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Taming the Dragon Heads: Controlling Air Emissions From Power Plants in China—An Analysis of China's Air Pollution Policy and Regulatory Framework

by Barbara A. Finamore and Tauna M. Szymanski

Coal combustion is the leading source of industrial air pollution in China today, contributing up to 87% of total sulfur dioxide (SO_2) emissions and 75% of carbon dioxide (CO_2) emissions.[1] In 2001, 46% of total SO_2 emissions stemmed from power plants alone.[2] 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.[3] China is now the world's largest emitter of SO_2[4] and the second largest emitter of greenhouse gases (GHGs).[5] Acid rain falls in 82% of Chinese cities and affects 29% of China's total landmass.[6] The Asian Development Bank estimates that acid rain is responsible for U.S. $14 billion in economic losses—nearly 2% of gross domestic product (GDP).[7] Total urban air pollution costs China U.S. $32.3 billion annually in human health impacts.[8] The World Bank estimates that outdoor air pollution in excess of average national standards is responsible for 178,000 premature deaths a year in China.[9] Researchers at the Chinese Academy of Sciences estimate that economic losses could amount to U.S. $240 billion over the next 10 years if SO_2 emissions are not controlled,[10] and the State Environmental Protection Administration (SEPA) estimates that overall environmental pollution could force a 10% loss in GDP.[11] Furthermore, without significant reductions, SO_2 emissions are expected to increase to 30 million tons from a current 20 million tons by 2010.[12] Since almost three-quarters of China's electric

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The majority of the statistics cited in this Article are taken from official Chinese government sources, including those cited in western materials and studies. We make the typical disclaimer here that accompanies most studies that rely on Chinese statistics: motivations to reach politically set goals continue to drive a lot of the reporting of economic and environmental data. However, since it is difficult to get direct access to raw numbers and monitoring equipment in China, these statistics must suffice for the time being. The authors are indebted to Jonathan Sinton of the Lawrence Berkeley National Laboratory and Jeffrey Logan of the Pacific Northwest National Laboratory for generously verifying and sharing several of these figures.

1. Energy Information Admin. (EIA), U.S. Department of Energy (DOE), China Country Analysis Brief 2002, *available at* http://www.eia.doe.gov/emeu/cabs/china.html (last visited June 28, 2002) [hereinafter EIA China Country Analysis Brief 2002]; 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 6 (Beijing, Nov. 15-18, 1999) (on file with Barbara Finamore); Research Team of China Climate Change Country Study, China Climate Change Country Study 56 (1999) (on file with Barbara Finamore).
2. People's Republic of China National Bureau of Statistics, 2002 Zhongguo Tongji Nianjian [2002 China Statistical Yearbook] (2002) [hereinafter 2002 China Statistical Yearbook].
3. *See* Michael B. McElroy, *Industrial Growth, Air Pollution, and Environmental Damage*, *in* Energizing China: Reconciling Environmental Protection and Economic Growth [hereinafter Energizing China] 241-46 (Michael B. McElroy et al. eds., 1998); Xu Xiping, *Air Pollution and Health Effects in Urban China*, *supra*, at 268-85.
4. Li Yan, *SEPA: Environmental Pollution May Incur 10% of GDP Loss* (Mar. 23, 2001), *available at* People's Daily Online, http://english.peopledaily.com.cn/200103/23/print20010323_65792.html (last visited June 4, 2002).
5. U.S. Environmental Protection Agency (EPA), The Kyoto Protocol and the President's Policies to Address Climate Change: Administration Economic Analysis 7 (1998), *available at* http://www.epa.gov/globalwarming/publications/actions/wh_kyoto/ (last visited June 14, 2002); Chris P. Nielsen & Michael B. McElroy, *Introduction and Overview*, *in* Energizing China, *supra* note 3, at 27.
6. United Nations Development Program (UNDP), UNDP Publications: Urban Air Pollution, Energy Resources and Coal Combustion (2000), *available at* www.unchina.org/undp/press/html/airp.html#energy (last visited May 30, 2002).
7. Asian Development Bank, Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Acid Rain Control and Environmental Improvement Project 2 (2001) (RRP PRC-33441), *available at* http://www.adb.org/Documents/RRPS/PRC/rrp_33441.pdf (last visited June 20, 2002). *See also* The World Bank, Clear Water, Blue Skies: China's Environment in the New Century 23 (1997) [hereinafter Clear Water, Blue Skies]. More recently, Wang Jinnan, of the Chinese Research Academy of Environmental Sciences (CRAES), presented estimates of the damages to China of acid deposition to be between 2% and 2.9% of GDP. Wang Jinnan, GPS-Based Pollution Control in Utility Sector, Powerpoint Presentation Before the Guangdong Electric Power and Renewable Energy Workshop (Guangzhou, Apr. 15, 2002) (on file with Barbara Finamore).
8. Clear Water, Blue Skies, *supra* note 7, at 23.
9. *Id.* at 19.
10. *Experts Call for Sulfur Dioxide Emission Control*, Xinhua News Serv., Sept. 4, 2001 (citing Xu Xuchang of the Chinese Academy of Sciences, in remarks given to the 21st Century Forum: Forestry and Environmental Protection).
11. Li Yan, *supra* note 4.
12. *Chinese Experts Call for Control Sulfur Dioxide Emissions*, (sic), Agence-France Presse, Sept. 5, 2001; *Environmental Protection Industry in China*, Interfax News Agency, China Business, Mar. 30, 2001.

power is derived from coal combustion, using about 60% of the country's coal, the power sector provides a model for examining China's overall industrial air pollution control.[13] Given the prominent role of electric power in China's rapidly growing economy[14] and its status as a sector targeted for reform and increased foreign investment by the central government,[15] studying ways to mitigate the sector's environmental impact is an essential undertaking in its own right.

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.[16] For many years, the central government focused on policies to facilitate the rapid development of the power sector, in some cases perhaps looking the other way when it came to enforcing environmental regulations on these plants. China's oldest power plants, as well as small ones built during the economic boom of the 1980s, typically 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, the gap between power supply and demand has narrowed, and in fact an oversupply of electricity and coal[17] has led some of China's top leaders 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 underfunded.[18] Even if consensus is reached at the central government level, translating national programs into action by local government and individual plants presents major challenges. Yet as China begins to restructure its electric utility industry, it has an important opportunity to put into place environmental and efficiency requirements that will encourage a long-term shift in investment toward cleaner generation resources.

Significant progress has been made in controlling air pollution in China over the past five years, both on the policy and legal fronts, and in practice. To cite a famous example, one of China's dirtiest provincial capitals, Lanzhou, in Gansu Province, which was once invisible in satellite photos, has reduced its SO_2 emissions by 2,100 tons since 1998.[19] China's Tenth Five-Year Plan for the Environment, released in December 2001, announced that SO_2 emissions nationwide were 19.95 million tons,[20] down almost 16% from a peak of 23.7 million tons in 1995. They declined a further 2.4% in 2001 to 19.48 million tons.[21] SEPA reported in its recently released *2001 State of the Environment Report* that there was little overall change in air quality last year, although only 2.9% of 341 monitored Chinese cities had Level I (excellent) air quality, while 66.6% had Level III (poor) or worse air quality.[22] Much of the progress gained between 1995 and 2000 is now known to owe to the economic slowdown and shutdown of highly polluting and inefficient power plants and other coal-intensive industrial entities, as well as to energy efficiency and emission control efforts.[23]

During the summer of 2001, several U.S. reports revealed to the world's surprise that China's climate change-inducing CO_2 emissions had fallen since 1998 despite continued economic growth.[24] Nevertheless, expected increases in gross coal use over the next 20 years are expected to drive China's GHG emissions, particularly CO_2, up 5.5% a year through 2020 from 1999, faster than any country.[25] Since about

13. Coal Industry Advisory Board (CIAB), International Energy Agency (IEA), Coal in the Energy Supply of China: Report of the CIAB Asia Committee 10, 20 (1999), *available at* http://www.iea.org/books/studies/1999/coalchina.pdf (last visited June 5, 2002) [hereinafter CIAB-IEA Report]; ValuAsia, *Archives, Study 20, Value of Externalities Due to Electricity Generation, China, 1998*, *at* http://www.geocities.com/Valuasia/studies/study20.html (last visited May 31, 2002); Barbara Finamore et al., *Controlling China's Power Plant Emissions After Utility Restructuring: The Role of Output-Based Emission Controls*, 4 Sinosphere J. 15 (2002), *available at* http://www.chinaenvironment.net/sino.

14. The official GDP growth rate in 2001 was 7.3%. SEPA, Quanguo Huanjing Tongji Gongbao 2001 [National Environmental Statistics Bulletin] (2001), *available at* http://www.zhb.gov.cn/bulletin/statistic/left.htm (last visited June 17, 2002) [hereinafter SEPA 2001 Envtl. Statistics Bull.]; EIA China Country Analysis Brief 2002, *supra* note 1.

15. Foreign investors in the power sector in the late 1990s have at times been scared away because power purchase agreements were not met. Jeffrey Logan, Electric Power and Climate Change in China: Current Context and Future Growth Options, Powerpoint Presentation Before the Regional Electrification Initiative Workshop, EPRI, (Washington, D.C., June 7, 2002) (materials on file with Barbara Finamore).

16. Michel Oksenberg, Remarks at Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy (Beijing, Nov. 8, 1999).

17. EIA China Country Analysis Brief 2002, *supra* note 1.

18. Kenneth Lieberthal, *China's Governing System and Its Impact on Environmental Policy Implementation*, 1 China Env't Series 3, 6 (Working Group on Environment in U.S.-China Relations, The Woodrow Wilson Center ed., 1997).

19. *"Invisible City" Alleviates Air Pollution*, Xinhua Gen. News Serv., Nov. 27, 2001. Lanzhou's air pollution control measures include planting trees, switching to natural gas for fuel, and shutting down heavily polluting factories and power plants. *Id.*

20. Guojia Huanjing Baohu Zongju et al. [State Environmental Protection Administration et al.], Guojia Huanjing Baohu "Shiwu" Jihua [China's Tenth Five-Year Plan (FYP) for the Environment] 53 (2001) [hereinafter China's Tenth FYP for the Env't]; *see also* SEPA, Report on the State of the Environment in China 2000 (2001), *available at* http://www.zhb.gov.cn/bulletin/soe2000/english/atmospheric/atmospheric_e.htm (last visited June 5, 2002); U.S. Embassy Beijing, *China's Year 2000 "State of the Environment" Report* (June 2000), *at* http://www.usembassy-china.org.cn/english/sandt/SOTE4web.htm (last visited June 5, 2002).

21. SEPA 2001 Envtl. Statistics Bull., *supra* note 14.

22. *China Issues Annual Report on Environment*, People's Daily, May 31, 2002, *available at* http://english.peopledaily.com.cn/200205/31/eng20020531_96861.shtml (last visited June 5, 2002); U.S. Embassy Beijing, *State of the Environment 2001*, Beijing Env't, Sci. & Tech. Update, May 31, 2002, at 3, *available at* http://www.usembassy-china.org.cn/sandt/estnews053102.htm (last visited June 5, 2002).

23. Jonathan Sinton & David Fridley, *Hot Air and Cold Water: The Unexpected Fall in China's Energy Use*, 4 China Env't Series 5-6 (2001).

24. *See, e.g.*, Energy Information Admin., U.S. DOE, *Total Primary Energy Information, World Carbon Dioxide Emissions From the Consumption and Flaring of Fossil Fuels* (1991-2000), *at* http://www.eia.doe.gov/emeu/iea/tableh1.html (last visited June 3, 2002) (noting that China's carbon emissions from these sources decreased from 824 million tons of carbon equivalent (mmtce) in 1998 to 805 mmtce in 1999, 792 mmtce in 1999, and 775 mmtce in 2000); *see also* section entitled The Ninth- and Tenth-Year Plans, *infra*.

25. EIA, U.S. DOE, International Energy Outlook 2002, Environmental Issues and World Energy Use (2002) (DOE/EIA-0484), *available at* http://www.eia.doe.gov/oiaf/ieo/environmental.html (last visited June 3, 2002); EIA, U.S. DOE, International Energy Outlook 2002 tbl. B10 (World Carbon Dioxide Emissions by Region, High Economic Growth Case,

three-quarters of China's carbon emissions come from the industrial sector, focusing on the carbon-intensive power sector to reduce conventional air pollutants brings the added benefit of reducing climate impacts.[26]

This Article will review and analyze China's current efforts to improve the environmental performance and efficiency of its power sector. The main focus will be on SO_2 emissions because controlling acid rain is one of China's top environmental priorities, as well as its primary air quality goal. Recent institutional and policy restructuring will be discussed as both a potential aid and obstacle to environmental mitigation in the power sector. Additionally, China is making a concerted effort to improve urban environmental quality, especially in and around Beijing in time for the 2008 Summer Olympics. During the bidding process, Beijing pledged to the International Olympic Committee that it would improve its ambient air quality to reach that of Paris.[27] Reducing power plant emissions in the acid rain-blighted urban areas will contribute significantly toward cleaning the air in time for China's much-anticipated international exposure and may provide something of a model for other Chinese locales, especially those most committed to attracting tourism and foreign investment.

