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An Assessment of Environmental Regulation of the Steel Industry in China

Alliance for American Manufacturing
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Keeping America Strong

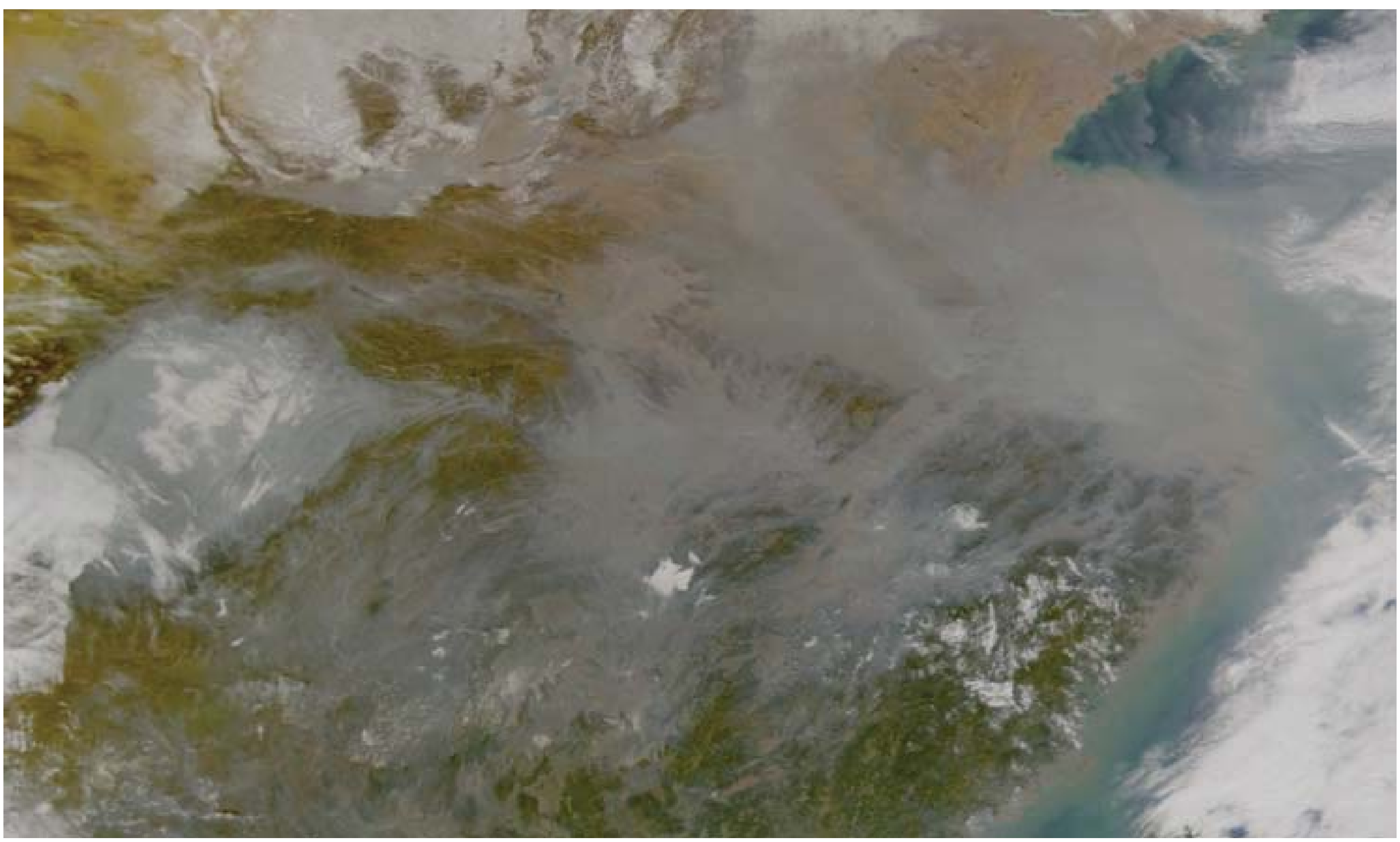

Photo by NASA Goddard Space Flight Center

NASA satellite image of eastern Asia shows a dense blanket of polluted air over central eastern China -- dense enough that the coastline around Shanghai virtually disappears. The "Asian Brown Cloud" is a toxic mix of ash, acids and airborne particles. The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) on board the Orbview 2 satellite captured this image January 10, 2003.

