changzhou, Xuzhou, Baotou, Kaiyuan, Mudianjiang and Pingdingshan. Northern cities focused their efforts primarily on controlling particulate emissions, and to a lesser extent on SO_2 emissions. Southern cities focused solely on SO_2 emissions. After three years, NEPA had issued nearly 1000 emission permits to 8628 sources in the 16 cities. NEPA's records indicate a total decrease in SO_2 emissions from these sources of 11.5 million tons. The real reduction in SO_2 emissions, however, may not be as large as the data show, since SO_2 emission data is generally estimated based on the amount of energy consumed according to the self-reporting of each enterprise.[108]

H. Total Emission Control

The latest step in SEPA's pollution control policy, initiated in 1996 as part of the Ninth Five-Year Plan, is the total emission control (TEC) system. The aim of TEC is to reduce total pollution loads on a national or regional level, rather than focusing only on

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[105] Somewhat smaller rate increases of 0.3-0.6 yuan RMB/kg are being tested in Hangzhou, Zhengzhou and Jilin, with plans to expand nationwide. *Id.* at 9.
[106] *Id.* at 10.
[107] "SEPA's Changing Emissions Permitting System." *China Environmental Review,* Vol. II Issue 2, Dec. 98-Jan. 99: 10-11 <http://www.asianenviro.com>. SEPA issued a circular in October 1999 regarding the licensing fee for air emission and wastewater discharge permits. "List of Newly Promulgated Laws, Regulations, and Circulars in China." *Energy: China Market Series,* Vol. 4, No. 2, Jan. 2000: 3.
[108] Ge et al., *supra* note 8, at 21; Chen, *supra* note 1, at 7.

individual point source emissions or local environments.[109] This approach is not authorized under existing law but is a major focus of SEPA's proposed amendments to the Law on Air Pollution Prevention and Control.[110]

Under TEC, emission quotas for specific pollutants will be allocated from central to local governments, with local governments then distributing these quotas to industry and other pollution sources through the emission permit system. Local governments may impose stricter emission limits than those determined by national quotas if particular environmental conditions warrant it.[111] Violators of permit conditions are subject to heavy administrative fines and other penalties in addition to the existing pollution levy.[112]

SEPA has already set national TEC quotas for sulfur dioxide, with an overall target of reducing SO_2 emissions to 1985 levels, or 24.6 million pounds, by the end of 2000. To reach this overall quota, eastern cities are required to cut emissions a further 5 percent from 1985 levels, while less developed western cities will be allowed to increase emissions 5 percent over 1985 levels.[113]

Some analysts question whether the TEC system will lead to significant environmental improvements, since these quotas were based primarily upon economic considerations rather than environmental quality.[114] SEPA plans to tighten these quotas gradually, perhaps beginning with the Tenth Five-Year Plan in 2002.[115] Fines for violations of permit conditions may also have to be increased to provide a strong incentive for compliance.

Once the TEC system is fully implemented, new, expanded and transformed thermal power plants within the two control zones will have to meet both national SO_2 emission standards and individual SO_2 emission permit limits based upon local TEC implementation plans. Large plants with tall stacks may eventually be required to make further reductions if their SO_2 emissions reach both zones. Plants will be subject to (1) pollution levies for emissions exceeding the national standards, (2) emission permit licensing fees and (3) fines and other administrative penalties for violation of permit conditions. Much work will need to be done to coordinate these requirements and resolve conflicts among the different systems.

I. Emissions Allowance Trading

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[109] Environmental Defense Fund (EDF) and Beijing Environment and Development Institute (BEDI). "Total Emissions Control and Emission Trading in China: A Case Study About SO_2." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China,* Nov. 15-18, 1999: 5.

[110] China Council for International Cooperation on Environment and Development. "China's Tenth Five-Year Plan Being Formulated." *CCICED Newsletter*, Sept. 1999:3-4.

[111] *China Environmental Review,* Vol. I, Issue 4, April-May 1998: 9.

[112] *CER, supra*, at 10-11.

[113] Chen, *supra* note 6, at 2.

[114] *Id.* at 9.

[115] Meng et al., *supra* note 20, at 4. The environmental portion of the Five-Year Plans is generally unveiled two years after the rest of the Plan.