Background on the Development of China's Power Sector

China is working to improve power plant efficiency primarily through technological renovation and the closure of older small-scale plants. 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 megawatts (MW)) with ordinary coal burning generators. In the 1980s, rapid increases in economic growth spurred the central government to open new lines of credit for infrastructure development to keep up with expanding business, the new consumer culture, and escalating power demands.[28] Dozens more small coal-fired power plants sprouted up around the country, and little attention was paid to process efficiency, pollution control, or economies of scale.[29] These small-size units (each between 6 and 50 MW), which supplied about 37,000 MW—or 22% of total capacity—in 1997,[30] are highly inefficient, consuming over 200 grams more coal per kilowatt hour (kwh) than 300 MW plants.[31] These plants drove down China's overall thermal power plant energy efficiency to around 30%, compared to a 38% efficiency rate in Organization for Economic Cooperation and Development countries.[32]

During the worldwide economic slowdown in 1998 and 1999, China closed many of the smaller thermal power plants after an electricity oversupply problem became evident.[33] The State Council,[34] China's top executive body, ordered all single unit plants with a capacity below 25 MW to be shut down by December 31, 1999, and all plants with a capacity of less than 50 MW to be closed by 2003. A moratorium on new plants was also in effect until January 1, 2002.[35] However, many of China's small plants have remained open or have stealthily reopened after officially closing.[36] Thus, statistics in the power sector should be considered accordingly. U.S. national laboratory researchers routinely disregard official power and energy production statistics, noting that political motivations spur their

1990-2020) (DOE/EIA-0484), *available at* http://www.eia.doe.gov/ieo/tbl_b10.html (last visited June 3, 2002).

26. EIA China Country Analysis Brief 2002, *supra* note 1.

27. Andrew Ness, *Blue Skies for the Beijing Olympics*, China Bus. Rev., Mar./Apr. 2002, at 1, *available at* http://www.chinabusinessreview.com/0203/ness.html (last visited Sept. 10, 2002). In addition, the Beijing Organizing Committee for the 2008 Olympic Games estimates that electricity use will increase from the current 31.8 billion kilowatt hours (kwh) to 50 billion kwh by 2005. *Id.* at 2.

28. Zhao Jimin, Reform of China's Energy Institutions and Policies: Historical Evolution and Current Challenges 17 (BCSIA Discussion Paper No. 2001-20, Energy Technology Innovation Project, Kennedy School of Government, Harvard University, Nov. 2001) ("price reforms and new funding mechanisms were introduced to attract non-governmental investment"); Chi Zhang et al., Impact on Global Warming of Development and Structural Changes in the Electricity Sector in Guangdong Province, China 8 (Institute for International Studies, Stanford University Working Paper, Mar. 2000), *available at* http://cisac.stanford.edu/docs/zhang.pdf (last visited June 7, 2002).

29. Small plants were dominant in this period because plants with a generating capacity under 300 MW did not require central government approval.

30. Jonathan E. Sinton & David G. Fridley, *What Goes Up: Recent Trends in China's Energy Consumption*, 28 Energy Pol'y 678 (2002), *available at* http://eetd.lbl.gov/EA/partnership/China/pubs/up.preprint2.pdf (tbl. 5) (last visited June 28, 2002).

31. Zu Chengzhang et al., Overview of Institutional and Market Reforms and Future Prospects in China's Utility Sector (unpublished paper commissioned by the Energy Foundation's China Sustainable Energy Program, July 21, 1999) (on file with Barbara Finamore).

32. Research Team of China Climate Change Country Study, China Climate Change Country Study, *supra* note 1, at 227; CIAB-IEA Report, *supra* note 13, at 25. The IEA in 1999, calculated that the average thermal efficiency of coal-fired plants in China ranged from 27% to 29%, though current efficiency rate estimates for these plants are in the low 30s, with the government hoping to raise this to 40% early in this century. Zhou Dadi et al., Developing Countries and Global Climate Change: Electric Power Options in China 4 (prepared for the Pew Center on Global Climate Change, May 2000) (citing China Annual Energy Review, 1996), *available at* http://www.pewclimate.org/projects/pol_china.pdf (last visited June 20, 2002). The study also notes that average efficiency for thermal powered plants in the West is around 35%. Personal Communications with Jeffrey Logan, Joint Global Change Research Institute, Battelle Memorial Institute/Pacific Northwest National Laboratory (June 19, 2002). The IEA also estimates that raising the efficiency of boilers and other coal-fired plants by one-third could save 300-400 million tons of coal. CIAB-IEA Report, *supra* note 13, at 25.

33. EIA China Country Analysis Brief 2002, *supra* note 1.

34. The State Council, known in the West as China's Cabinet, oversees the "executive branch" ministries and commissions in China's bureaucracy. It is responsible for promulgating specific implementing measures and regulations on all topics under the basic laws passed by the National People's Congress (NPC). Generally, this task will be initiated by the sector-specific ministry or agency and then will be approved by the State Council.

35. EIA China Country Analysis Brief 2002, *supra* note 1.

36. Jonathan Sinton et al., Status Report on Energy Efficiency Policy and Programs in China 3 (Lawrence Berkeley National Laboratory, Energy Analysis Dep't eds., 1999). 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 1% sulfur or take other SO_2 control measures before they are shut down. Ge Chazhong et al., SO_2 Control Measures in Power Sector in China [sic], Paper Presented at the Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China 10 (Beijing, Nov. 15-18, 1999) (on file with Barbara Finamore).

adjustment, and instead rely on consumption to derive production figures.[37]

Overall average efficiency has almost certainly improved since the shutdowns, though precise figures are unavailable. In addition, new plants coming online in China are about 37% efficient, pushing up the overall average efficiency rate.[38] Average gross coal consumption rates for thermal power plants in China in 2000 were 363 grams per kwh (g/kwh) for units with above 6 MW generating capacity[39] (down already from 414 g/kwh in 1995),[40] compared to around a 320 g/kwh average for developed countries.[41] Large power plants with a generating capacity above 300 MW now account for about one-third of China's power plants.[42]

Over the past 20 years, power generation has grown faster than any other energy source in China, at an average rate of 7.8%.[43] By the end of 2001, China's total installed generating capacity was 338 gigawatts (GW), with 240 GW coming from thermal-generating units, contributing to 60% of China's coal consumption.[44] Total electricity generation in China at the end of 2001 was 1,487 terawatt hours (twh),[45] with electricity consumption expected to grow 5.5% a year to 2020.[46] Under the Tenth Five-Year Plan, installed capacity should reach 390 GW by the end of 2005.[47] China is constructing over 15 GW of new electricity capacity per year. The U.S. Department of Energy's (DOE's) Energy Information Administration also predicts electricity consumption in a high economic growth case to rise to 3,602 twh by 2020, an average 5.9% growth a year.[48] Recognizing that coal will continue to comprise a large source of this generation (one official estimate puts it as high as 83% in 2001,[49] though others assume around three-quarters and declining), these figures urge that close attention be paid to adopting stringent emissions controls in the power sector as soon as possible, as well as incentives and programs for clean energy development.

China recently commenced a massive restructuring of its electric power sector that will ultimately create a market for independent and competitive power generation open to all investors.[50] China's main restructuring goals are to expand markets, reduce prices, introduce competitive pressure on power producers, develop the western regions of China, improve the environment, increase energy efficiency, and attract private investment.[51] This restructuring, launched in early 2002, focuses on the entire electricity production and distribution process, and plans are underway to improve transmission and distribution efficiencies and develop demand-side management programs.[52] The State Council announced in April 2002 that it will be breaking up the State Power Corporation (SPC)[53] entirely by the end of the year, splitting it into regional grid operators and a few generating companies. The SPC currently owns about 45% of China's generating capacity and about 70% of transmission and distribution.[54] Some generating assets will be injected into existing independent power producers like Huaneng Power International and Beijing Datang Power.[55] In addition, the Chinese government is experimenting with bringing one transmission and distribution grid company public within the next year, the Southern Alliance, also known as the

37. Jonathan Sinton, Voluntary Agreements in China's Steel Industry: A Pilot Project in Shandong, Remarks at A Way Forward: Innovative Approaches for Addressing Industrial and Urban Environmental Problems in China (Stanford University, May 17, 2002) (notes on file with Barbara Finamore).

38. Jeffrey Logan, Electric Power and Climate Change in China: Current Context and Future Growth Options, Powerpoint Presentation Before the Regional Electrification Initiative Workshop, EPRI, (Washington, D.C., June 7, 2002); Personal Communications with Jeffrey Logan, *supra* note 32; CIAB-IEA Coal Report, *supra* note 13, at 25.

39. National Bureau of Statistics, Zhongguo Gongye Jingji Tongji Nianjian (2001) (Statistical Yearbook of China's Industrial Economy); Personal Correspondence with Jonathan Sinton, Lawrence Berkeley National Laboratory (June 2002).

40. Clean Water Blue Skies, *supra* note 7, at 49 (tbl. 4.2).

41. Li Guanghua, Department of Science and Environmental Protection, State Power Corporation, Restructuring China's Power Industry for Saving Resource and Protecting the Environment, Paper Presented at the Eighteenth Annual International Pittsburgh Coal Conference in Newcastle, NSW, Australia (Dec. 4, 2001), *available at* http://www.engr.pitt.edu/pcc/2001plenary/LiGuanghuaPCC_ Australia_ presentation.pdf (last visited June 3, 2002).

42. Sinton & Fridley, *supra* note 30, at 9. According to the CRAES, the average coal consumption in coal-fired power plants in 1998 was 412 grams of standard coal/kwh, 25% higher than the world average of 317 grams of standard coal/kwh; Tang Dagang, Emission Standards of Air Pollutants for Power Plants, Power Sector Regulatory Reform in China, Paper Presented at the Workshop on Encouraging Energy Efficiency and Renewable Energy 9 (Beijing, Nov. 8, 1999) (on file with Barbara Finamore).

43. Sinton & Fridley, *supra* note 30, at 8. However, electricity generation was up 13.5% between 1999 and 2000, while installed power grew only 5.5%. *China Forecasts on Installed Power Capacity*, Alexander's Oil & Gas Connections, June 13, 2002 (citing Jingji Ribao [Economic Daily]), *available at* http://www.gasandoil.com/goc/frame_nts_news.htm (last visited June 13, 2002).

44. *China Forecasts on Installed Power Capacity*, *supra* note 43.

45. *Id.*

46. EIA China Country Analysis Brief 2002, *supra* note 1.

47. Personal Communications with Jeffrey Logan, *supra* note 32; Guanghua, *supra* note 41, at 2; *China Forecasts on Installed Power Capacity*, *supra* note 43.

48. EIA, U.S. DOE, International Energy Outlook 2002 tbl. B9 (World Net Electricity Consumption by Region, High Economic Growth Case, 1990-2020) (DOE/EIA-0484), *available at* http://www.eia.doe.gov/oiaf/ieo/tbl_b9.html (last visited June 3, 2002).

49. *China Forecasts on Installed Power Capacity, supra* note 43.

50. Chengzhang et al., *supra* note 31, at 31-33.

51. David Moskovitz, Why Restructure the Power Sector? Powerpoint Presentation Before the Guangdong Electric Power and Renewable Energy Workshop (Guangzhou, Apr. 15, 2002) (conference materials on file with Barbara Finamore).

52. *See* Barbara Finamore et al., Demand-Side Management in China: Opportunities and Policy Options (July 2002) (unpublished paper, on file with Barbara Finamore).

53. The SPC, 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 and 1998 to separate business management from the administrative and regulatory functions of government institutions. Chengzhang et al., *supra* note 31. For further discussion of the SPC, see section entitled China's Efforts to Combat Air Pollution and Improve Power Plant Efficiency, *infra*.

54. *China to Split State Power Corp. Into Smaller Power, Grid Companies*, Xinhua News Agency, Apr. 12, 2002; *see also China to Split State Power Corp.*, Alexander's Gas & Oil Connections, Mar. 6, 2002, *available at* http://www.gasandoil.com/goc/company/cns21015.htm (last visited June 7, 2002); Jackie Horne, Editorial, *First Chinese Grid Co Mandates Jumbo IPO*, FinanceAsia.Com, Apr. 23, 2002, *available at* http://www.financeasia.com/Articles/51185E7F-5258-11D6-81DF0090277E174B.cfm (last visited Sept. 30, 2002).

55. *China to Split State Power Corp.*, *supra* note 54.

Guangdong Grid Company.[56] The overall focus of the restructuring is to separate generation from transmission and distribution and to introduce competition into the generation side.