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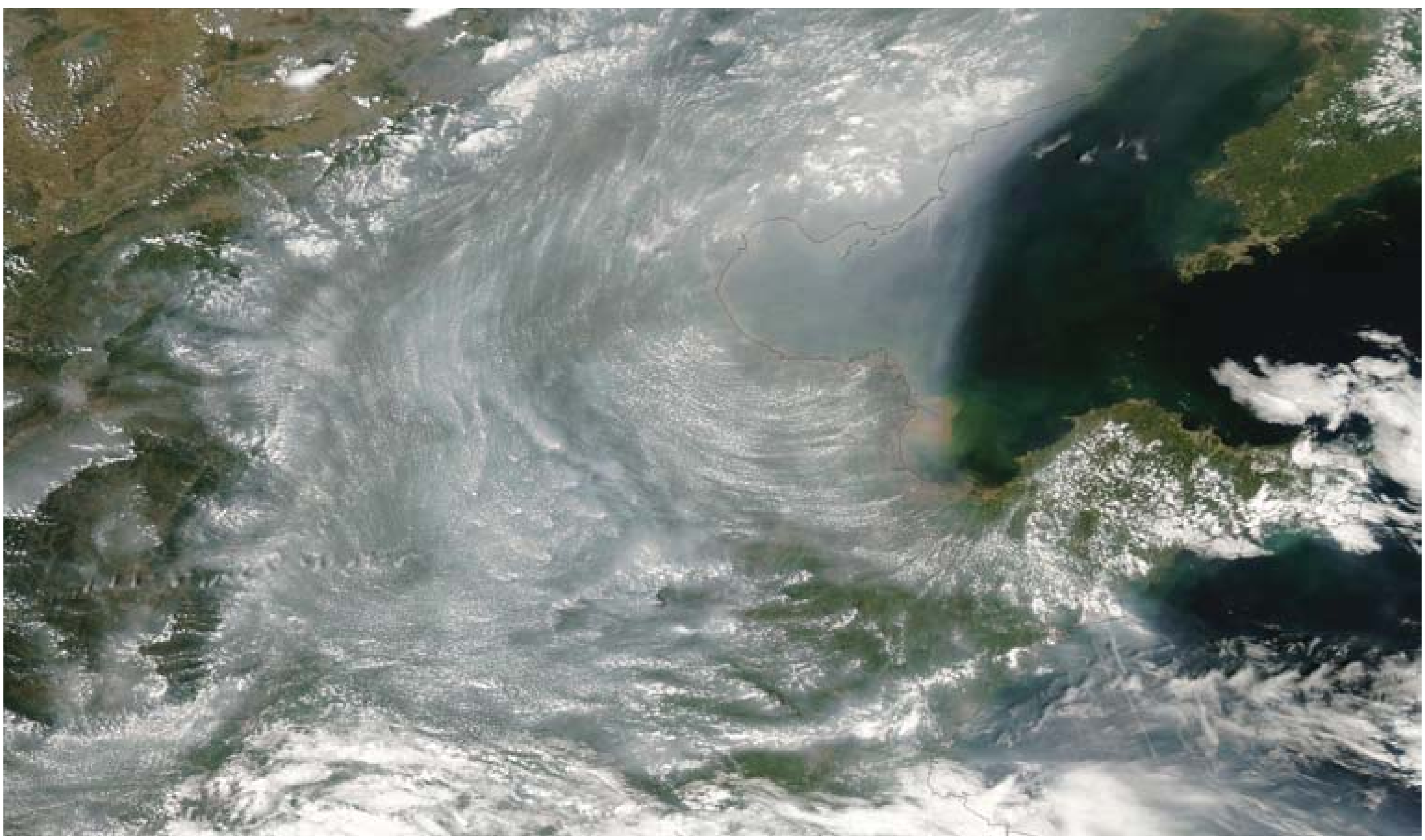

Photo by NASA Goddard Space Flight Center

On July 26, 2008, the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite took this picture of eastern China. This image shows a thick band of haze snaking through the region, largely hugging the coastal lowlands along Bo Hai and the Yellow Sea. The haze mixes with clouds, and an especially thick band of clouds occurs just west of the Yellow Sea. South of this, the brown-green color along the coast results from sediments in the water, although some haze likely occurs directly overhead. In the mountainous region to the west, skies are relatively clear.