SEPA hopes that the limits on total SO_2 emissions within the acid rain and sulfur dioxide pollution control zones, combined with the development of an emissions permit system based upon TEC limits, will lay the groundwork for eventual SO_2 emissions allowance trading in China. If implemented successfully, emission allowance trading could achieve total SO_2 emission control at a lower overall cost by allowing enterprises to select emission reduction strategies freely and take advantage of large differences in SO_2 abatement costs.[116]

Some proponents of emissions allowance trading note that many of the basic preconditions for such trading already exist in China: a clear environmental goal with a cap on total maximum allowable loads (TEC); an identifiable trading area (the two control zones); a sufficient number of large point sources that are easy to control and have similar features (thermal power plants in the two control zones); a large difference in SO_2 abatement costs among sources; and a trading mechanism based on the emission permit system.[117] CRAES has performed a comprehensive comparison of the relative benefits of emission trading and the pollution levy system in China.[118]

Other analysts point to a number of prerequisites to trading that are still under development in China, including:

- Adequate monitoring and tracking capacity to ensure accurate, reliable and sufficient data;
- Open exchange of information;
- Market-like operating conditions with clear distinctions between regulators and regulated enterprises;
- Strong institutions with sufficient resources to administer the trading program;
- Understanding and acceptance by local regulatory agencies and enterprises; and
- A strong legal system to enforce emission trades.[119]

The World Bank contends that market-based instruments (MBIs), such as emissions allowance trading, cannot substitute for weak institutions or inadequate command-and-control mechanisms. Both MBIs and command-and-control mechanisms require strong institutions, adequate legislation and effective monitoring and enforcement. Both carry high administrative burdens in terms of monitoring requirements, legal design requirements, public consultation, enforcement and collection. Both can be hamstrung by inadequate funding, administrative inexperience, unclear jurisdiction and lack of political

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[116] Ge et al., *supra* note 8, at 22-23.
[117] Ge et al., *supra* note 8, at 22; EDF and BEDI, *supra* note 109, at 12; Abeygunawardena, P. "Emissions Trading in PRC's Energy Sector: The Role of the Asian Development Bank." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China*, Nov. 15-18, 1999: 8.
[118] Yang et al., *supra* note 79, at 13-16.
[119] Nielson, Chris and Michael B. McElroy. "Introduction and Overview." In *Energizing China: Reconciling Environmental Protection and Economic Growth.* Cambridge, MA: Harvard University Press, 1998: 20, 36; Raufer, Roger and Wang Weili. "Air Quality Management in Chinese Cities: The Policy Setting for Future Controls." *Sinosphere*, Vol. 2, Issue 4, Fall 1999: 22-25.

will. Market-based reforms can help or hinder the success of MBIs. The World Bank argues that the scope of emissions trading or other MBIs should match the available institutional capacity, that resources should be channeled to local governments to build capacity, and that MBIs that introduce gradual and flexible reforms are more likely to be consistent with ongoing institutional change.[120]

SEPA began experimenting with emissions allowance trading in 1994 through pilot projects in the six cities of Taiyuan, Liuzhou, Pingdingshan, Guiyang, Kaiyuan, and Baotou. Tianjin and Shanghai have also conducted some emission trades. These pilot projects, which only involved one or two trades in each city, did not take place under real market conditions, since the government played a major role in arranging most of the trades.[121] Nonetheless, the pilot programs did enable SEPA, local governments and enterprises to gain useful experience with emissions trading under existing conditions in China. Such small-scale experiments may ultimately help to create the necessary conditions for a full-scale trading regime.

The pilot projects focused mainly on new, expanded or retrofitted facilities, but differed in terms of emission limits, target pollutants and types of trades. Some cities set total emission control (TEC) loads for certain pollutants and then allocated the quotas to enterprises through individual permits. Others required existing plants with emissions exceeding national standards to obtain credits from other enterprises before they could expand. Other cities required new or expanding plants to obtain emission credits in order to help meet ambient air quality standards. Covered pollutants included SO_2, fluoride and dust. Trading took place within enterprises, between similar types of enterprises, and even between different types of enterprises, including point and non-point sources.[122]

Power plants participated in a number of emission trades, although the State Power Corporation has not yet adopted an official position on emission trading, perhaps because its experience is still quite limited.[123]

- In Pingdingshan City in Henan Province, the local mining bureau planned to build a new 120 MW thermal power plant in an area where new projects with significant air pollution were prohibited because TSP concentrations exceeded Type III ambient air quality standards. The city arranged an emission trade in which the power plant replaced six 4-ton boilers and one 1-ton boiler, providing replacement power to nearly 1,500 households. This trade reduced overall dust emissions from 2,623 tons to 666 tons annually and provided a net economic benefit.