Air Pollution in China Today

During summer and autumn 2001, respected researchers released several studies documenting a significant decrease in China's air pollution over the previous three years. The most conservative study described an 8.8% drop in CO_2 emissions from fossil fuel combustion between 1996 and 2000, even though GDP officially rose 35%.[57] This revelation was particularly interesting to many because it became apparent just months after U.S. President George W. Bush announced he would not be submitting the Kyoto Protocol on climate change to the U.S. Senate for ratification.[58] Some commentators emphasized the point that under the Kyoto Protocol, China, as a developing country, was not required to make *any* reductions in its GHG emissions, yet was seemingly doing more to mitigate the intensity of climate change than the wealthy United States. The studies, conducted separately by DOE's Energy Information Administration, the U.S. Lawrence Berkeley National Laboratory, Battelle Memorial Institute/Pacific Northwest National Laboratory, and the International Energy Administration, with two reports by the Natural Resources Defense Council, also emphasized reductions in SO_2 emissions.[59]

Power plants were responsible for seven million tons of SO_2 emissions in 2000, or about 35% of China's total, and the percentage is rising.[60] According to official statistics, power plant SO_2 emissions rose to 46% of total SO_2 emissions in 2001,[61] and some experts estimate they could comprise up to two-thirds of total emissions by the year 2010.[62] This pattern resembles U.S. experience over the last 50 years when the percentage of power plant SO_2 emissions rose from 10% to 67% of total emissions as households and transportation systems switched away from coal.[63] In Shanghai in the late 1990s, power plants were already responsible for 72% of SO_2 emissions.[64]

A significant source of air pollution is China's use of relatively low-quality coal that is largely unwashed. In addition, much of the coal burned has high sulfur content (greater even than 4% or 5%).[65] Very few power plants have installed flue gas desulfurization (FGD) equipment in China because of its high cost, although virtually every type of desulfurization technology has been demonstrated.[66] Similarly, although a handful of plants in China have installed continuous emission monitoring systems, only a few of them are in operation because of their high cost and the ambiguous role of monitoring in China's environmental regulatory system.[67] Many of the plants built before 1980 have relatively low smokestacks and are located near cities, contributing greatly to local air pollution.[68] 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.[69]

China is taking active steps to increase the contribution of natural gas, renewables, and energy efficiency, or "negawatts," to the nation's energy mix in large part to address China's serious emissions problems. Yet until such time as the price of coal reflects its full economic, environmental, and societal cost, coal is likely to remain a primary resource for electricity generation for some time to come. The China Coal Field Geology Administration has introduced the concept of "effective coal resource supply capacity," which de-

56. Horne, *supra* note 54.

57. David G. Streets et al., *Recent Reductions in China's Greenhouse Gas Emissions*, 294 SCIENCE 1835, 1835 (2001) (noting that official figures for both GDP and coal consumption are unreliable and were revised downward after an initial claim of a 17% drop in fossil fuel-based CO_2 emissions). *See also* JEFFREY LOGAN, CHINA'S AIR POLLUTION DOWN DRAMATICALLY, BUT CAN IT LAST? 2 (Pacific Northwest National Laboratory, Apr. 2001) (citing BEIJING STATE STATISTICAL BUREAU 2000, CHINA STATISTICAL ABSTRACTS 2000 [ZHONGGUO TONGJI ZHAIYAO], stating also that SO_2 and particulate emissions dropped by 20% from their peaks in the mid-1990s), *available at* http://www.pnl.gov/china/polldown.pdf (last visited May 30, 2002).

58. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, U.N. Doc. FCCC/CP/197/L.7/Add.1, *reprinted in* 37 I.L.M. 22 (1998) [hereinafter Kyoto Protocol].

59. EIA, U.S. DOE, INTERNATIONAL ENERGY ANNUAL 1999 tbl. H1 (World Carbon Dioxide Emissions From the Consumption and Flaring of Fossil Fuels, 1990-1999) (2001), *available at* http://www.eia.doe.gov/emeu/iea/carbon.html (last visited July 16, 2002); Sinton & Fridley, *supra* note 30; LOGAN, *supra* note 57, at 1 ("The reductions . . . are unprecedented for any developing or industrialized country"); Natural Resources Defense Council, *Second Analysis Confirms Greenhouse Gas Reductions in China* (Oct. 2001), *at* http://www.nrdc.org/globalWarming/achinagg.asp (last visited June 3, 2002) (citing data provided by Hiroyuki Kato, an energy analyst from the Economic Analysis Division of the International Energy Agency). *But see* U.S. Embassy Beijing, *The Controversy Over China's Reported Falling Energy Use* (Aug. 2001), *at* http://www.usembassy-china.org.cn/english/sandt/energy_stats_web.htm (last visited June 3, 2002):

> It is now widely acknowledged within China that the official statistics have overstated the decline in coal consumption . . . . If, as appears likely, China's energy use has been flat or grown only slightly since 1995 while economic output has grown 20-25 (not 36 percent), that would still be noteworthy, and good news for those who care about global climate change. It is important to note though, that much of the efficiency improvement has been achieved through one-off gains, such as closing redundant plants.

60. 2002 CHINA STATISTICAL YEARBOOK, *supra* note 2; Personal Correspondence with Jonathan Sinton, Lawrence Berkeley National Laboratory (June 2002); Chen, *supra* note 1, at 2.; Chazhong et al., *supra* note 36, at 4.

61. 2002 CHINA STATISTICAL YEARBOOK, *supra* note 2.

62. Chen, *supra* note 1, at 6.

63. Participant Discussion, Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China (Beijing, Nov. 15-18, 1999) (notes on file with Barbara Finamore).

64. CLEAN WATER, BLUE SKIES, *supra* note 7, at 52.

65. *Id.* at 46; William P. Alford & Benjamin L. Liebman, *Clean Air, Clear Processes? The Struggle Over Air Pollution Law in the People's Republic of China*, 52 HASTINGS L.J. 703, 719 (2001) (citing Vaclav Smil, *China's Energy and Resources Uses: Continuity and Change*, 156 CHINA Q. 935, 941 (1998)).

66. CLEAN WATER, BLUE SKIES, *supra* note 7, at 50; Chen, *supra* note 1, at 6; Stephanie Ohshita, Cleaner Coal Technology Diffusion in China: Air Pollution Control and Economic Reform, Remarks at "A Way Forward: Innovative Approaches for Addressing Industrial and Urban Environmental Problems in China" (Stanford University, May 17, 2002) (notes on file with Barbara Finamore).

67. Meng Fan et al., Management and Monitoring of SO_2 Emission Sources in China, Paper Presented at the Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China 16-17 (Beijing, Nov. 15-18, 1999) (on file with Barbara Finamore).

68. CLEAN WATER, BLUE SKIES, *supra* note 7, at 50.

69. DADI ET AL., *supra* note 32, at 15.

fines exploitable coal resources in terms of technological feasibility, economic rationality, and compliance with relevant national environmental protection standards and practices. Using this measure, the Coal Field Geology Administration estimates that China's effective coal resource supply capacity in 2020 will be insufficient to satisfy demand.[70] In the meantime, the SPC, and its soon-to-be spin-off generating companies, is also experimenting with cleaner coal technologies like circulating fluidized bed combustion, FGD, and even integrated gasification combined cycle technologies.[71]

China's Efforts to Combat Air Pollution and Improve Power Plant Efficiency

China's original environmental protection law, the Environmental Protection Law (Trial), was passed during the country's first wave of economic reforms and opening in 1979.[72] With a well-known history of heavy industrialism, the Chinese leadership recognized early on that air pollution was a significant threat to China's environment. The first law dedicated to this subject, the Air Pollution Prevention and Control Law (APPCL), was passed by the National People's Congress in 1987.[73]

Many developing countries view their paths to economic wealth as necessarily accompanied by choking smog and other forms of environmental deterioration. They look upon the United States and western Europe and see efficient models of capitalism that disregarded environmental concerns until they reached a certain level of economic prosperity. There are very few examples of nations that developed and simultaneously protected their natural resources and maintained clean air and water. Environmental degradation is viewed by many in China as an indicator of successful economic development and as a necessary cost that will easily be remedied once the country achieves full industrialization.

While a handful of Chinese advocates for environmental protection did speak out in the post-Mao Tse-tung period, it was not until the 1990s that China, spurred by the United Nations Conference on Environment and Development in Rio de Janeiro, began to tackle its environmental problems in earnest. China's Agenda 21, which the State Council adopted in 1994, set forth an ambitious and wide-ranging blueprint for sustainable development.[74] In addition, a deluge of foreign government experts, nongovernmental organization representatives, green activists, and environmental scientists began to beat their way to China's door. These foreign representatives, all offering money or free expertise to combat local, regional, and global pollution resulting from China's rapid economic growth, supported those in the Chinese government that advocated change. In 1997, the World Bank, a significant source of development assistance in China, issued a widely read, mostly negative assessment of the state of China's environment.[75] The report highlighted the health and economic costs of pollution and, perhaps for the first time, provided the government with a dollar figure estimate of these costs to the economy.[76]

Focusing in on the acid rain crisis, the State Council declared in 1999 that the control of SO_2 emissions and acid rain would be one of China's top environmental priorities.[77] Endorsing this stated priority, the government over the last four or five years has put into place a series of forward-looking regulatory and policy measures to ensure that more than lip service is paid to the goal of environmental protection and sustainable development. China is developing an integrated approach to the control of SO_2 and acid rain, including 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.

Many of these reforms are embodied in the 2000 Amendments to the APPCL, amended first in 1995. China's Tenth Five-Year Plan also contains significant pollution control provisions. In addition to the "green" international assistance described above, this shift in political acceptability likely can be attributed to several other factors: first, growing domestic public awareness of the worsening environmental situation in China; second, the upcoming Beijing 2008 Summer Olympics bringing with it international attention; and finally, international pressure applied by countries "downwind" of China experiencing deteriorating environments because of China's neglect.

Graduate student and researcher Eric Zusman asserts that the coordination and linkages among the new policies and measures described below evidence a new-found confidence and legitimacy among the pro-environment forces in the central government to push forward strong environmental policies that do not leave much room for local interpretation or nonimplementation.[78] The early environmental laws, primarily the 1995 version of the APPCL, gave localities

70. Beijing Energy Efficiency Center, Study on Incentive Policy for Improving Power Energy Efficiency (2001).

71. Guanghua, *supra* note 41, at 4. *See also* State Power, *Power Source*, *at* http://www.sp.com.cn/newsp/english/powersource/thermal.htm (last visited June 3, 2002).

72. Handbook of Regulations on Environmental Protection in China 4 (trans. Lu Ruilan (Resources for the Future eds., 1995) (unofficial translation). *See also* http://www.zhb.gov.cn/index11.htm (in chinese only).

73. Zhonghua Renmin Gongheguo Daqi Wuran Fangzhi Fa [Air Pollution Prevention and Control Law of China] (enacted Apr. 29, 2000, effective Sept. 1, 2000, previously adopted Sept. 5, 1987, effective June 1, 1988, and amended Aug. 29, 1995), *earlier versions reprinted in* Zhongguo Huanjing Baohu Fagui Quanshu (1982-1997) [The Complete Book of Environmental Protection Laws and Regulations of China 1982-1997] (Guojia Huanjing Baohu Ju Zhengce Fagui Si [Policy, Law, and Regulation Division of the National Environmental Protection Administration] ed., 1997) [hereinafter 2000, 1995, or 1987 APPCL].

74. China's Agenda 21—White Paper on China's Population, Environment, and Development in the 21st Century (Adopted at the 16th Executive Meeting of the State Council of the People's Republic of China, on 25 March 1994) (China Environmental Science Press, Beijing, first ed. 1994).

75. Clean Water, Blue Skies, *supra* note 7.

76. *Id.* at 23.

77. U.S. Embassy Beijing, *China EPA Head Discuses Challenges, Priorities: An October 1999 Report From the U.S. Embassy Beijing*, (Oct. 1999), *at* http://www.usembassy-china.org.cn/english/sandt/Idahowb.htm (last visited May 30, 2002). The other priorities are the cleanup of three rivers, three lakes, and the city of Beijing. *Id.*

78. Eric Zusman, Fragmented Authoritarianism and Air Pollution Regulation in China: A Case Study, Paper Presented at the International Studies Association Conference (New Orleans, La., Mar. 24-27, 2002), *available at* http://www.sscnet.ucla.edu/soc/groups/ccsa/zusman.pdf (last visited June 13, 2002).

significant discretion to enforce or not enforce emissions standards, pollution levies, and other regulations, thus resulting in a less than optimal environmental control system.[79] Zusman argues that the new, often market-based measures suggest that the environmental protection bureaucracy is capitalizing on several factors including the post-1996 drop in SO_2 emissions and on international resources and expertise encouraging such an emphasis.[80] The main obstacle to promoting environmental protection, he argues, is the preexisting structural deficiency in which authority over promulgation comes from above (Beijing) whereas authority over enforcement comes from the side (the locality).[81] Furthermore, responsibility for enforcement and the devolution of power to the provinces in the 1990s resulted in localities operating without close regard to central control.[82] Chinese authorities have only recently started to recognize this problem and are beginning to harmonize and coordinate environmental policies.

The U.S. Embassy in Beijing noted recently that although the air pollution control regime has been strengthened in recent years, provincial and local governments are retaining control over how to achieve SO_2 and acid rain control targets dictated by the central government.[83] Though this freedom gives polluted, forward-looking provinces the flexibility to adopt market-based measures or other incentives to clean their air, it also gives more recalcitrant or less-developed areas the nod to continue polluting.