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ConstructionPhotography

Benxi steelworks and city, Liaoning Province, near Shenyang, China.

List of Acronyms

AISI	American Iron and Steel Institute
APA	Administrative Procedure Act
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Technology
BOF	Basic Oxygen Furnace
BPT	Best Practicable Control Technology Currently Available
BSO	Benzene Soluble Organics
CAA	Clean Air Act
CEMs	Continuous Emissions Monitoring systems
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COMs	Continuous Opacity Monitoring systems
CPMs	Continuous Parameter Monitoring systems
EAF	Electric Arc Furnace
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPB	Environmental Protection Bureau
FOIA	Freedom of Information Act
FWPCA	Federal Water Pollution Control Act
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HCl	Hydrochloric Acid
IISI	International Iron and Steel Institute
MACT	Maximum Achievable Control Technology
MEP	Ministry of Environmental Protection
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NDRC	National Development and Reform Commission
NEI	National Emissions Inventory
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NO_X	Nitrogen Oxides
NPC	National People's Congress
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
O & M	Operations & Maintenance
OECD	Organisation for Economic Co-operation and Development
pH	The measure of acidity or alkalinity of a solution
PM	Particulate Matter
POTW	Publicly Owned Treatment Works
RCRA	Resource Conservation and Recovery Act
SEPA	State Environmental Protection Administration
SIP	State Implementation Plan
SMA	Steel Manufacturing Association
SMEs	Small and Medium Enterprises
SO_2	Sulfur Dioxide
TDS	Total Dissolved Solids
TRI	Toxic Release Inventories
VOCs	Volatile Organic Compounds

Executive Summary and Introduction

China is by far the leading source of steel in the world. It produces more than the U.S., Russia and Japan combined. Between 2000 and the end of 2007 China nearly quadrupled its production of steel, and now produces more than one-third of the world's total steel output. Only the world's current economic troubles may now interrupt the industry's rapid growth.

China has also become one of the world's biggest polluters. Much of this is due to increased emissions from rapid industrial expansion in steel and other industries, and the fact that China applies less stringent environmental standards than most developed countries to industrial pollution, including pollution from the steel industry. China now produces more sulfur dioxide than any other country in the world, and reports suggest that China has recently become the number one generator of carbon dioxide as well.

This report documents how China's steel industry has been advantaged by less stringent pollution control standards, as it expands into global markets. Not only is our environment imperiled by this activity, but U.S. steelmakers must compete with Chinese companies that play under a different set of rules.

Steelmaking in China clearly poses global environmental concerns. Recent data show that one-quarter of the particulate matter in the air in Los Angeles on some days originates in China. China's steel industry now accounts for 50 percent of the world's production of carbon dioxide from steelmaking—approximately equal to all the other steel mills in the world combined. Other countries have an obvious stake in addressing the level of carbon dioxide production in any future international agreement on global warming.

There are also economic considerations. The Chinese steel industry benefits economically from environmental requirements that are less stringent than those the U.S. and many other countries have adopted. Curtailing pollution requires considerable capital investment and continued spending to operate and maintain pollution control equipment. The failure of many Chinese steel companies to adequately invest in pollution control may have contributed to China's growing strength in markets around the world, including the U.S. market. An economist serving in China's Ministry of Commerce told The New York Times that, with respect to steel, "the shortfall of environmental protection is one of the main reasons why our exports are cheaper." Another reason the official cited was cheap energy.