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[120] Huber, Richard M., Jack Ruitenbeek and Ronaldo Serôa Da Motta. "Market Based Instruments for Environmental Policymaking in Latin America And The Caribbean: Lessons From Eleven Countries." World Bank Discussion Paper No. 381, 1998.
[121] Lin Hong, "Practice on Air Emissions Trading In China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China*, Nov. 15-18, 1999: 4.
[122] *Id.* at 3-4; EDF and BEDI, "Experiences of Emission Trading in China." *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China*, Nov. 15-18, 1999.
[123] Ge et al., *supra* note 8, at 25.

- In Guiyang City in Guizhou Province, an existing thermal power plant in an area exceeding TSP and SO_2 ambient air quality standards wished to construct a new 200 MW unit. Before doing so, it was required to phase out an existing 25 MW unit, install an electrostatic precipitator and construct a 140-meter stack.

- In Tianjin City, SEPA rejected plans for two new power plants, even though their emissions would meet applicable standards, because there were no more emission quotas available under the city's Total Emission Control Plan. At SEPA's suggestion, the two plants agreed to buy emission quotas from the municipal government for 12 million yuan RMB each, with the funds to be used for integrated pollution prevention and environmental improvements.

- In Shanghai, the Waigaoqiao Power Plant was able to construct two additional 1000 MW units by paying for the installation of flue gas desulfurization equipment at two existing 300 MW units of the Shanghai No. 1 power plant, which achieved greater levels of SO_2 emission reduction at a lower cost.[124]

The Environmental Defense Fund (EDF) and the Beijing Environment and Development Institute (BEDI) are working on emission trading pilot projects in the cities of Benxi and Nantong, with a focus on TEC. They are working to develop and implement local legislation, promote bilateral transactions, assess the effectiveness of alternative compliance strategies and integrate emissions trading with existing environmental policies such as the pollution levy system. The quality of emissions data and monitoring remains a major issue, as well as the problem of controlling transboundary SO_2 emissions. EDF and BEDI recommend that any new emissions trading pilot projects should take place in larger municipalities with a greater diversity of sources, serious pollution problems from coal, an existing legislative framework, a commitment to treat emissions and external incentives.[125]

The ultimate development of an emissions allowance trading program in China will require national authorizing legislation, as well as a regulatory and management system, technical instruments, quota allocation rules, trading rules, an information system, monitoring and reporting capacity and capacity building.[126] China will also need to coordinate this trading program with existing environmental management systems, particularly the pollution levy system.[127] Efforts to develop these requirements could also improve overall environmental management in China regardless of whether an emissions allowance trading program is ever developed.

SEPA and the U.S. Environmental Protection Agency are working together on a feasibility study on the use of market mechanisms to achieve SO_2 emission reductions in China, with a focus on emissions allowance trading. SEPA and EPA met in June of 1999 to develop a joint work plan on the feasibility study. The first step was a workshop in

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[124] *Id.*
[125] EDF and BEDI, *supra* note 109.
[126] Lin, *supra* note 121, at 6-7.
[127] Ge et al., *supra* note 8, at 24.

November 1999 to exchange information on SO_2-related issues in both nations and to identify key questions and experiences to be included in the feasibility study. The study will review the fundamental features of an emission trading system (e.g., geographic scope, applicability, emissions measurement requirements, allocations, etc.) and outline possible design options based on the situation and data available in China.[128]

The feasibility study will examine (1) which conditions are available now and which need to be strengthened in order to successfully implement a trading program, including politics, law and regulation, management systems, technical instruments, human resources capacity, etc; (2) the ideal scope of an emissions trading program in China, including geographic size, regions, cities and sources to be included; (3) how to carry out pilot implementation, including the development of a detailed plan for law and regulation, trading rules, technical supporting systems, information systems and human resource development; and (4) what results can be achieved in terms of cost, environmental impacts and economic benefits.[129]

J. Clean Production

SEPA is drafting a new Clean Production Law with assistance from the Asian Development Bank. If the scope of this law is broad enough to include the power sector, it could provide an important vehicle for improving power plant efficiency and reducing emissions through better management and technology methods, not just end-of-pipe solutions. The 1995 Law on Air Pollution Prevention and Control already encourages enterprises to adopt clean production technologies that feature high energy efficiency and low pollutant emissions.[130]

VI. MINISTRY OF FINANCE

As part of its overall financial reform program, the Chinese government plans gradually to convert many of its specialized charges and levies into taxes in order to strengthen the central government's ability to exercise macroeconomic control and combat corruption by local government officials.[131] To implement this plan, the Ministry of Finance has developed a proposal that reportedly includes shifting from the pollution levy system to a system of environmental taxation, perhaps in the near future.[132] This new system might strengthen and simplify the collection of revenue, enable the pooling of funds for larger environmental projects, and separate enforcement and investment decisionmaking.