Total Emissions Control and the Two Control Zones

Over the past five to seven years, control over acid rain and SO_2 has centered in various forms around the policy pronouncements of total emissions control (TEC) and the "two control zones." China introduced the concept of capping pollutant emissions in its Ninth Five-Year Plan (1996-2000), the first Five-Year Plan to focus in detail on the environment. Termed TEC (also known as "total amount control"), the aim is to reduce total pollution loads on a national or regional level rather than focusing only on individual point source emissions or local environments.[84] However, the cap idea at the time was not formal law (TEC was not enshrined into law until the 2000 APPCL) and was applied differentially in three regions of the country based on economic and environmental factors. The TEC plan addressed 12 air, water, and solid waste pollutants[85] and stressed key geographical areas for control.[86] Eastern cities were told to reduce emissions to 5% below 1995 levels, while cities in poorer western China were permitted to increase emissions slightly, to 5% above 1995 levels. Areas in the middle had to reduce their emissions to 1995 levels.[87] Provincial-level amounts were to be distributed among the provinces on the basis of applications made and historical 1995 emissions levels. The overall goal was to go from the 1995 SO_2 emission level of 23.7 million tons to 24.6 million tons by 2000, allowing for an overall increase of 3.82%, but aiming for achieving 1995 levels evenly.[88]

Due to a number of factors, including the Asia-wide economic slowdown, closures of dirty coal-fired plants, and a broad restructuring of the energy and coal sector, these goals were not only met, but were exceeded by almost five million tons. China's official SO_2 emissions in the year 2000 were 19.95 million tons.[89] SEPA recently announced that annual SO_2 emissions in 2001 amounted to 19.48 million tons, a further decrease of 2.4% from 2000.[90]

In January 1998, the State Council unveiled an ambitious plan originally proposed by SEPA for the control of acid rain and SO_2 emissions in the most seriously affected regions, designated the "two control zones." The Acid Rain and SO_2 Control Zones together cover about 11% of China's territory (1.1 million square kilometers) and are responsible for 60% of China's total SO_2 emissions.[91] The regions with the largest SO_2 emissions are mainly those with high sulfur coal and large energy production and consumption, including Guizhou, Hebei, Henan, Jiangsu, Liaoning, Shandong, and Sichuan provinces.[92] The areas most seriously polluted by SO_2 emissions include the provinces of Gansu, Guangxi, Guizhou, Hebei, Shaanxi, Shandong, Shanxi, and Sichuan, and the municipalities of Beijing and Chongqing.[93]

The 1995 APPCL specifically authorizes the demarcation of acid rain and SO_2 control zones and the development of SO_2 control measures in these problem areas.[94] Almost every province and autonomous municipality contains a zone. Under the 1995 APPCL, China's overall goals for those then-undemarcated regions for the year 2010 were to: (1) hold SO_2 emissions to year 2000 levels; (2) bring all cities into compliance with ambient air quality standards; and (3) significantly reduce the area of land with rainfall hydrogen ion concentration (pH) levels below 4.5.[95]

The State Council announced a comprehensive set of requirements for achieving these goals, mainly focusing on

79. Susmita Dasgupta et al., *Bending the Rules: Discretionary Pollution Control in China* (World Bank Group, Policy Research Working Paper No. 1761, Feb. 1997), *available at* http://www.worldbank.org/nipr/work_paper/1761/ (last visited June 19, 2002).

80. Zusman, *supra* note 78, at 4.

81. *Id*. at 10.

82. *Id*. at 11.

83. U.S. Embassy Beijing, *Provinces Given Free Hand to Combat Acid Rain,* Beijing Env't, Sci. & Tech. Update, June 14, 2002, at 1, *available at* http://www.usembassy-beijing.org.cn/sandt/estnews061402.htm (last visited June 20, 2002).

84. State Environmental Protection Administration, *The Plan for Total Amount Control of Major Pollutants Discharge in China During the Ninth Five-Year Plan Period, at* http://www.zhb.gov.cn/english/plan/Totalp-right.htm (last visited June 17, 2002).

85. The 12 pollutants were soot, industrial dust, and sulfur dioxide on the air side; chemical oxygen demand, oil pollutants, cyanide, arsenic, mercury, lead, cadmium, and sexivalent chromium on the water side; and an index of solid waste pollutants. *Id*.

86. The key geographical areas of control were: the Acid Rain and SO_2 Control Zones; the Huaihe, Haihe, and Liaohe River basins; and the Taihu, Dianchi, and Chaohu Lake basins. *Id*.

87. *Id.*

88. *Id.*

89. China's Tenth-FYP for the Env't, *supra* note 20, at 53.

90. State Environmental Protection Admin., Zhongguo Huanjing Zhuangkuang Gongbao 2001 [China State of the Environment Report 2001] (2002), *available at* http://www.zhb.gov.cn/index3.htm (last visited June 20, 2002).

91. 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.*

92. Jing Lixin et al., SO_2 Pollution and Acid Rain Monitoring in China, Paper Presented at the Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reduction in China 4 (Beijing, Nov. 15-18, 1999).

93. *Id.* at 6.

94. 1995 APPCL, *supra* note 73, art. 15.

95. Chen, *supra* note 1, at 3-4.

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% of the major SO_2 polluting enterprises controlled by the government within the two zones. About one-half of total SO_2 emissions from the power sector come from plants located within these zones.[96] A policy circular released in January 2002 by SEPA, the State Economic and Trade Commission, and the Ministry of Science and Technology recently reinforced these requirements.[97]

Under the State Council's plan, no new thermal power plants (except for combined heat and power plants) were to be approved for construction in or around large and medium cities or their surrounding suburbs until January 2002. Newly built and renovated plants fueled by coal with a sulfur content above 1% 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.[98]

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. The plan does, however, forbid the construction of new mines with sulfur content in coal seams above 3%. Existing coal fields that produce coal with a sulfur content above 3% will be gradually phased out. Existing coal mines producing 1.5% sulfur coal or above must install appropriate coal washing and selecting facilities.[99]

A November 2000 SEPA report claimed that in the two control zones, SO_2 emissions declined by 800,000 tons between 1995 and 2000.[100] This reduction was partially achieved by closing 198 small power plants that had combined capacity of greater than 2 GW.[101]

The TEC and two control zone policies, while administratively complex and difficult to enforce, arguably have initiated China's break away from its once-accepted plan to pollute without restraint until attaining industrialized status. Whether due mostly to an economic slowdown or to "optimistic" statistics, China's impressive SO_2 emissions reductions are almost certainly due at least in part to the TEC and two control zone policies. Nevertheless, the regulated community surely experiences frustration at the confusing overlap and oft-changing peripheral regulatory adjustments made to the policies.

The Ninth and Tenth Five-Year Plans

China and other Communist nations are famous for their centrally dictated five-year plans. In China, the plans are agreed upon through a behind-the-scenes bargaining process among the various ministries and their higher-up advocates a year or more before the plan period commences. The State Development Planning Commission (SDPC) is responsible for devising these strategies for national economic and social development, setting targets, and developing regulatory policies to coordinate the development plans of major industries, including the power sector. In addition, the SDPC maps out specific 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.[102] Although China's five-year plans do not have the force of law, they provide important benchmarks for regulators who develop enforceable standards and provide an indication of the level of political commitment the senior leadership has on policy issues.

China's Ninth Five-Year Plan (1996-2000) introduced the concept of TEC for 12 pollutants, setting a general, nonmandatory goal to reach 1995 levels by the end of the plan's term. The plan urged the installation of desulfurization equipment on power plants.[103] The U.S. Embassy in Beijing reports mixed results.[104] The report notes that although 3 of 31 provincial-level jurisdictions report 100% compliance, and 9 reported 99% success, "local officials responsible for enforcing the two-targets policy are beholden to local leaders who, although cognizant of the political price of not meeting Central Government targets, may be more concerned about maintaining employment and economic growth."[105] Focusing on the more reliable statistics of air quality, the report describes some definite progress, including a 41% drop in SO_2 concentrations in Beijing between 1998 and 2000.[106]

Under the Tenth Five-Year Plan (2001-2005), issued jointly by SEPA, the SDPC, the State Economic and Trade Commission, and the Ministry of Finance, China aims to reduce SO_2 emissions nationwide to 10% under 2000 levels by 2005.[107] The 2000 baseline is significant because SO_2 emissions in that year were over 4 million tons under the

96. Chazhong et al., *supra* note 36, at 5, 23.

97. SEPA, State Economic & Trade Commission & Ministry of Science and Technology, Ranmei Eryanghualiu Paifang Wuran Fangzhi Jishu Zhengce [Policy on Sulfur Dioxide Pollution Control Technology] (2002) [hereinafter Policy on Sulfur Dioxide Pollution Control Technology], *available at* http://www.cenews.com.cn/hjbweb/Template/NewsTemplate.asp?NewsID=15796 (last visited May 23, 2002). A brief English summary can be found on the U.S. Embassy Beijing website. U.S. Embassy Beijing, *New Guidelines Issued to Control SO_2 Pollution*, Beijing Env't, Sci. & Tech. Update, May 17, 2002, *available at* http://www.usembassy-china.org.cn/sandt/estnews051702.htm (last visited May 23, 2002).

98. Chazhong et al., *supra* note 36, at 4.

99. Chen, *supra* note 1, at 4-5.

100. *Id.* (citing November 2000 SEPA report published in the journal Environmental Protection).

101. *Id.*

102. China Online, *State Development Planning Commission—PRC Ministry/Commission Profile: In-Depth Version, 1999*, *at* http://www.chinaonline.com/refer/ministry_profiles/SDPCL3.asp (last visited June 6, 2002).

103. *Id.*; Chazhong et al., *supra* note 36, at 8; National Environmental Protection Agency et al., The National Ninth Five-Year Plan and the Long-Term Targets for the Year 2010 for Environmental Protection 22 (1997).

104. U.S. Embassy Beijing, *Ninth Five-Year Plan Environmental Report Card*, (Mar. 2001), *at* http://www.usembassy-china.org.cn/english/sandt/9th5yearplan.htm (last visited May 30, 2002).

105. *Id.* (also noting that "another open question is whether enterprises that were ordered closed in late 2000 will quietly re-open now that the pressure is off").

106. *Id.* (though noting that urban areas are still heavily polluted by international standards, "the *average* daily concentration of [total suspended particulates] in Beijing in 1999 was more than three times the highest concentration recorded anywhere in metropolitan Los Angeles for *any single day* that year").

107. China's Tenth-FYP for the Env't, *supra* note 20, at 11; *China to Reduce Sulfur Dioxide Emissions*, People's Daily, Mar. 20, 2002, *available at* http://english.peopledaily.com.cn/200203/20/print2002-320_92414.html (last visited June 13, 2002).

24.6-million-ton goal stated in the Ninth Five-Year Plan. The latest plan specifically states that nationwide SO_2 emissions will be controlled at 17.96 million tons, with industrial SO_2 emissions limited at 14.5 million tons.[108] Furthermore, the Tenth Five-Year Plan states that SO_2 emissions in the two control zones must be 20% under 2000 levels by 2005, or 10.53 million tons.[109] Provinces and autonomous municipalities are allocated SO_2 emissions goals under the plan, with all areas having to reduce by between 1.5% and 20.5%, except for Hainan, Qinghai, and Tibet, which are all allowed to increase their very small emissions.[110] Provincial and local governments are presently dividing up their allocations among individual sources within their boundaries.[111]

During the Tenth Five-Year Plan period, China has said it plans to spend about U.S. $84 billion on environmental protection, or the equivalent of 1.3% of GDP.[112] On air pollution alone, the plan specifies that U.S. $33 billion will be invested.[113]

One of the goals in the Tenth Five-Year Plan is to conduct emission reduction projects on 37 coal-fired power plants in the two control zones, with an aim to reduce SO_2 emissions by 1.05 million tons annually.[114] The plan notes that the investment requirement for this project is U.S. $1.45 billion.

In January 2002, SEPA, the State Economic and Trade Commission, and the Ministry of Science and Technology jointly issued new policy guidelines on reducing SO_2 emissions from coal use.[115] While few of the policy pronouncements break new ground, the guidelines do say that new, expanded, or retrofitted coal-fired power plants will be required to install FGD equipment.[116] It is uncertain how many existing power plants in China have this technology, but it is claimed that around 8 GW of power is generated with such equipment.[117] In 1998, five power plants had FGD, with several more in the works.[118] The guidelines say that plants nearing the end of their design life or those emitting inordinate amounts of SO_2 should also install FGD.

Air Quality Standards for Thermal Power Plants

Power plants in China are required to fulfill a number of different air quality standards, including ambient standards, concentration standards, and soon, output-based standards. Although no clear oversight exists to guide plants in complying, the overlapping regulation remains. In practice, this means that compliant plants must follow the strictest variation.

Ambient Air Quality Standards

In 1996, SEPA promulgated national ambient air quality standards for SO_2 and nine other pollutants for natural resource conservation areas, residential/urban areas, and industrial areas. In accordance with many developed country systems, including the United States, the standards include annual, daily, and one-hour concentration limits for the different types of regions. Class I regions are specially protected areas such as natural conservation areas, scenic spots, and historical sites. Class II regions are residential areas, mixed commercial/residential areas, and cultural, industrial, and rural areas. Class III regions are special industrial areas. The average annual SO_2 ambient air quality limits are 0.02 milligrams per cubic meter (mg/m^3) for Class I regions, 0.06 mg/m^3 for Class II regions, and 0.10 mg/m^3 for Class III regions.[119] For comparison's sake, U.S. average annual ambient standards for SO_2 are 0.08 mg/m^3.

Emission Standards for Thermal Power Plants

SEPA and the State Bureau of Quality and Technical Supervision promulgated national emission standards for thermal power plants in 1996, effective January 1, 1997.[120] These standards were based on the age and size of the plant, and generally applied only to thermal power plants with boilers whose capacity is greater than 65 tons per hour.[121] The emission standards covered smoke and dust, SO_2, and nitrogen oxide (NO_x), but do not include particulate emissions. There were no time limits for compliance in the standards. Instead, the government relied either on general compliance targets (such as those found in five-year plans or the two control zone plan) or on directives setting compliance deadlines for individual plants or cities.[122] Although these standards were mandatory, emissions exceeding the standards were not considered a legal violation until the 2000 APPCL was promulgated.[123]

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 environmental impact assessments or initial designs were approved between August 1, 1992, and December 31, 1996. Phase III stan-

108. China's Tenth-FYP for the Env't, *supra* note 20, at 12.

109. *Id.* at 11.