Officials in China's central government have indicated that they are aware of the problem. They know that China's pollution control standards are less stringent than those that apply in the U.S., and while they have stated their desire to address this situation, the state of the country's current regulations, enforcement efforts, and pollution levels continue to suggest that sufficient concrete steps have yet to be taken. China President Hu Jintao pledged to improve the situation in October 2007, saying "our economic growth is realized at an excessively high cost of resources and the environment." In early 2008 the State Environmental Protection Administration was elevated to full ministry status, in order to give greater prominence to China's pollution-fighting efforts, but the Ministry of Environmental Protection's low staffing levels and inadequate legal authority continue to undermine the ministry's effectiveness. China has been seeking to close some of the smaller, less efficient steel mills that contribute disproportionately to the high levels of pollution in China, but small mills continue to be the fastest growing segment of the steel sector. Over the past several years, the government has indicated it is developing more stringent emission and discharge standards for the steel industry, but existing standards remain far below U.S. and industrialized economy norms.

Now, in light of the current global economic troubles, China may cut back on its efforts to close polluting factories, to enforce existing laws, and to build pollution control facilities. The net effect of the current economic conditions on overall levels of pollution remains unclear, because China may also produce less steel during this period, although this will depend on what effect the Chinese government's stimulus program has on the demand for steel.

By putting industry first, unfortunately, the Chinese people suffer most from this pollution. According to World Bank researchers, China's pollution causes as many as 750,000 premature deaths in China each year. Some 99 percent of the 540 million Chinese who live in urban areas breathe air that would be considered unsafe in Europe. Emissions of pollutants from steel mills, including sulfur dioxide and particulate matter, have significantly contributed to these problems. The Chinese steel industry accounts for between 10 and 15 percent of the country's total production of wastewater, particulate matter, and sulfur dioxide even though it accounts for only 3 percent of the country's gross domestic product.

Some of the key findings of this report are as follows:

1. China's air and water pollution standards for steel production are substantially less stringent than comparable U.S. standards.

The air and water pollution standards that currently apply to the steel industry in China fall far short of those that apply in the U.S. For example:

- Emissions controls for particulate matter from existing sintering machines are three times more stringent in the U.S. than in China; emissions controls for new sintering machines are more than four times more stringent in the U.S.

- Emissions controls for particulate matter from the ironmaking process are more than six times as stringent in the U.S. as in China.

- Emissions controls for particulate matter from blast furnaces during the steelmaking process are more than twice as stringent in the U.S. as in China for closed hood operations, and more than three times as stringent for open hood operations. For electric arc furnaces, the U.S. standard is more than ten times as stringent as the comparable Chinese standard.

- Limits on sulfur dioxide emissions are often so relaxed in China that steelmakers can satisfy the standards without installing expensive pollution control equipment.

- Water pollution standards governing discharges of oil, total suspended solids, and zinc from steel mills are generally much more stringent in the U.S. than in the China, although discharge standards for two other pollutants, cyanide and chromium, are more comparable.

Even the proposed new emission and effluent standards for steel production now under consideration in China—while representing a substantial improvement—would still leave China lagging behind the U.S.

2. China's enforcement and financial penalties are largely ineffective.

In addition to standards that are substantially less stringent than in the U.S., the Chinese steel industry operates in an environment in which enforcement of existing standards is weak, the permit system is ineffective, and facilities do not do an adequate job of monitoring their own emissions and discharges. Financial penalties for violations are too low to have a substantial deterrent effect.

- China's environmental permit system for existing facilities is ineffective; it is not comparable to operating permits in the U.S. for both air and water pollutants, which contain detailed requirements specific to each steelmaking facility.

- The pollution discharge fees that China requires companies to pay are far too low to deter companies from violating pollution control limits. The amount collected in discharge fees is as little as 30 percent of what is actually owed, and a large portion of what is collected may be eventually returned to the companies for the stated purpose of improving environmental abatement programs. One of the country's largest steel companies, Baosteel, paid about 18 cents per ton in discharge fees in 2007.

- The maximum amount a company can be fined for non-compliance with the environmental standards is around $14,000 for most violations. Repeated offenses do not necessarily bring increased penalties, so some companies choose to pay the occasional penalty rather than purchase or maintain expensive pollution control equipment. In the U.S., companies that violate the Clean Air Act may incur penalties of as much as $32,500 per day of violation.