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[128] Summary, *Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China*, Nov. 15-18, 1999.
[129] *Id.*
[130] "Cleaner Production Law – a CER Update." *China Environmental Review*, Vol. II, Issue 4, April-May 1999: 4.
[131] Yang et al., *supra* note 79, at 11; "News on the Shift to Environmental Taxation." *China Environmental Review,* Vol. II, Issue 2, Dec. 1998- Jan. 1999: 2.
[132] "Pollution Fees and Environmental Taxation." *China Environmental Review,* Vol. I, Issue 6, Aug.-Sept. 1998: 5; Stover, Jim. "The Environmental Market in China: Investment Opportunities and Priorities." *Sinosphere*, Vol. 2, Issue 4, Feb. 1999: 32-33 <http://www.chinaenvironment.net/sino>.

SEPA and local EPBs, who stand to lose direct control of a significant portion of their budget, oppose the move.[133] SEPA and CRAES argue that an environmental tax cannot and should not substitute for the pollution levy system, but that the two systems should be integrated. In the near term, a strengthened pollution levy system based on total emissions control could provide a strong incentive to reduce SO_2 and other emissions. In the longer term, an SO_2 charge could be incorporated into the existing energy consumption tax and/or natural resource tax. Since energy consumption tax revenues belong to localities, the SO_2 funds could be used to help cover EPB administrative expenses. If an SO_2 charge were added to the natural resource tax, the local and central government would share the funds. In either case, the revenues from an SO_2 tax could be used to establish SO_2 pollution prevention funds or augment environmental protection funds.[134]

Some analysts believe that while environmental taxes may be a very important pollution control option for China in the future, realistically they are a prospect for the medium term at best, because of the likelihood of political opposition.[135] Indeed, China's new fuel tax, which was enacted recently after months of opposition, has already run into problems due to conflicts among stakeholders, and its implementation has been delayed for the foreseeable future.[136]

VII. LOCAL ENFORCEMENT

Although the central government has been very active in developing policies to control sulfur dioxide emissions and improve power plant efficiency, enforcement of these policies at the local level remains a serious problem. The editors of *Energizing China: Reconciling Environmental Protection and Economic Growth* argue that there are structural barriers to enforcement of emission control policy options that make them unlikely to be broadly effective in the next ten to twenty years. They note that there are systematic and deeply rooted reasons why power plants emit pollutants that will be difficult to overcome in a political and economic system deep in transition.[137]

The reasons for weak environmental enforcement have been analyzed extensively.[138] They include overwhelming pressure to expand the local economy, SEPA's lack of

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[133] *CER*, *supra* note 131, at 2.
[134] Yang et al., *supra* note 79, at 10-12.
[135] Nielson et al., *supra* note 119, at 37-38. *See also* Cao Dong, Jintian Yang and Ge Chazhong. "SO_2 Charge and Tax Policies in China: Experiment and Reforms." In *Environmental Taxes: Recent Developments in China and OECD Countries*, Paris: OECD, 1999; *Applying Market-Based Instruments to Environmental Policies in China and OECD Countries,* Paris: OECD, 1999.
[136] *See* "Why China's Congress Rejected the State Council Fuel Tax Bill," *China Online*, June 14 1999; "Fuel Tax Postponed." *China Daily*, Jan. 23, 2000.
[137] Nielson et al., *supra* note 119, at 7.
[138] *See, e.g.,* Alford et al., *supra* note 48; Zhang et al., *supra* note 64; Raufer et al., *supra* note 119; Lieberthal, Kenneth. "China's Governing System and Its Impact on Environmental Policy Implementation." In *China Environment Series*, Working Group on Environment in U.S.-China Relations, The Woodrow Wilson Center, 1998; Oxsenberg, Michael, Discussion, *Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy* (Beijing, Nov. 8, 1999);

horizontal and vertical administrative leverage,[139] personnel and budget limitations, vaguely drafted provisions allocating responsibility and liability,[140] a complicated distribution of environmental enforcement power, a low level of public awareness, a lack of transparent decisionmaking, and a weak judicial system.[141] Local governments often ignore or give low priority to environmental directives from the central government that are not required by national law, are too complex or irrelevant, or amount to unfunded mandates. In addition, increasing numbers of state-owned enterprises are slipping into the "neither state nor private" status that has proven so difficult to subject to the discipline of environmental regulations.