110. *Id.* at 53, tbl. 1.

111. U.S. Embassy Beijing, *Provinces Given Free Hand to Combat Acid Rain*, Beijing Env't, Sci. & Tech. Update, June 14, 2002, at 1, *available at* http://www.usembassy-china.org.cn/sandt/estnews061402.htm (last visited June 20, 2002); *see also* discussion in section titled Air Quality Standards for Thermal Power Plants, *infra*.

112. China's Tenth-FYP for the Env't, *supra* note 20, at 44; *China to Invest Heavily in Environment Protection*, People's Daily Online, Mar. 25, 2001, *at* http://english.peopledaily.com.cn/200103/25/print20010325_65957.html (last visited June 4, 2002).

113. China's Tenth-FYP for the Env't, *supra* note 20, at 44.

114. *Id.* at 47.

115. Policy on Sulfur Dioxide Pollution Control Technology, *supra* note 97.

116. *Id.* at §5.1.2.

117. Personal Communications with Jeffrey Logan, *supra* note 32.

118. Shigeru Nozawa et al., *Deployment of Flue Gas Desulfurization (FGD) in Developing Countries*, World Bank Energy Wk., Apr. 10-14, 2000, at 3, *available at* http://www.worldbank.org/html/fpd/em/ccts_for_china/fgd_hitachi.pdf (last visited June 19, 2002).

119. SEPA, *Ambient Air Quality Standard (GB 3095-96)*, *in* Selected Environmental Standards of the People's Republic of China (1979-1997) (1998).

120. SEPA, *Emission Standard of Air Pollutants for Coal-Fired Power Plants (GB 13223-1996)*, *in id*.

121. 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.*

122. 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, NO_x, 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; Fan et al., *supra* note 67, at 6.

123. Dasgupta et al., *supra* note 79, at 3.

dards, which were added in 1996, apply to new, extended, and reconstructed thermal power plants whose environmental impact assessments or initial designs were approved after January 1, 1997.

All thermal power plants must comply with maximum total SO_2 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 240 meters), 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.

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 2,100 mg/m^3 if the fuel sulfur content is below 1%, and 1,200 mg/m^3 if the fuel sulfur content is above 1%.[124] 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% and therefore avoid the more stringent emission standard.[125]

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. The 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.[126]

According to the 1996 standards, for power plants outside the two control zones that use coal with a sulfur content of 1% or less but exceed applicable standards, a decision on whether to require desulfurization equipment should 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.[127]

Draft Output-Based Power Plant Emissions Standards

The thermal power plant emissions standards described above are currently undergoing massive review, and new draft standards were released in December 2001.[128] In these draft standards, SEPA is proposing a new approach to power plant air emission regulation recently introduced in the United States: output-based, or generation performance standards (GPS).[129] Unlike traditional regulations, which limit emissions on the basis of pounds of emissions per unit of fuel burned, GPS levels are expressed in pounds of emissions per kwh of electricity produced. Such an approach favors those facilities that are more efficient, i.e., those 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 historic fuel use and thus avoid creating a competitive advantage for more polluting resources.[130]

The draft standards incorporate an output-based approach by limiting emissions of SO_2, NO_x, smoke, and dust in terms of g/kwh. For example, new, expanded and retrofitted plants within the two control zones will have to limit SO_2 emissions to 1.5 g/kWh. Less stringent limits will apply to older plants and to plants located outside the two control zones. NO_x emissions will be limited to 2.5 g/kwh for new, expanded, and retrofitted plants, and 4.0 g/kwh for older plants. Over time, the more stringent standards will gradually be applied to older plants.

The new draft power plant emissions standards issued in late December 2001 are currently open for comment and are expected to be finalized by the end of 2002.[131] The standards encourage a rapid switch to utilizing more efficient generation technologies as well as cleaner and more efficient fuels. Given past bargaining over air pollution standards ably documented by Profs. William Alford and Benjamin Liebman, it remains unclear whether these relatively stringent and forward-looking standards will enter into force, or perhaps be scaled back by industry and government opponents.[132]

In partnership with SEPA, three provinces—Shandong, Shanxi, and Zhejiang—have volunteered to test the use of an output-based approach to allocate their provincial SO_2 emissions cap. Shandong and Zhejiang were chosen because they are provinces undergoing heightened utility reform, and Shanxi was chosen because of its central importance in coal production and also as a serious sufferer of acid rain.[133] As described above, SEPA has already allocated the Tenth Five-Year Plan national SO_2 emission cap of 18 million tons to each of China's provinces based on environmental and economic considerations. It is now up to each province to further allocate its provincial cap on a municipal or sectoral basis in order to ensure the necessary emission re-

124. *See supra* note 120.

125. Workshop Discussion, Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy (Beijing, Nov. 8, 1999) (notes on file with Barbara Finamore). Sixty percent of the coal used in China's power plants has a sulfur content of less than 1 %, 30% has a sulfur content between 1 and 2%, and 10% has a sulfur content above 2%. Dagang, *supra* note 42, at 10.

126. Workshop Discussion, Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy (Beijing, Nov. 8, 1999) (notes on file with Barbara Finamore).

127. Chazhong et al., *supra* note 36, at 6.

128. Emission Standards of Thermal Power Plants, The People's Republic of China (6th version for comments).

129. In addition to the groundbreaking, output-based measures adopted in Massachusetts, the U.S. Environmental Protection Agency (EPA) recently announced that it is drafting voluntary guidelines for ultimate adoption by states nationwide to encourage output-based standards. The U.S. guidelines, which will also specifically encourage the use of combined heat and power (CHP) cogeneration facilities, are expected to be released at the end of summer 2002. *EPA Guidelines Would Revamp Power Plant Emission Assessments*, 23 Inside EPA 15 (May 24, 2002).

130. Barbara A. Finamore et al., *Controlling China's Power Plant Emissions After Utility Restructuring: The Role of Output-Based Emission Controls*, 4 Sinosphere J. 14 (July 2002).

131. *Huodian Chang Wuranwu Paifang Biaozhun–Zhengqiu Yijian Gao* [*Thermal Power Plant Pollutant Emissions Standards—Open for Comment*], Zhongguo Huanjing Bao [China Env't News], Dec. 24, 2001 (on file with Barbara Finamore).

132. William P. Alford & Benjamin L. Liebman, *Clean Air, Clear Processes? The Struggle Over Air Pollution Law in the People's Republic of China*, 52 Hastings L.J. 703 (2001).

133. *Thermal Power Plant Pollutant Emissions Standards—Open for Comment, supra* note 131, at 5.

ductions.[134] The three pilot provinces have each completed assessments of the current status of their power plant emissions and are now working to develop preliminary GPS standards that will serve as the basis for allocating emission allowances to each power plant. They will also explore the feasibility of trading these emission allowances and consider conducting one or more trading experiments.[135]

Pollution Levy/Emission Fee System

China's primary mechanism for enforcing pollution emission standards at thermal power plants has been the pollution levy system, now more appropriately 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.[136] Under the original pollution levy system, charges were based on:

> The amount of emissions exceeding the standards (which did not provide any incentive to lower emissions below the level of the standards);
>
> The concentration of emissions rather than the total amount emitted (which encouraged 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 encouraged plant owners to view pollution levies as a cost of doing business rather than an incentive to install pollution control equipment).[137]

The low ratio between fees and costs of abatement, as well as politically powerful local plants perhaps implicitly citing their employment of many otherwise restive and unemployed local residents in their nonpayment of fees, meant that the pre-2000 pollution levy system was ineffectual.[138] Plants were often owned by local governments, thereby creating a conflict of interest. There was also little oversight on how fees were spent—most of the funds went right back into the enterprises. Zusman has described the inherent inefficiency in a governmental structure where rules are promulgated from above but enforcement is expected at a far-away local level where priorities are different.[139]

The original 1982 pollution levy system included an SO_2 charge rate of 0.04 yuan per kilogram (yuan/kg). This levy, however, did not apply to boilers for power plants and heating, only targeting 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.[140]

In September 1992, China instituted a two-year trial SO_2 pollution levy system in nine cities and two provinces that strengthened the original system in several respects.[141] Power plant emissions were covered for the first time. The charge rate was higher (0.2 yuan/kg or 200 yuan/ton) 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.[142]

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, however, found that the implementation of this pilot program encountered a number of obstacles.[143]

In 1998, the State Council decided to extend 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 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).[144]

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% abatement of SO_2 would be cost-effective and yield large benefits in terms of human health.[145] However, an SO_2 pollution levy charge rate of 0.2 yuan/kg is still much lower than the marginal cost for SO_2 reduction or the average cost of SO_2 mitigation.[146] Installing FGD equipment, for instance, costs between 1,200 and

134. State Environment Protection Administration, Notification of Pilot GPS Projects in Zhejiang, Shandong and Shanxi to Control SO2 Emission of the Utilities (Oct. 26, 2001) (on file with Barbara Finamore).

135. Notes of Meeting With GPS Pilot Provinces, Beijing, China (Apr. 18, 2002) (on file with Barbara Finamore).

136. Yang Jintian et al., SO_2 Charge in China, Paper Presented at the Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China 1 (Nov. 15-18, 1999).

137. *Id.* at 6.

138. Alford & Liebman, *supra* note 65, at 722.

139. Zusman, *supra* note 78; see discussion in section titled China's Prospects for Blue Skies and Taming the Dragon Heads, *infra*.

140. Jintian et al., *supra* note 136.

141. 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. *Id.* at 7. Wang Hangchen & Liu Bingjiang, *Policymaking for Environmental Protection in China*, *in* Energizing China: Reconciling Environmental Protection and Economic Growth 398 (1997).

142. Jintian et al., *supra* note 136, at 3; Hangchen & Bingjiang, *supra* note 141, at 398-99.

143. Hangchen & Bingjiang, *supra* note 141, at 399. Several of the nine pilot cities had difficulties 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 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 (10%) insufficient to cover their expenses in measuring emissions and applying the levies; and perceived the levies as only a two-year pilot project, which could be ignored, as opposed to a compulsory policy. *Id.*

144. Jintian et al., *supra* note 136, at 3-5.

145. Susmita Dasgupta et al., Surviving Success: Policy Reform and the Future of Industrial Pollution in China §5.3, chs. 7-8 (World Bank 1997).

146. Jintian et al., *supra* note 136, at 6.

1,800 yuan/ton (compared to a 200 yuan/ton of emission fee).[147] Therefore, coal-fired power plants, which are key targets for SO_2 pollution levies, would still prefer to pay than to install pollution control equipment. In November 1999, Beijing's emission fee rate for SO_2 was raised to 1.2 yuan/kg, but other localities have yet to follow suit.

Emissions fees in the late 1990s were only collected from profitable enterprises. The fee amount could still be bargained over with local Environmental Protection Bureau (EPB) officials. Recognizing this problem, the State Council promulgated the "Decision on Various Environmental Protection Issues" in August 1998 saying that all industrial polluters must meet emissions standards by the end of 2000. However, the State Council simply promoted the status quo by not stipulating a clear punishment for failing to achieve this goal.

2000 Amendments to the APPCL

The path toward enacting the reform-oriented and market-based 2000 APPCL is worth mentioning briefly. Alford and Liebman have described in lucid detail the almost decade-long compromise and bargaining process involved in revising China's main air pollution law in major amendments in 1995 and in 2000.[148] They note that the 1995 version evidenced the triumph of heavy industrial interests over the pro-environment factions.[149] One obvious motivator for strengthening the APPCL in 2000 was to combat weaknesses in enforcement. China's environmental patriarch, Qu Geping, has pointed out that localities often ignored the air quality law.[150]

Primary responsibility for lawmaking in China lies with the National People's Congress (NPC) and its Standing Committee. The NPC, which convenes as a body for only two weeks a year, and its Standing Committee, which works year-round, pass all "basic laws" under which more specific administrative measures and regulations are enacted by the State Council and ministries and institutions under it like SEPA and the SDPC.

The two central government institutions known to be the most ardent advocates for stronger air pollution standards in China are SEPA and the Environment and Natural Resources Protection Committee of the National People's Congress (ENRPC). Both of these institutions pushed for stringent pollution control amendments to the 1987 APPCL, both during the 1995 and the 2000 processes.[151]

The 2000 Amendments went into effect on September 1, 2000, even with the realization that full compliance might cost up to 1.5% of GDP by 2010.[152] While retaining the ambient air quality framework, the law aims to control the total volume of air pollutants to 1995 levels by 2010 by setting a firm cap. SO_2 is specifically targeted to be limited to 10 million tons in the SO_2 and Acid Rain Control Zones by 2010. As noted above, the TEC concept had been introduced in 1996 for the two control zones in the Ninth Five-Year Plan, but the 2000 APPCL expands the concept nationwide and makes it mandatory.