- Chinese law provides that companies should monitor their pollution levels, but the central government has failed to prescribe how frequently samples should be taken, and there are no specified sanctions for non-complying companies. In contrast, U.S. steelmakers must maintain continuous or periodic monitoring of their pollution discharges and report the information. The Chinese system relies on occasional inspections that cannot detect all violations and cannot determine whether the pollution control equipment is employed when the inspector is not present.

- The absence of effective monitoring in China means (1) that it is very difficult to detect companies responsible for pollution in excess of applicable standards; (2) that the government lacks data that would enable it to do reliable modeling of air and water quality; and (3) that the government can not adopt the needed standards that effectively reduce pollution, because it does not know the extent of reductions required in order to improve air and water quality in specific locations and regions.

3. China's environmental regime has major structural problems.

China's use of less stringent standards and its ineffective efforts to enforce the standards that do exist arise in large part from the way that China structures its environmental regime:

- The central government role in enforcing environmental standards is limited. The Ministry of Environmental Protection has about 300 employees, almost all in Beijing. This is compared to its counterpart in the U.S., the Environmental Protection Agency, which has 9,000 employees in its headquarters office alone, and around 18,000 altogether. As of 2004, State Environmental Protection Agency's Environmental Monitoring and Inspection Bureau had only 45 employees and an annual budget of about $600,000; the Environmental Protection Agency bureau with enforcement responsibilities has more than 3,000 employees and an annual budget of more than $700 million.

- The Ministry of Environmental Protection must largely depend for implementation of the environmental laws on provincial and local governments that have limited resources, and that are expected to enforce laws that are often vague. Provincial and local governments in China may pay less attention to edicts from the Ministry of Environmental Protection, and place less emphasis on enforcing environmental laws than on local economic growth and employment.

- China's pollution standards specific to the steel industry are being prepared primarily with input from the steel industry itself, with little or no opportunity for public input or debate.

- Public interest groups are subject to strict controls in China and are not actively involved in the development of pollution standards. Courts play a minimal role, and pressure from the news media is sporadic and limited.

- The large number of small steel companies in China's steel industry makes it more difficult to enforce the existing standards or to persuade the owners of such companies to expend the money necessary to reduce pollution. The central government's ambitious plans to restructure the industry include shutting down 948 small, inefficient and highly polluting furnaces. As of November 2007, however, only about 40 percent of the target had been achieved, and in the meantime small steel mills have made up the fastest growing portion of the Chinese steel industry.

4. Chinese steel companies spend considerably less on pollution control equipment than companies in the U.S.

U.S. steel companies out spend their Chinese counterparts by around 80 percent per ton of steel on direct operation and maintenance expenditures to control air and water pollution alone. If the Chinese industry's operation and maintenance expenditures to control air and water pollution were at the same level per ton as the U.S. steel industry, in 2006 the environmental abatement expenses of the Chinese steel industry would have been more than $1.7 billion higher. Overall, a reasonable estimate is that U.S. steel companies probably spend around twice as much per ton of steel than the Chinese steel industry on operation and maintenance expenditures to control pollution of all kinds.

There is also widespread evidence of relatively low capital expenditures by Chinese steel companies on pollution control equipment. As of January 2006, for example, 60 percent of the coke ovens in China were not equipped with dust control facilities. Overall, Chinese industry is expending only about three percent of its capital expenditure budget on pollution control equipment, far less than the over 17 percent U.S. industry averaged for years as it was improving its environmental controls. For China to reach pollutant emissions levels comparable to those in the U.S., the Chinese steel industry may have to increase its present capital expenditures by three or four times.

5. Chinese steel companies emit significantly higher levels of pollution per ton of steel produced.

Less stringent standards, lower industry expenditures on environmental controls, a decentralized regulatory structure, and a less effective enforcement program all result in levels of pollution from the Chinese steel industry that are nearly twenty times higher per ton of steel than in the U.S. in the case of overall emissions of particulate matter, and between two and six times higher in the case of other measures of pollutants levels. Recent statistics compiled by governmental and industry sources in China indicate that —

- Chinese steelmakers emit 4.94 kg of particulate matter per ton of steel produced; the comparable figure in the U.S. is about 0.25 kg.

- Chinese steelmakers emit 3.53 kg of sulfur dioxide per ton; the U.S. figure is 0.7 kg. Chinese steelmakers emit 1.89 kg of nitrogen oxides per ton; the U.S. figure is 0.65 kg.