Recent studies by the World Bank reveal that local Environmental Protection Bureaus, who bear primary enforcement responsibility, have applied pollution control regulations with a great deal of discretion and flexibility based upon local factors including the sectoral composition of industry, scale of operations, and whether or not a plant is state-owned. The World Bank also found that local factors play a large role in determining the effectiveness of environmental regulation, including the level of existing pollution damage, and the local community's capacity to negotiate with local industry (based upon local per capital income, average education, and available income).[142]

Kenneth Lieberthal and Michael Oxsenberg note that despite numerous obstacles, China's central government can generally obtain high levels of compliance with its directives when all top leaders agree on an issue and give it high priority, and when the degree of compliance by lower levels is measurable. Most environmental policies, however, are too complex and subject to competing economic interests to be effective, so local officials will comply only when top leaders turn their attention to the issue and

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"Environmental Compliance and Enforcement: The Real Story." *China Environmental Review*, Vol. I, Issue 1, Oct. 1997: 5.

[139] In December 1998, SEPA submitted a plant to the State Council designed to improve its vertical enforcement powers. SEPA proposed to consolidate the multilevel EPB network by demoting the lowest level EPBs (county, township, and city) to the level of technical advisors, turning district level EPBs into branch offices, and requiring all local level EPBs to be appointed by upper level (provincial and independent municipal) EPBs. The State Council has reportedly approved these changes. SEPA also proposed to set up supervision teams at the national and provincial levels to monitor the performance of lower level EPBs, but the State Council reportedly believes that this move would be disruptive, and decided that if any supervision is done it will be by cross-government teams across a range of functions. "Reorganization of China's Environmental Institutions." *China Environmental Review,* Vol. II, Issue 2, Dec. 1998-Jan. 1999: 2.

[140] In a July 1999 decree, SEPA set a range of increasingly stringent administrative penalties for violations, coordinated penalties for trans-regional pollution, and set procedures for imposing, reviewing and executing administrative penalties. "Methods of Administrative Penalty of Environmental Protection," Decree No. 7 of the State Environmental Protection Agency, 1999.

[141] China is trying to improve the court system by opening all trials to the public except those involving national secrets, personal privacy and minors, and by asking news media to publicize how the courts handle trial. "Courts opening to public," *China Daily*, Jan. 28, 2000. <http/www.china.org.cn/English/News/Society/0128/04.htm>. The Supreme People's Court has also issued new regulations to curb nepotism and corruption among judges. "Corrupt judges face crackdown." *South China Morning Post Internet Edition,* Feb. 1, 2000. <http://www.scmp.com/News/Template/Print/Article.asp>.

[142] Dasgupta, et al., *supra* note 72; Dasgupta, et al., *supra* note 102.

publicize their concern about it. Therefore, while foreign partners should work with central government authorities to gain support for environmental initiatives, they should also cultivate understanding and support in the localities whose actions can make a significant difference. The most successful approaches will work to build consensus among key units and individuals, and tie environmental improvements to short term economic growth if at all possible.[143]

Lieberthal notes that there are a number of trends in China that over time will enhance its capacity and desire to move towards sustainable development. These include:

- Greater circulation of information, based on a more relaxed view towards release of data, better communications infrastructure, and more tolerance for a diversity of views on technical issues;
- Greater expertise, based in part on increased contacts with the international environmental community, better educational resources within China, and resources dedicated to tackling environmental problems;
- Growing concern with the quality of life as the standard of living increases, which leads to the government's greater willingness to consider the opinions of the population and to try to be responsive to popular sentiment;
- Greater understanding on the part of national political leaders of the real costs of environmental degradation; and
- Gradual separation of government and enterprises, which may result in greater official willingness to enforce environmental standards.

In Shanghai and Beijing, some of these factors have already converged to improve the prospects for sustainable development. Shanghai's municipal government has decided to shift its focus from transportation and housing to environmental protection, pledging to transform Shanghai into an "ecological city" over the next 15 years. Between now and 2002, the city will spend over 3% of its annual GDP to achieve strategic goals in water and air quality improvements, the highest rate nationwide.[144] Shanghai is also exploring new ways to promote energy efficiency, including the creation of a uniformed inspectorate to enforce energy efficiency regulations.[145]

The State Council has named Beijing, the world's most polluted capital city, as its top priority for urban environmental cleanup (seen as a prerequisite to a successful Olympics bid).[146] As the level of public awareness and environmental concern has risen, the Beijing government has shown a growing degree of political will and muscle in fighting