The 2000 APPCL revisions give more flexibility to provincial and local governments to achieve air quality goals, while at the same time significantly strengthening enforcement. Violating emissions standards is now a legal transgression. Pollution levies, or emission fees, now apply to all pollutants, not just the one pollutant with the highest concentration, and to all emissions, not just to emission levels exceeding the standards. The new law includes a national system to collect the fees, with all fees to be turned over to the Treasury and used for prevention and control of air pollution as prescribed by the State Council.[153]

In addition to pollution fees, fines for violating provisions of the law are to be determined by localities on a compliance timetable set by the State Council (or, more likely, SEPA under it), but are authorized up to 100,000 yuan for polluters, with fines of up to 200,000 yuan to certain industrial facilities—not including most power plants—for failure to install desulfurization equipment.[154] Penalties also include criminal liability for extreme cases.[155]

The 2000 APPCL for the first time provides legal authority for local-level EPBs to issue permits to sources in the two control zones, but this program is still in development. In 1992, China initiated a pilot air pollutant permit program in 16 cities, with reported positive results.[156] The main problem with moving forward with this program is the almost complete absence of continuous emissions monitoring equipment on plants.

With regard to coal use, the law prohibits the use or production of coal with sulfur content above 3%. Article 24 requires washing of high sulfur (over 1.5%) and high ash coal at new and existing coal mines. Article 30 requires desulfurization equipment to be used at new and retrofitted power plants.

The law also recognizes the beneficial role of the public in enforcing environmental laws. It calls for increasing public awareness by publicizing regular local pollution assessments.[157]

Many of the provisions in the 2000 APPCL were introduced by SEPA and the ENRPC during the debate over the

147. Clear Water, Blue Skies, *supra* note 7, at 52 (Box 4.2).

148. Alford & Liebman, *supra* note 65.

149. *Id.* at 725-27.

150. U.S. Embassy Beijing, *China's Clean Air Price Tag: US$40 Billion*, (May 2000), *at* http://www.usembassy-china.org.cn/english/sandt/airqualitycost.htm (last visited June 12, 2002).

151. Alford & Liebman, *supra* note 65, at 713.

152. U.S. Embassy Beijing, *China Revises Its Air Pollution Law*, (June 2000), *at* http://www.usembassy-china.org.cn/english/sandt/Cleanairlaw.htm (last visited June 4, 2002). The law addresses a wide range of contributors to pollution, including cars, heating, and leaded gas; this overview will cover only those provisions related to electric power.

153. 2000 APPCL, *supra* note 73, art. 14.

154. *Id*. art. 57.

155. *Id*. art. 60.

156. In 1994, the National Environmental Protection Agency (the predecessor of the State Environmental Protection Administration) initiated a trial air emissions permit program in 16 cities, including Baotou, Changzhou, Chongqing, Guangzhou, Guiyang, Jilin, Kaiyuan, Liuzhou, Mudanjiang, Pingdingshan, Shanghai, Shenyang, Tianjin, Xuzhou, and Yichang. 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, the agency had issued nearly 1,000 emission permits to 8,628 sources in the 16 cities. The agency'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.

157. 2000 APPCL, *supra* note 73, arts. 20, 23.

1995 Amendments.[158] Provisions that were knocked down in the 1995 debate but adopted in the 2000 version include TEC (rather than concentration-based standards), three categories of cities for air pollution control, illegality of emissions violations, mandatory coal washing, and raising pollutant fees.[159]

The U.S. Embassy in Beijing noted shortly after the promulgation of the amendments that the new law "merely rati[fies] what many localities are already doing." The report continues:

> The director of the municipal environmental protection bureau in Shenyang recently told us the revised law would have little impact there, because Shenyang was already doing (or at least trying to do) everything it called for. But the new legislation gives a stronger legal underpinning to such practices as total emissions control, pollution permits and emissions trading and should lead to an extension of these practices beyond the priority cities and SO_2 and acid rain control zones. More importantly, it indicates the central government's vision for the future direction of Chinese pollution-control policy.[160]

Indeed, legal authorization is necessary (though perhaps not sufficient) to compel provinces to accept new policies and programs. It also provides support for provinces that wish to move ahead to more rapidly improve their air quality. Furthermore, the enforcement provisions must be enshrined into law or they are not enforceable. Thus, the 2000 APPCL demonstrates a significant leap forward in China's political commitment to air quality.

China's Experimentation With Emissions Trading

For the past decade, China has demonstrated an open mind and interest in the possibilities of emissions trading, made most famous through its successful application in the U.S. Environmental Protection Agency's (EPA's) Acid Rain Program under the Clean Air Act.[161]

SEPA began experimenting with emissions trading in 1994 through pilot projects in the six cities of Baotou, Guiyang, Kaiyuan, Liuzhou, Pingdingshan, and Taiyuan. Shanghai and Tianjin 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.[162] 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 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. Some 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 particulate matter. Trading took place within enterprises, between similar types of enterprises, and even between different types of enterprises, including point and nonpoint sources.[163]

More recently, the city of Taiyuan in Shanxi Province has been the focus of an experimental trading program for 26 permitted sources, with the guidance of the Asian Development Bank, EPA, and the U.S. environmental group Resources for the Future. The parties believe that emissions trading could prove suitable for Taiyuan since a small number of polluters emit roughly one-half of the total SO_2 emissions and have large differences in estimated cleanup costs, ranging from $60 to $1,200 per ton of emissions.[164]

Environmental Defense and the Beijing Environment and Development Institute (BEDI) have helped China to conduct emission trading pilot projects in the cities of Benxi and Nantong, with a focus on TEC implementation.[165] These projects included the development of local legislation, bilateral transactions, and assessments of the effectiveness of alternative compliance strategies. The quality of emissions data and monitoring remains a major issue, as well as the problem of controlling transboundary SO_2 emissions. Environmental Defense 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.[166]

In May 2002, SEPA announced plans to extend the pilot SO_2 emission trading projects to a wider area encompassing the provinces of Henan, Jiangsu, Shandong, Shanghai, and Shanxi, the autonomous city Tianjin, and Liuzhou, a tourist destination in Guangxi Province with a long history of heavy industry.[167] This project will also be conducted with Environmental Defense and BEDI. The announcement emphasizes the benefits of utilizing market mechanisms in

158. *See generally* Alford & Liebman, *supra* note 65, at 716-25.

159. *Id.*

160. U.S. Embassy Beijing, *China Revises Its Air Pollution Law*, *supra* note 152. It should be noted that the electric power sector did oppose the introduction in this law of the acid rain and SO_2 control zones. Alford & Liebman, *supra* note 65, at 746-47.

161. *See generally* Energy Division (East), Asian Development Bank, Emissions Trading in the Energy Sector: Opportunities for the People's Republic of China (1999).

162. 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 4 (Nov. 15-18, 1999).

163. *Id.* at 3-4; Environmental Defense Fund & Beijing Environment and Development Institute, 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).

164. Zusman, *supra* note 78, at 25; *A Great Leap Forward*, The Economist (May 11, 2002), *available at* http://www.rff.org/news/newsarticles/greatleapforward.htm (last visited July 16, 2002).

165. Daniel J. Dudek & Ma Zhong, Total Emissions Control and Emissions Trading in China, Paper Presented to the Harvard University Center for the Environment (Nov. 26-27, 2001) (on file with Barbara Finamore).

166. Environmental Defense Fund & Beijing Environment and Development Institute, *supra* note 163.

167. Chen Shurong, *"Er Yang Hua Liu Paifang Jiaoyi" Shidian zai Qi Sheng Shi Zhan (Sulfur Dioxide Emissions Exchange Pilot Program Launched in Seven Provinces)*, People's Daily, May 31, 2002, *available at* http://www.environfo.org.cn/Air_Pollution/Green_House_Gas/e053104_en.htm (last visited June 4, 2002); *China to Trial Sulfur Dioxide Quota*, Xinhua, June 3, 2002, *available at* http://english.peopledaily.com.cn/200206/01/eng20020601_96926.shtml (last visited Sept. 30, 2002).

complying with TEC standards more cheaply, more easily, and with greater autonomy. Permit trades will be conducted among enterprises that are required to comply with SO_2 emissions standards.[168] This program is the most comprehensive emissions trading program announced to date and, if successful, may lead to a broader, perhaps national-scale scheme.

The ultimate development of a mandatory nationwide 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.[169] China will also need to coordinate this trading program with existing environmental management systems, particularly the pollution levy system.[170] Efforts to develop these requirements could also improve overall environmental management in China regardless of whether an emissions allowance trading program is ever developed.

Proponents of emissions trading note that many of the basic preconditions for such trading already exist in China: a clear environmental goal with a cap on 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); wide differences in SO_2 abatement costs among sources; and a trading mechanism based on the emissions permit system.[171] CRAES has performed a comprehensive comparison of the relative benefits of emission trading and the pollution levy system in China.[172] Emissions trading may be particularly suited to the power sector, since marginal abatement costs vary from region to region and from plant to plant based on technology, age, and fuel, and since varying market forces exist to create the demand and supply necessary to an active and effective trading system.[173]

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.[174]

The World Bank contends that market-based instruments (MBIs), such as emissions 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 will. Market-based reforms can help or hinder the success of MBIs. The World Bank and other commentators argue 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.[175]

Emissions Monitoring

Current power plant emissions standards require SO_2 continuous emissions monitoring equipment for all plants built in acid rain and SO_2 pollution control zones, as well as all plants using FGD equipment.[176] 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 equipment.

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.[177] 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 emissions trading.[178]

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 con-

168. *China to Trial Sulfur Dioxide Quota*, *supra* note 167.

169. Hong, *supra* note 162, at 6-7.

170. Chazhong et al., *supra* note 36, at 24.

171. *Id*. at 22; Environmental Defense Fund & Beijing Environment and Development Institute, *supra* note 163, at 12; P. Abeygunawardena, Emissions Trading in PRC's Energy Sector: The Role of the Asian Development Bank, Paper Presented at the Workshop on the Feasibility of Using Market Mechanisms to Achieve Sulfur Dioxide Emissions Reductions in China 8 (Nov. 15-18, 1999).

172. Jintian et al., *supra* note 136, at 13-16.

173. *Id.* at 21; Chen, *supra* note 1, at 7.

174. Chris Nielsen & Michael B. McElroy, *Introduction and Overview*, *in* Energizing China: Reconciling Environmental Protection and Economic Growth 20, 36 (1998); Roger Raufer & Wang Weili, *Air Quality Management in Chinese Cities: The Policy Setting for Future Controls*, 2 Sinosphere 22-25 (1999), *available at* http://www.chinaenvironment.net/sino/sino6/; Jintian Yang & Stephanie Benkovic, *The Feasibility of Using Cap and Trade to Achieve Sulfur Dioxide Reductions in China*, 4 Sinosphere 10-14 (2002), *available at* http://www.chinaenvironment.net/sino/sino12/ (last visited Sept. 30, 2002).

175. *See generally* Richard M. Huber et al., Market Based Instruments for Environmental Policymaking in Latin America and the Caribbean: Lessons From Eleven Countries (World Bank Discussion Paper No. 381, 1998); Ruth Greenspan Bell & Clifford Russell, *Environmental Policy for Developing Countries*, Issues in Sci. & Tech. 63 (Spring 2002).

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

177. Chazhong et al., *supra* note 36, at 24.

178. Jintian et al., *supra* note 136, at 9.

sumption. 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.[179] Some cities in China are unable to develop this estimated data since they lack the means to measure the sulfur content of coal.[180] 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.[181]

China's Prospects for Blue Skies and Taming the Dragon Heads

China is beginning to recognize the structural and institutional deficiencies that have plagued full enforcement of its relatively strong laws and policies. However, a number of systemic obstacles remain, ranging from divergent central-local priorities, to lack of central financial influence over localities, to weak mechanisms for publicizing laws and ensuring consistent application and enforcement.

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.[182] 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. Some cities have installed hotlines for citizens to call in to complain, and some include giving rewards to those who report pollution violations.[183]

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.[184] Although the government is encouraging a general switch in fuel toward natural gas and renewables in the near future, newly added generating plants are expected to continue to comprise overwhelmingly thermal (mostly coal-fueled) power plants.[185] China can guide its emerging energy market along a sustainable development path by identifying and including environmental costs and benefits in energy prices.

The psychological and political dynamics implicated in China's full entry to the world community, indicated in part by China's 2001 accession to the World Trade Organization (WTO), should not be underestimated as a motivator to improve China's environment. In many ways, it is evident that China wishes to become a developed country as soon as possible and views its severe pollution shamefully as demonstrative of its "backwardness." Any perceived intransigence on China's part in terms of its "right" to pollute as a developing country has been studiously avoided in the past decade, as the country even goes as far as to take a leading role in multinational environmental treaty regimes.[186] This recognition of the "reputational capital" inherent in environmental policymaking will induce further progress in this area.[187]

Structural and Economic Issues With Environmental Enforcement

Although the central government has been very active in developing policies to control SO_2 emissions and improve power plant efficiency, enforcement of these policies at the local level remains a serious problem. A key obstacle to reforming the environmental protection regime in China is institutional. Although there are almost 100,000 local environmental protection officials in China charged with the enforcement of China's environmental laws and regulations, these officials are paid and supervised by the local municipality.[188] Thus, though they receive their mandates from the central government, their actual loyalties will most probably lie with their mayors or governors who hold the purse strings and directly supervise their work. Since localities view economic and social concerns as more immediate and politically weighty than environmental protection, pollution enforcement will often be disregarded.[189]

Another major obstacle is a lack of financing from the central government, even though the Tenth Five-Year Plan calls for 1.3% of GDP to be spent on environmental protection by 2005.[190]

The editors of *Energizing China: Reconciling Environmental Protection and Economic Growth* argue that there are structural barriers to the enforcement of emissions control policy options that make them unlikely to be broadly effective in the next 10 to 20 years. They note that there are systemic and deeply rooted reasons why power plants emit pollutants that will be difficult to overcome in a political and economic system absorbed in transition.[191]

The reasons for weak environmental enforcement have been analyzed extensively.[192] They include overwhelming

179. *Id.* at 6.