- Average concentration levels of emissions of particulate matter from sintering machines at large and medium sized Chinese companies are 131.5 mg/m^3, nearly three times the limit for existing sintering machines in the U.S. and nearly six times the U.S. limit for new machines.

- Some large and medium sized Chinese companies have a concentration level of particulate matter in the primary emissions from their basic oxygen furnaces of 150 mg/m^3, more than twice the least stringent U.S. limit for existing facilities.

The Challenge Facing China

While this report identifies a number of areas in which the pollution control regime applicable to the Chinese steel industry is less stringent than the regime in the U.S., it is important to consider some of the challenges facing the Chinese government and an industry in which it has major investments. The country's regulatory systems are less developed than those in the U.S., and the Chinese steel industry has grown dramatically in the past few years. Meanwhile, China has only recently begun to develop the regulatory procedures and standards required to address the large environmental problems it faces. China's heavier reliance on basic oxygen furnaces to produce steel poses additional challenges, since such furnaces raise more difficult environmental issues than electric arc furnaces, which produce around 60 percent of U.S. steel. The Chinese steel industry is more fragmented than in the U.S., with a far larger number of small companies with limited resources, thereby complicating the adoption and enforcement of effective standards throughout the industry.

Efforts to monitor and potentially reduce the pollution are underway in a few provinces, including the possible use of market based emissions trading. Both the Chinese government and the leading companies in the steel industry have indicated that they want to address the industry's environmental problems, but those encouraging words are not yet reflected in policies, practices, and enforcement actions adequate to successfully address the problem.

The important question remains, whether government leaders and the steel industry are placing enough priority on environmental issues, and committing enough resources, to enable the country to move as rapidly and effectively as it could towards achieving a cleaner environment. The position of the steel industry in China today is not fully analogous to that of the steel industry in the U.S. in the late 1960's, before the advent of modern environmental regulation and pollution control technologies. Environmental technology that is in widespread use today has made the human and environmental impacts of industrial pollution both quantifiable and controllable. Measurements of pollution and the sophistication of technologies to curtail it continue to improve. As a result, the Chinese government and the Chinese steel industry have access to the knowhow needed to effectively address the industry's environmental problems.

The Chinese State Council wrote in 2006 that "the conflict between environment and development is becoming even more prominent." This is a particular problem at the local level, where a senior environmental official in the central government has noted that that there may be a "mistaken view of what counts as political achievement." In his view businesses protected by local governments "treat the natural resources that belong to all the people as their own private property." The perceived conflict, especially at the local level, between clear air and water, and economic growth and social stability, may present the largest challenge to the central government's effectively addressing its environmental problems.

The recent success the central government enjoyed, however, in improving the air quality in Beijing for the 2008 Olympics demonstrates that with sufficient will, and sufficient commitment of resources, the country's environmental problems can be successfully addressed. Some of the solutions utilized in Beijing for the Olympics, including temporarily shutting down some steel mills, may not be enough to achieve the long term resolution of the country's environmental problems. Additional approaches will be required, including the acquisition and maintenance of baghouses, electrostatic precipitators, scrubbers, and other state-of-the-art technologies that would enable the Chinese steel industry to fully comply with more stringent environmental standards. The country's experience during the Olympics demonstrates, however, that if it wishes to do so China can muster the political will and the necessary resources to address successfully the country's environmental problems.

Otherwise, China's trading partners are likely to complain about the unfair competitive advantage that this confers on domestic steelmakers in China. And countries whose environment is adversely affected will also complain about the Chinese steel industry's excessive contribution to worldwide pollution levels.

*   *   *

This report provides an overview of the environmental regime in China as it applies to the Chinese steel industry. Wherever possible, the report compares the regime in China and its effectiveness to the one that applies to U.S. steelmakers. The first two chapters describe the Chinese steel industry, and the process by which pollution control programs in China are developed and implemented. The report also discusses the role the Chinese steel industry plays in developing environmental rules applicable to it, and contrasts the active involvement of the public and nonprofit organizations in the U.S. with the limited role that the public and nonprofits play in China.