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[143] Lieberthal, *supra* note 138, at 6-7; Lieberthal, Kenneth and Michael Oxsenberg, *Policy Making in China: Leaders, Structures and Processes.* Princeton: Princeton University Press, 1988.
[144] "Shanghai Earmarks 3% of GDP to Fight Pollution," Jan 31, 2000. <http://www.chinaenvironment.com/news/jan00/0131shanghai.htm>. *See also* "Shanghai Cleans Air and Water," *China Online* 1999. <http://www.chinaonline.com/industry/environmental/newsarchive/sec…/C90920140-ss.doc.as>.
[145] Sinton et al., *supra* note 36, at 3.
[146] "China's Capital Has Worst Air Quality," *Lateline News,* June 1, 1999 <http://www.lateline.muzi.net>; "Beijing To Launch Massive Cleanup Drive for Olympic Bidding," <http://www.china.org.cn/English/News/Society/0202/04.htm>.

pollution. Beijing's Vice Mayor held a press conference on October 14, 1999, to announce the beginning of stage three of the city's year-old clean air campaign. Premier Zhu Rongji conducted a personal inspection of the city's environmental efforts to demonstrate high-level support for this campaign.[147]

During the first two stages of the campaign, Beijing issued 46 new air pollution measures, established coal-free zones, removed nearly 40,000 older vehicles off the roads, and dispatched about 600 buses and taxes using LPG or natural gas.[148] Beijing is now making plans to move its 700 large State-owned enterprises outside the city's central area, and to ensure that the plants upgrade to cleaner and more efficient technologies as part of the relocation process.[149]

Beijing claims that these measures have brought SO_2 concentrations in Beijing to their lowest level in a decade. This may have been largely the result of temporary emergency measures to prepare the city for the 50th anniversary celebration in October, including the closure of 25 heavy industry and coal-fired power plants.[150] Yet official statistics show that SO_2 levels fell in nine consecutive months through September 1999 by an average of 25 percent compared with the same month of 1998.[151]

Beijing plans to adopt a new standard for SO_2 emissions from power plants, presumably more stringent than the existing national standard. This revised standard could provide a model for strengthening the existing national standard. Beijing also plans to step up enforcement, install four new air quality monitoring stations, and provide incentives for firms upgrading old coal boilers to reduce emissions.[152]

As described above, Beijing has also increased its SO_2 pollution levy rate to the highest level in China. This rate is designed to exceed the marginal cost of compliance with SO_2 emission standards and to stimulate enterprises to reduce SO_2 emissions or substitute high sulfur coal with low sulfur coal or cleaner energy generation resources. Applying this new pollution levy effectively to power plants could make Beijing a model for the rest of the nation.

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[147] U.S. Embassy Beijing, "Beijing Gets Serious About Air Quality," Oct. 1999. <http://www.usembassy-china.org.cn/English/sandt/Bjairwb.htm>.
[148] "Pollution Control Measures Pay Off," *China Daily,* March 22, 1999.
[149] "Beijing Moving 700 Firms Out," *China Daily,* Nov. 15, 1999. <http://wwwchinaenvironment.com/news/nov99/1115beijing.htm>. Beijing also required the Capital Steel factory, one of the largest of its kind in the country, to give up its yearly goal of 10 million tons of steel and allot 130 million yuan of its annual 350 million yuan profit for pollution treatment. *Id.*
[150] "Beijing To Clear the Air for Oct. 1 Celebrations," *China Online* 1999. <http://www.chinaonline.com/industry/environmental/NewsArchive/Secure/199…C90833014.as>; China: Leaded Gas Production To Stop; Natural Gas Pushed," *Reuters,* March 8, 1999.
[151] U.S. Embassy Beijing, *supra* note 147, at 2.
[152] *Id.* at 2-4.

ANALYSIS

As described above, China has developed a variety of ambitious programs for controlling SO_2 emissions from power plants. These programs must compete with other, often-conflicting priorities at both the central and local government levels. Foreign assistance can help to raise the profile of these efforts and provide needed funds for capacity building, law and policy development, pilot implementation projects and technology transfers. Success will ultimately depend on China's ability to consolidate national support, develop a coordinated approach based on appropriate regulatory mechanisms and economic incentives, and strengthen local enforcement.