180. Hangchen & Bingjiang, *supra* note 141, at 399.

181. Fan et al., *supra* note 67, at 18.

182. *See* The World Bank, Greening Industry: New Roles for Communities, Markets, and Governments 144-48 (2000).

183. *Tough Campaign Clears Air*, People's Daily Online, Sept. 26, 2001, *at* http://english.peopledaily.com.cn/200109/26/print20010926_81055.html (last visited June 4, 2002).

184. As of mid-2002, there were 39 Sino-foreign power plants in China, with a total installed capacity of 27,000 MW, comprising 8.5% of China's total. *China Power Reform Will Not Hurt Foreign-Invested Power Plants*, Alexander's Gas & Oil Connections, June 13, 2002, *at* http://www.gasandoil.com/goc/company/cns22432.htm (last visited June 13, 2002).

185. Zhou Jiaping, EVA—The Austrian Energy Agency, *The Current Situation of China's Electric Power Industry*, (Nov. 14, 2001), *at* http://www.eva.ac.at/(en)/projekte/china_power.htm. The author is the director of the general engineering office of the Chongqing Energy Conservation Technical Service Center.

186. In addition to the climate change mitigation progress mentioned above, in 1996 China was also the first country to adopt an "Agenda 21" plan for sustainable development after the 1994 United Nations Conference on Environment and Development in Rio.

187. Alford & Liebman, *supra* note 65, at 714-15.

188. *Id.* at 710.

189. *See* Ma Xiaoying & Leonard Ortolano, Environmental Regulation in China: Institutions, Enforcement, and Compliance 8-9, 33-40, 60-69 (2000).

190. *See* Logan, *supra* note 57, at 5.

191. Nielsen & McElroy, *supra* note 174, at 7.

192. *See, e.g.*, Hua Wang et al., Incomplete Enforcement of Pollution Regulation: Bargaining Power of Chinese Factories (New Ideas in Pollution Regulation Research Paper, The World Bank, Aug. 2001), *available at* http://www.worldbank.org/nipr/china/IncompleteEnforcementofPollutionRegulation.htm (last visited June 12, 2002); Alford & Liebman, *supra* note 65; Raufer & Weili, *supra* note 174; Kenneth Lieberthal, *China's Governing System and Its Impact on Environmental Policy Implementation*, 1 China Env't Series 3 (Working Group on Environment in

pressure to expand the local economy, SEPA's lack of horizontal and vertical administrative leverage,[193] personnel and budget limitations, vaguely drafted provisions allocating responsibility and liability,[194] a complicated distribution of environmental enforcement power, a low level of public awareness, a lack of transparent decisionmaking, and a weak judicial system.[195] 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.

One factor exacerbating the lack of local adherence to centrally established environmental laws has been the vagueness of wording in the regulations. On the one hand, localities are given freedom and flexibility to implement as best they see fit; on the other, ambiguity leaves lots of room for discretion on whether to enforce the laws at all.[196] Local governments have neither the motivation nor do they receive the "stick" compelling them to enforce strict standards.[197]

Academics Kenneth Lieberthal and the late Michel Oksenberg have noted 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 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.[198]

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

> Greater circulation of information based on a more relaxed view toward 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.[199]

The central government's granting of power to localities to adopt more stringent air pollution standards has in some cases allowed the provincial and municipal authorities to demonstrate political and economic willingness and feasibility even when the central level was unprepared to promulgate stricter standards.[200] This is evidenced particularly in the case of Beijing, which has made significant strides in improving its local air environment, as described below.

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 an approach focused primarily on emission control standards and market-based incentives.[201]

Command-and-control measures, however, are likely to encounter a great deal of resistance from local governments,

U.S.-China Relations, The Woodrow Wilson Center ed., 1997); Michel Oksenberg, Discussion, Power Sector Regulatory Reform in China: Workshop on Encouraging Energy Efficiency and Renewable Energy (Beijing, Nov. 8, 1999); Marilyn Beach, *Local Environment Management in China*, 4 China Env't Series 21-31 (2001); *Environmental Compliance and Enforcement: The Real Story*, 1 China Envtl. Rev. 5 (Oct. 1997).

193. 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*, 2 China Envtl. Rev. 2 (Dec. 1998/Jan. 1999).

194. In a July 1999 decree, SEPA set a range of increasingly stringent administrative penalties for violations, coordinated penalties for transregional pollution, and set procedures for imposing, reviewing, and executing administrative penalties. State Environmental Protection Agency, Methods of Administrative Penalty of Environmental Protection, Decree No. 7 (1999).

195. 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, *at* 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, *at* http://www.scmp.com/News/Template/Print/Article.asp.

196. Zusman, *supra* note 78.

197. *See generally* Beach, *supra* note 192.

198. Lieberthal, *supra* note 192, at 6-7; *see generally* Kenneth Lieberthal & Michel Oksenberg, Policy Making in China: Leaders, Structures, and Processes (1988).

199. Lieberthal, *supra* note 192, at 6-7.

200. Alford & Liebman, *supra* note 65, at 727, 732, 733 (also noting that stricter revisions to the Air Pollution Prevention and Control law were driven in part by local governments, "in particular Beijing, which faced massive environmental problems but which felt that their ability to enact tougher regulations was limited by the 1995 APPCL").

201. Nielsen & McElroy, *supra* note 174, at 8.

especially if they threaten the local economy and eliminate jobs, not to mention cutting off local sources of tax income.[202] Moreover, they may not be the most cost-effective way to reduce total power plant emissions.[203] 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.[204]

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.[205] Strengthening China's existing regulatory system can help provide the necessary incentives for power plants to undertake both pollution prevention/efficiency strategies and end-of-pipe control mechanisms where appropriate.

Regardless of which emission standards China adopts, however, enforcement will remain a major problem. The 2000 APPCL allows localities some flexibility via the TEC system in *how* SO_2 emission standards are met—through such means as efficiency improvements, cleaner production methods, or emission credit/allowance trading. Uniform standards and requirements for emissions monitoring and reporting are still needed and will become essential if China wishes to adopt national 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 the utilization of pollution levy revenues, such as a national Environmental Protection Fund.

More recently, World Bank researchers have determined that enforcing pollution charges in China has been heavily dependent on several factors: whether the polluting firm was state or privately owned; the financial stability of the firm; and the popularly known social impact of the emissions of the polluting firm.[206] The researchers collected data from one Chinese municipality of three million people, noting that municipalities are responsible for enforcing the pollution levy system. Because local EPBs lack power to force industrial enterprises to pay fees, remittance is determined ultimately through a bargaining process between the environmental officials and the enterprise.[207] They found that state-owned firms, unstable financial situations, and lower social impact all resulted in a greater bargaining power on the part of the enterprises trying to reduce pollution levies.[208]

Recent state-issued statistics, if accurate, provide some hope that China is getting serious about local enforcement of its pollution laws in general. During three months of summer 2001, SEPA screened 1.4 million enterprises for pollution violations and "punished" 8,754 for "seriously contaminating the environment."[209] Of these, 27% were shut down completely, and 56% were fined.[210] Punishment measures also included penalizing managers personally.[211] Another 9,000 enterprises were found to have violated environmental laws to a lesser extent.[212] In addition, in August 2001, SEPA announced that it had punished officials in eight provinces, including vice mayors and heads of local EPBs, for not enforcing national environmental protection laws.[213]

Public Environmental Awareness and Participation

In order to legitimize its pro-environment agenda and overcome its lack of a financial carrot, SEPA is taking a number of steps to increase public awareness of environmental issues. A number of cities have begun to broadcast weekly readings of their local air quality. The cities monitor SO_2, NO_x, and total suspended particulates and combine the three readings into a weekly air pollution index. The program is successful and homebuyers in Shanghai reportedly consider air pollution index readings when deciding where to live. The Beijing city government began to publish daily air quality reports in 1999.[214] The air pollution forecasts were an explicit step toward helping SEPA with its enforcement problems, and have been acknowledged as such by SEPA Deputy Director Wang Xinfang.[215]

In addition, the Environmental Protection Law requires municipalities 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.[216] In August 1997, Beijing held its first public press conference, in which it discussed the state of the city's environment.[217]

Public hotlines have been set up in major cities, and the government appears more than willing to hear from local citizens about excessive polluters. SEPA's publicly accessible website recently published statistics on the number of public complaints referring to environmental pollution. In 2001, 367,402 complaint letters were received from the public on environmental issues.[218] Of that number, SEPA reportedly attended to 349,454 complaints.[219]

202. *See supra* note 16 and accompanying text.

203. Robert Stavins & Bradley Whitehead, *Market-Based Environmental Policies*, *in* THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 106 (Marian R. Chertow & Daniel C. Esty eds., 1997).

204. *See* RESEARCH TEAM OF CHINA CLIMATE CHANGE COUNTRY STUDY, *supra* note 1, at 229.

205. Raufer & Weili, *supra* note 174, at 27.

206. WANG ET AL., *supra* note 192, at 4.

207. *Id.* at 7.

208. *Id.* at 15.

209. *Tough Campaign Clears Air*, PEOPLE'S DAILY ONLINE, Sept. 26, 2001, *at* http://english.peopledaily.com.cn/200109/26/print20010926_81055.html (last visited June 4, 2002).

210. *Id.*

211. *Id.*

212. *Id.*

213. U.S. Embassy Beijing, BEIJING ENV'T, SCI. & TECH. UPDATE, Sept. 7, 2001, *available at* http://www.usembassy-china.org.cn/english/sandt/estnews090701.htm (last visited Apr. 25, 2001).

214. *Air Pollution Blocks Beijing's Blue Sky*, ENV'T NEWS SERV., Sept. 1, 1999.

215. *China to Release Daily Air Quality Forecast*, PEOPLE'S DAILY ONLINE, June 4, 2001, *at* http://english.peopledaily.com.cn/200106/04/eng20010604_71748.html (last visited June 4, 2002).

216. *Publicizing Pollution Data*, CHINA ENV'T REP., Apr. 30, 1997, at 5.

217. *News in Brief*, CHINA ENVTL. REV., Dec. 1997, at 4.

218. SEPA 2001 ENVTL. STATISTICS BULL., *supra* note 14.

219. *Id.*

SEPA and the NPC Committee on Environmental Protection and Natural Resources Conservation have also completed an "All-China Trans-Century Environmental Tour," a four-year program aimed at exposing polluters to the public through television, newspapers, and other media.[220]

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.[221] More recently, the draft power plant emissions standards, released in late December 2001, were published in the *China Environment News* periodical and specifically designated as open for public comment.[222] A number of Chinese managers who have considered a public consultation approach appear to believe that it is feasible and even necessary to increase understanding and support for the myriad reforms being introduced. They indicate that the traditional decisionmaking approach of "Decide-Announce-Defend" is coming under increasing pressure.[223]

At the senior central government level, officials responsible for nationwide planning must deal with conflicting instincts: while air pollution is recognized as a key health hazard, leaders are perhaps predominantly concerned with maintaining their legitimacy—they keenly fear the disaffection of the growing population of unemployed workers laid off from nonproductive state-owned enterprises closed in recent years. Thus, although the leadership appears committed to its recent policy of closing small, inefficient power plants and polluting backyard coal mines, it must be simultaneously conflicted and torn about the resulting layoffs.[224] However, the solution of prioritizing jobs is not so clear when the sheer number of public complaints about a deteriorating local environment comes into consideration.

Electric Power Pricing

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 will also provide incentives for energy efficiency and pollution prevention in thermal power plants.[225]

The current pricing structure of electricity is based on four factors: costs of power generation, transmission, and distribution; local living standards; market demand; and type of recipient, e.g., agricultural, urban office, rural household. Prices are fixed by the pricing bureaus of provincial or municipal governments.[226] In 1995, coal sold to power plants was priced about 20 yuan/ton below market rates in order to maintain low electricity prices.[227] This policy had a chilling effect on the adoption of mandatory coal washing measures proposed in the 1995 Air Pollution Law.[228] More recently, low coal prices and low fees for pollution discharges have meant that little incentive exists to switch to cleaner fuels or to adopt pollution control equipment.

Although the government has improved the fee system by making fees applicable to all pollution discharges and by raising fees to 200 yuan/kg, this fee is still too low to induce behavior changes. In addition, while the central government establishes the level and structure of the fee system, local environmental officials still have the responsibility (and political burden) of collecting the fees.[229]

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.[230] China has made progress in each of these areas, but faces tremendous challenges during the implementation stage.

Another promising mechanism for promoting cleaner energy in China is a renewable portfolio standard, also known as a mandatory market share. Such standards are intended to ensure that a certain percentage of retail suppliers' electricity sales are generated from renewable resources such as wind, solar, and qualifying hydropower. Upwards of 30 American states have adopted a renewable portfolio standard, including as part of recent electric utility restructuring legislation.[231] China's Tenth Five-Year Plan includes language supporting the development of its own domestic renewable portfolio standard.[232]

The Impact of WTO Entry on Air Pollution in China

China's recent accession to the WTO[233] means that more

220. *Qu Geping's Seminar: Progress Made, More Challenges Ahead*, China Env't Rep., May 30, 1997, at 10.