Chapter III describes the basic characteristics of the Chinese environmental regime in the steel area, including the permit and discharge fee programs, and contrasts them with the permitting program and other structural elements of the U.S. regulatory system. Chapter IV reviews in some detail the pollution standards governing steelmaking in China, and compares these with standards that apply in the U.S. Much of the focus of Chapter IV is on air pollution standards because air pollution abatement efforts account for the large majority of the capital expenditures on environmental controls incurred by the steel industry in both countries. The remaining sections of Chapter IV discuss water pollution controls, solid waste controls, and the issue of greenhouse gas emissions.

Chapter V briefly discusses the technologies that are used to control pollution in the steel industry, and compares expenditures on purchasing and operating such pollution control equipment in China and the U.S. Chapter VI reviews the ways the Chinese government seeks to enforce applicable environmental requirements, and compares the country's enforcement and compliance programs with those in the U.S.

Much of the statistical and other essential information relied upon in this report is derived from official publications of the Government of China, from studies by the Chinese steel industry itself, and from Chinese researchers unaffiliated with the industry. Sources of the information discussed in each chapter are identified in endnotes, which also indicate those sources that are in Chinese. When experts or employees of steel companies in China agreed to speak only on a confidential basis, the identity of the individual is protected, as requested.

Throughout this study there are comparisons between the standards and costs of the environmental regime in the U.S. and China. Care has been exercised to make all quantitative comparisons as accurate as possible. However, in some instances that are noted, the comparisons can not be exact. China and the U.S. may regulate different pollutants, or the same pollutant in different ways, and the units of measurements the countries use in expressing emission limits or other standards may differ. In some instances, the date of the most current statistics available in one country may be different than the date of the most current statistics available in the other country. The relative reliability of the data used in a comparison may vary. The statistics that the U.S. and Chinese governments report may not be exactly comparable with respect to the types of companies surveyed or the methods followed in compiling the data.

Finally, this report does not undertake to describe the environmental records of all the provisional or local governments. Developments in particular provinces are noted for illustrative purposes, but in a country as large and varied as China it was not possible to comprehensively review the environmental abatement programs of all the provincial and local governments.

Nevertheless, the comparisons provide a clear picture of the overall differences that exist between the environmental regulation of the steel industry in the two countries. These comparisons show that the differences between the U.S. and China in this area are significant.

dreamstime

Chapter I: The Chinese Steel Industry and its Environmental Record

On August 8, 2004, journalists in China received a one-page press release with a headline that read:

国家环保总局副局长、新闻发言人潘岳
通报唐山钢铁行业污染情况

(Translation: Deputy Minister of SEPA Introduces Pollution Situations in Tangshan's Iron and Steel Industry)

The press release came from Pan Yue, deputy minister of SEPA, the State Environmental Protection Administration, China's equivalent of the U.S. Environmental Protection Agency. Within government circles, Pan was known as "Hurricane Pan" for the tumult he could cause whenever a particularly abusive instance of pollution caught his attention.

Pan's press release reported on an investigation that the residents of Tangshan, an industrial city located in Hebei province, had stimulated. Anyone who visited Tangshan for only a day could easily see why local people were complaining. Particulate matter, waste gases, and sludge were widespread. Some darkness at noon was not uncommon.

No one had listened to the complaints, so they had intensified. Near steel factories, families could no longer sit outside their homes and eat. There was too much soot in their food. Clothes hung on the line to dry became black. Water smelled of chemicals. Far more significantly, seemingly-healthy people developed coughs that would not go away.

At fault, people said, was the steel industry. Tangshen is headquarters for Hebei province's steel industry. Hebei is the foremost steel production province in China, and in 2004, its 57 million tons accounted for one-fifth of China's entire steel output.[1] *The city of Tangshan had 57 steel companies, producing 60 percent of Hebei's steel.*[2]

Local officials had continued to ignore these complaints, which became more frequent. Then a few Tangshan parents got Pan's attention. At first, they felt good. Then they began to realize that the story had only just begun.