The State Council's initiatives rely heavily on command-and-control mechanisms such as forced closures of small-scale power plants and high-sulfur coal mines, prohibitions on new construction, relocation of existing plants away from city centers, and the compulsory use of desulfurization equipment. These measures carry the weight of central government authority, and if successful, could significantly reduce SO_2 emissions. Some analysts believe that measures like these, which focus directly on the energy sector instead of China's policy apparatus, may prove more effective in reducing emissions in the near-to-medium term than a policy-only approach.[153]

These command-and-control measures, however, are likely to encounter a great deal of resistance from local governments, especially if they threaten the local economy and eliminate jobs. Moreover, they may not be the most cost-effective way to reduce total power plant emissions.[154] Requiring all plants to install desulfurization equipment does not recognize the highly varying costs of control among different plants and the potential for reducing emissions through increased efficiency and cleaner production methods. End-of-pipe desulfurization methods also increase a plant's energy requirements and therefore its emissions of other pollutants.[155]

The best approach may be one that combines policy development, pollution control technology, and direct measures to adjust China's energy structure, while gradually developing the economic, institutional, political and legal structures necessary for the adoption of market-based instruments. Energy analyst Roger Raufer suggests that both pollution prevention/efficiency strategies and end-of-pipe control mechanisms are needed to achieve substantial emission reductions.[156] Strengthening China's existing regulatory system can help provide the necessary incentives for power plants to undertake both types of controls.

Following the transfer of authority from the former Ministry of Electric Power, the State Economic and Trade Commission now has several regulatory tools at its disposal to

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[153] Nielson et al., *supra* note 119, at 8.
[154] Stavins, Robert and Bradley Whitehead. "Market-Based Environmental Policies." In *Thinking Ecologically: The Next Generation of Environmental Policy*, New Haven and London: Yale University Press, 1997:106.
[155] *See* Research Team of China Climate Change Country Study, *supra* note 1, at 229.
[156] Raufer et al., *supra* note 119, at 27.

improve power plant efficiency and environmental performance. It could develop new regulations to implement existing provisions of the Law on Electric Power or seek to revise the law itself to address these issues more specifically. It could develop specific regulations aimed at implementing the Law on Energy Conservation in the power sector, and consider whether its regulations to improve efficiency in key energy consuming enterprises could be interpreted or expanded to include thermal power plants. Some international assistance organizations have already begun to assist SETC in developing such regulatory initiatives.

The State Environmental Protection Agency has launched an ambitious and comprehensive set of initiatives to control acid rain and sulfur dioxide emissions, with thermal power plants a major target. Before these initiatives can be implemented on a broad scale, SEPA needs to obtain the necessary legislative authority for programs such as Total Emission Control, work to resolve conflicting requirements, and coordinate its efforts with other national programs such as the Two Control Zone program. Efforts to reach interagency agreement on a SO_2 emissions cap for thermal power plants could also reap major benefits.

SEPA and CRAES have been considering a number of options to strengthen SO_2 power plant emission standards. Tighter standards, which could be introduced gradually, could help speed up the closure of small, inefficient power plants, the renovation of existing plants and the development of cleaner power sources. They could also provide needed incentives for the development of a domestic desulfurization industry. Options include developing uniform emission standards that apply regardless of the age and size of the plant, and reconsidering the two-tiered SO_2 standard for Phase III plants within the two control zones.

SEPA is also considering a new approach to power plant air emission regulation being developed in the United States: output-based Generator Performance Standards (GPS). Unlike traditional regulations, which limit emissions on the basis of pounds of emissions per unit of fuel burned (e.g., lb./mBtu), GPS is expressed in pounds of emissions per kilowatt-hour of electricity produced. Such an approach favors those facilities that are more efficient, i.e., that need less fuel input to generate a unit of electricity, and therefore emit less pollution. These standards are applicable to all plants regardless of age or historic fuel use, and therefore avoid creating a competitive advantage for older, more polluting resources.[157]

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[157] "Hibbard, Paul J, Nancy L. Seidman, Barbara Finamore and David Moskowitz. "Output-Based Emission Control Programs: U.S. Experience." May 2000. *See also* Northeast States for Coordinated Air Use Management (NESCAUM). "Emission Performance Standards, Model Rule Background Information Document." December 1999. http://www.nescaum.org/workgroups/energy.html. The U.S. Senate is now considering S. 1369, the Clean Energy Act of 1999, which includes, among other things, a national cap on emissions from all power plants of nitrogen oxides, sulfur oxides, mercury and carbon dioxide; and output-based emissions performance standards to ensure that the emission limits are met. *See* "Hearing on the Energy Policy and Climate Act of 1999(S.882) and the Climate Change Energy Policy Response Act of 1999 (S. 1776) before the Committee on Natural Resources, United States Senate. Testimony of Daniel Lashof, Ph.D, Senior Scientist, on Behalf of the Natural Resources Defense Council." March 30, 2000: 6.