221. Zhang et al., *supra* note 28, at 47. Article 13 of the Law of the People's Republic of China on Prevention and Control of Water Pollution, art. 13 (adopted May 11, 1984; amended May 15, 1996).

222. *Zhonghua Renmin Gongheguo Guojia Biaojun [PRC National Standard]—Huodianchang Wuranwu Paifang Biaojun [Thermal Power Plant Pollutant Emission Standards] (Zhengqiu Yijian Gao) [Draft Soliciting Comments]*, Zhongguo Huanjing Bao [China Env't News], Dec. 24, 2001, at 3.

223. Desmond M. Connor, *Public Consultation for China's Environment*, 2 Sinosphere 28 (1999), *available at* http://www.chinaenvironment.net/sino/sino4/.

224. Logan, *supra* note 57, at 5.

225. Todd Strauss & John A. Urquhart, *Energy Prices and Environmental Costs*, *in* Thinking Ecologically: The Next Generation of Environmental Policy 220, 227 (Marian R. Chertow & Daniel C. Esty eds., 1997).

226. Jiaping, *supra* note 185.

227. Alford & Liebman, *supra* note 65, at 719-20.

228. *Id.* at 719.

229. Wang et al., *supra* note 192, at 4.

230. Strauss & Urquhart, *supra* note 225, at 229.

231. *See* Union of Concerned Scientists, *Table C-1, State Minimum Renewable Energy Requirements (as of May 2002), available at* http://www.ucsusa.org/energy/state_rps.pdf (last visited June 25, 2002). *See also* Jan Hamrin, *Background Paper on Electric Industry Restructuring and Renewable Energy and Energy Efficiency Public Benefit Programs in California*, Prepared for the Energy Foundation, Mar. 2000, at 13-15 (on file with Barbara Finamore).

232. *See* Center for Resource Solutions, *The China Program*, *at* http://www.resource-solutions.org/China.htm (last visited Oct. 1, 2002).

233. Protocol on the Accession of the People's Republic of China, Nov. 19, 2001 (annexed to the WTO Decision on the Accession of the People's Republic of China, done at the Ministerial Conference of the World Trade Organization at Doha, Qatar).

laws and regulations pertaining to the environment and affecting international trade must be published and released in draft form for public comment.[234] Acceptance of these WTO provisions, provided for specifically under the Agreement on Sanitary and Phytosanitary Measures and the Technical Barriers to Trade Agreement Under the General Agreement on Tarriffs and Trade/WTO,[235] are perhaps indicated by the March 2002, publication of the December 24, 2001, draft power plant emissions standards, specifically labeled "open for comment."[236]

However, it has been widely noted that China's long-standing institutional structure and weak legal and judicial systems will likely impede smooth and widespread acceptance of these new procedures. Some systemic issues that have been identified by Richard Ferris and Zhang Hongjun include the current peripheral role of courts in China, the political sensitivity toward creating new responsibilities for bureaucrats, and the preexisting sense of propriety and secrecy held by government officials toward official documents.[237]

Beijing Hosts 2008 Summer Olympics

The State Council named Beijing, the world's most polluted capital city, as its top priority for urban environmental cleanup, especially during and after China's successful bid to host the 2008 Summer Olympics.[238] 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 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.[239]

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 liquified petroleum gas (propane) or natural gas.[240] 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.[241]

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 1999, including the closure of 25 heavy industry and coal-fired power plants.[242] Yet official statistics show that SO_2 levels fell in nine consecutive months through September 1999 by an average of 25% compared with the same month of 1998.[243]

As described above, Beijing has also increased its SO_2 pollution levy rate to the highest level in China. In June 1999, the State Council approved an SO_2 emission rate increase of 1.2 yuan/kg for Beijing, effective November 1999. This rate corresponds to approximately 7% of the price of coal in Beijing. Beijing 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.[244] Applying this new pollution levy effectively to power plants could make Beijing a model for the rest of the nation.

Shortly after Beijing was granted the privilege of hosting the 2008 Summer Olympics in July 2001, a long hoped-for accomplishment, the city announced it would devote U.S. $6.6 billion or 4% to 5% of its GDP between 2003 and 2007 to improve the city's environment.[245] This investment will be on top of U.S. $5 billion already invested between 1998 and 2001 while Beijing was in the running for the site selection. Much of the investment will go toward developing Beijing's urban rail system as well as to reducing the occurrence of sandstorms by planting more trees and vegetation both within and surrounding the city.[246]

The Kyoto Protocol's Clean Development Mechanism

Another potential venue through which to mitigate China's air pollution problems is to encourage the development of projects under the Kyoto Protocol's clean development

234. Richard Ferris Jr. & John Weiner, *WTO Membership: Promoting Sound Environmental Policy in China,* China Envtl. Rev., Summer 2000, at 1, 3, *available at* http://www.asianenviro.com (on file with Barbara Finamore).

235. Agreement on the Application of Sanitary and Phytosanitary Measures, Apr. 15, 1994, Agreement Establishing the World Trade Organization, Annex 1A, *in* Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, Marrakesh, 15 April 1994 69 (1994); Agreement on Technical Barriers to Trade, Apr. 15, 1994, *id.* at 17. Richard J. Ferris Jr. & Hongjun Zhang, China's Expanding Environmental Regulatory Regime and the Implications of WTO Membership on the Regime's Future Development, Powerpoint Presentation to the Environment Section Luncheon Briefing, Women in International Trade (Washington, D.C., Apr. 3, 2002) (on file with Barbara Finamore). *See generally* Richard J. Ferris Jr. & Hongjun Zhang, *The Challenges of Reforming an Environmental Legal Culture: Assessing the Status Quo and Looking at Post-WTO Admission Challenges for the People's Republic of China*, 14 Geo. Int'l. Envtl. L. Rev. 429 (2002).

236. *See* discussion on Draft Output-Based Emissions Standards, *supra*.

237. Ferris & Zhang, *supra* note 235.

238. Andrew Ness, *Blue Skies for the Beijing Olympics*, The China Bus. Rev. (2002), *available at* http://www.chinabusinessreview.com/0203/ness.html (last visited Oct. 1, 2002).

239. U.S. Embassy Beijing, *Beijing Gets Serious About Air Quality*, (Oct. 1999) *at* http://www.usembassy-china.org.cn/english/sandt/Bjairwb.htm.

240. *Pollution Control Measures Pay Off*, China Daily, Mar. 22, 1999.

241. *Beijing Moving 700 Firms Out*, China Daily, Nov. 15, 1999, *available at* http://wwwchinaenvironment.com/news/nov99/1115beijing.htm. Beijing also required the Capital Steel factory (Shougang), 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.*

242. *Beijing to Clear the Air for Oct. 1 Celebrations*, China Online, Aug. 31, 1999, *at* http://www.chinaonline.com/industry/environmental/NewsArchive/cs-protected/1999/august/c9083014.asp; *China: Leaded Gas Production to Stop; Natural Gas Pushed*, Reuters, Mar. 8, 1999.

243. U.S. Embassy Beijing, *supra* note 152.

244. Somewhat smaller rate increases of 0.3-0.6 yuan RMB/kg are being tested in Hangzhou, Jilin, and Zhengzhou, with plans to expand nationwide. *Id.* at 9.

245. *Ambitious Plan Ensures a Greener Beijing,* People's Daily Online, Sept. 7, 2001, *at* http://english.peopledaily.com.cn/200109/07/print20010907_79579.html (last visited June 4, 2002).

246. *Beijing to Improve Environment, Traffic for Olympics*, China Online, Apr. 3, 2002, *at* http://www.chinaonline.com (citing the *Beijing Olympic Action Plan*, Zhongguo Huanjing Bao [China Env't News], Mar. 30, 2002).

mechanism (CDM).[247] Although the Kyoto Protocol is not yet in force, the recent ratification of the climate change treaty by the European Union and Japan[248] brings hope that the agreement could become effective within the next year. CDM projects, whereby an entity from a developed country party to the Kyoto Protocol undertakes a GHG abatement project in a developing country, could easily provide the ancillary benefit of reducing SO_2 and other local air pollution. CDM projects are permitted to generate credits from the year 2000, even though the Kyoto Protocol is not in force and the host and investor countries have not ratified. Many China-based CDM projects will likely focus on energy efficiency improvements as well as renewable energy.[249] China is seen as a very attractive CDM market because of its especially low marginal abatement costs.[250] In fact, it is projected to provide 65% of the Asian carbon export market. Initial abatement projects have been estimated to cost as little as U.S. $10 per ton of carbon.[251] China ratified the Kyoto Protocol in August 2002, ensuring that official CDM projects will soon be launched on its soil.

The first activities implemented jointly (a precursor to the CDM) project in China was conducted with Japan in 1997 and involved installing more efficient heat energy technology at a steel plant in Beijing.[252] It cost U.S. $24 million and offset 86,900 tons of CO_2.[253] Japan has been active throughout Asia in purchasing carbon offsets.[254]

A recent survey of specialists indicates that China is presently the most favored host country for CDM projects because it is large, well-known, contains ample carbon-reducing investment opportunities, particularly in the energy sector, and the government is committed to CDM project development.[255] Although China has yet to officially promulgate a CDM investment policy, earlier this year it convened an interagency working group under the leadership of the SDPC.[256] Other involved ministries include the Ministry of Foreign Affairs and the Ministry of Science and Technology. Multinational donors, in particular the Canadian, Dutch, German, and Swiss governments, the Asian Development Bank, and the World Bank, have been working with the Chinese government to conduct investment feasibility studies.[257]

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.

China could significantly improve its air quality by enforcing laws and regulations already on the books. Emissions fees, especially for SO_2, are too low to incentivize the incorporation of even end-of-pipe control technologies like FGD, much less a fuel switch to cleaner natural gas or renewable sources, or even adoption of power generation process efficiencies. Even where desulfurization equipment has been mandated at power plants, entities are moving slowly to adopt them and to reach emissions standards.[258]

China has developed a variety of ambitious programs for controlling air 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 policies, regulatory mechanisms, and economic incentives, and strengthen local enforcement. Only then will China be able to tame its dragon heads so that they can continue to power China's economic growth without fouling their own nests.

247. Kyoto Protocol, *supra* note 58, at art. 12. Tauna M. Szymanski, *The Clean Development Mechanism in China*, 29 China Bus. Rev. (forthcoming Nov./Dec. 2002).

248. Howard French, *Japan Ratifies Global Warming Pact and Urges U.S. Backing*, N.Y. Times, June 4, 2002, *available at* http://www.nytimes.com/2002/06/05/international/asia/05JAPA.html (last visited June 5, 2002); Irwin Arieff, *EU Ratifies Global Warming Pact, Slams Washington*, Reuters-Planet Ark, June 3, 2002, *at* http://www.planetark.org/dailynewsstory.cfm/newsid/16233/story.htm (last visited June 4, 2002).

249. For a detailed study of GHG mitigation options available in China, see Wei Zhizhong, Global Climate Change Institute, Tsinghua University, Beijing, Clean Development Mechanism Project Opportunities in China 6 (Dec. 2000), *available at* http://www.teriin.org/climate/cdm-china.pdf (last visited June 5, 2002). Proposed CDM project as of December 2000 are provided in the report. *Id.* at 11, tbl. 10.

For detailed guidelines on drafting project-based carbon offset contracts, see James Cameron et al., Carbon Contracts Cornerstones: Drafting Contracts for the Sale of Project-Based Emissions Reductions (International Emissions Trading Association Discussion Paper No. 02-01, Apr. 2002), *available at* http://www.ieta.org/Documents/Discussion_Papers/IETA_discussion_paper_0201.pdf (last visited June 5, 2002).

250. Jürg M. Grütter, The Potential GHG Market in Asia 20 (prepared for the National Strategy Study Program of the World Bank, Apr. 2002), *at* http://www.ghgmarket.info (last visited June 20, 2002).

251. U.S. Embassy Beijing, *China and Its Donors Prepare for Kyoto Protocol's Clean Development Mechanism*, (Jan. 2002), *at* http://www.usembassy-china.org.cn/english/sandt/ChinaCDM.htm.

252. Axel Michaelowa et al., CDM Projects in China's Energy Supply and Demand Sectors: Opportunities and Barriers 22 (Hamburgisches Welt-Wirtschafts-Archiv [Hamburg Institute of International Economics] Discussion Paper No. 90, 2000), *available at* http://www.hwwa.de/Projekte/Forsch_Schwerpunkte/FS/Klimapolitik/PDFDokumente/Michaelowa,%20Jusen,%20Krause_2000.pdf (last visited June 5, 2002).

253. *Id.*

254. For example, the Tokyo Electric Power Company (TEPCO) purchased the rights to future carbon sequestration occurring from the planting of trees in Australia's National Forests of New South Wales in July 1999. Press Release, State Forests of New South Wales, Major Investment in Greenhouse Forests (July 8, 1999), *available at* http://www.forest.nsw.gov.au/carbon/media/releases/080799.asp (last visited June 5, 2002).

255. Point Carbon, *CDM Investments: Where and How?*, (June 14, 2002), *available at* http://www.pointcarbon.com/article_view.php?id=1832.

256. U.S. Embassy Beijing, *supra* note 251.

257. *Id.*

258. U.S. Embassy Beijing, *Provinces Given Free Hand to Combat Acid Rain*, Beijing Env't, Sci. & Tech. Update, June 14, 2002, at 1, *available at* http://www.usembassy-china.org.cn/sandt/estnews061402.htm (last visited June 20, 2002).