Regardless of which emission standards China adopts, however, enforcement will remain a major problem. The whole enforcement structure may change if the Ministry of Finance succeeds in its proposal to shift the pollution levy system to a system of environmental taxation. In the meantime, SEPA could consider ways to allow plants flexibility in **how** SO_2 emission standards are met -- through such means as efficiency improvements, cleaner production methods or emission credit/allowance trading – and in **when** standards are met, through the use of phased compliance schedules. Uniform standards and requirements for emissions monitoring and reporting are needed now, and will become essential if China wishes to adopt market-based regulatory systems such as emissions allowance trading. SEPA's efforts to revamp and expand the overall pollution levy system should also help to strengthen the enforcement system, especially if it includes a new mechanism for utilization of pollution levy revenues, such as a national Environmental Protection Fund.

As the World Bank has come to realize, informal regulatory systems based on public education and disclosure regarding the sources and impacts of pollution can provide a powerful lever for curbing industrial emissions.[158] SEPA has been working hard to use the media to improve public awareness of environmental issues, and to enhance citizen involvement in environmental activities through such means as the environmental impact assessment process.

As China restructures its power sector to allow for more competition among generators and ultimately more foreign participation, it will become increasingly important to find ways to channel private investment into cleaner power options. To illustrate the importance of foreign direct investment, in 1996 China received a total of about $2.5 billion in official governmental assistance from all sources including the World Bank, other multilateral development banks, and bilateral aid donors such as Japan and the United States. During that same year, China absorbed more than $40 billion worth of foreign investment.[159]

China can guide its emerging energy market towards a sustainable development path by identifying and including environmental costs and benefits in energy prices. A guiding environmental principle for electricity restructuring should be the "polluter pays" principle: that no electricity producer should be able to obtain a competitive advantage by creating pollution for which it is not held accountable. Full cost energy pricing will not only level the playing field for renewables but also provide incentives for energy efficiency and pollution prevention in thermal power plants.[160]

Another promising mechanism potentially applicable to China is a renewable portfolio standard (RPS). Such standards are intended to ensure that a certain percentage of retail

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[158] *See* The World Bank. *Greening Industry: New Roles for Communities, Markets, and Governments.*, New York: Oxford University Press, 2000.
[159] Chertow, Marian R. and Daniel C. Esty, eds. *Thinking Ecologically: The Next Generation of Environmental Policy*, New Haven and London: Yale University Press, 1997: 12.
[160] Strauss, Todd and John A. Urquhart. "Energy Prices and Environmental Costs." In *Thinking Ecologically: The Next Generation of Environmental Policy*, New Haven and London: Yale University Press, 1997: 220, 227.

suppliers' electricity sales are generated from renewable resources such as wind, solar and qualifying hydropower. A number of states, including Connecticut, Maine, New Jersey and Massachusetts, have adopted renewable portfolio standards (RPS) in recent electric utility restructuring legislation.[161]

At every stage of the electricity restructuring process, China has opportunities to introduce environmental costs and benefits into the electric power system. These include identifying, analyzing and disclosing the effects and costs of pollution on human health and natural ecosystems; setting baseline emission and efficiency requirements; establishing monitoring and reporting requirements; charging for emissions through fees or taxes; eliminating subsidies that distort fuel prices; allowing flexibility in meeting emission requirements through increased efficiency, cleaner production, and ultimately emission credit or allowance trading; and developing the necessary institutions to administer and enforce these programs.[162] China has made progress in each of these areas, but faces tremendous challenges during the implementation stage.

CONCLUSION

After decades of rapid power development with little concern for its environmental impact, China has begun to recognize and address the full societal costs of such development. Although China has already launched a number of programs and policies to control acid rain and improve power plant efficiency, much more can be done to consolidate national support and translate these programs into action at the local government level. As China begins to restructure its electric power industry, it has the opportunity to develop new regulatory approaches and incentives to channel investment away from coal-fired power into efficient and cleaner power generation. These efforts could result in major health benefits, increased productivity, and protection of natural resources and the global environment.

[161] Hamrin, Jan. "Background Paper on Electric Industry Restructuring and Renewable Energy and Energy Efficiency Public Benefit Programs in California." Prepared for the Energy Foundation. March 2000: 13-15.
[162] Strauss, *et al*., *supra* note 160, at 229.