1. Environmental Conditions in China.

China is now the largest source of sulfur dioxide (SO_2) emissions in the world, largely due to the country's heavy reliance on coal.[3] Water pollution has also reached an alarming level. In 2005, a survey of 509 Chinese cities revealed that one-third of industrial wastewater is discharged to the environment without any treatment.[4] In a particularly well-publicized example of the danger to China's supply of safe water, millions of people in the city of Harbin went several days in November 2005 without running water after a chemical plant explosion contaminated the Songhua River with toxic benzene, forcing authorities to shut off the supply of water to the city.[5] As a result of the incident the head of the State Environmental Protection Administration (SEPA) was removed within weeks from his office after criticism by the State Council that the agency "failed to pay sufficient attention to the incident and has underestimated its possible serious impact."[6]

A 2001 World Bank study found that pollution is a significant source of premature death in China, and that one-third of the country's territory is affected by acid rain, which damages forests, crops and aquatic life.[7] A subsequent World Bank study in 2007 found that pollution still afflicts the country's people with serious health problems.[8] About 750,000 Chinese people die prematurely each year because of pollution in China. Although this mortality estimate was not included in the official World Bank report, the Chinese government subsequently acknowledged that this was one of the conclusions reached by the World Bank.[9] The study also concluded that only one percent of China's urban population of 560 million now breathes air that would be considered safe to breathe in the European Union.[10] Other studies have shown that roughly 400,000 premature deaths per year and 75 million asthma attacks in China are linked to air pollution.[11] Preliminary estimates suggest that about 11 percent of cases of cancer of the digestive system may be attributable to polluted drinking water.[12] The Ministry of Health has concluded that pollution is responsible for making cancer the leading cause of death in China.[13]

Recently, the Chinese government tried to quantify the extent of the environmental degradation in economic terms. The China Green National Accounting Study Report 2004, issued in 2006, concluded that the economic loss caused by environmental pollution was 511.8 billon yuan (about $73.1 billion, according to the conversion rate used throughout this report).[14] This accounted for 3.05 percent of national gross domestic product (GDP) in 2004. Of that amount, water pollution accounted for 55.9 percent, air pollution accounted for 42.9 percent, and solid wastes and pollution accidents accounted for 1.2 percent.[15]

About 750,000 Chinese people die prematurely each year because of pollution in China.

The study deducted natural resource depletion costs and environmental degradation costs from growth figures in order "to assess the quality of economic development in real sense."[16] According to the government, "the calculated figures again prove that environmental crisis is more and more severely restricting economic development of China."[17] The report stimulated controversy and concerns were raised about the validity of the methodology employed and the accuracy of the information used. The Chinese government subsequently suspended efforts to prepare such an accounting each year.

Likewise, a 2007 World Bank study indicates that air and water pollution in China is not only a health problem, but a severely destructive economic force. By quantifying the overall cost of air and water pollution in China, the World Bank found that "the economic burden of premature mortality and morbidity associated with air pollution was 157.3 billion yuan (around $22.5 billion) in 2003, or 1.16 percent of GDP."[18] Using a different method of calculation, the World Bank concluded that "[i]f a premature death is valued using a value of a statistical life of 1 million yuan (around $142,857), reflecting people's willingness to pay to avoid mortality risks, the damages associated with air pollution are 3.8 percent of GDP."[19]

As National Geographic magazine reported in a 2004 cover story, China's rush to economic growth in the past decade may "have not so much been creating an economic superpower as committing ecological suicide."[20]

The pollution directly affects far more than the Chinese people. The Earth's upper atmosphere picks up aerial pollutants in China and transports them to North America. "Scientists have tracked clouds of Chinese pollution as they drift over the Pacific and descend on America's west coast," wrote Pulitzer Prize-winning New York Times columnist Nicholas Kristof. "The impact on American health is uncertain."[21] According to the EPA, on certain days almost 25 percent of the particulate matter in the air above Los Angeles can be traced to China.[22] The amount of carbon dioxide (CO_2) and other Greenhouse Gases (GHGs) generated in China have made it the world's leading contributor to global warming, according to several studies by the Netherlands Environmental Assessment Agency.[23]

China's leaders have stated they appreciate the growing tension between the country's economic goals and its environmental record. "The conflict between environment and development is becoming even more prominent," states a 2006 report from the Chinese State Council, the country's highest and most prestigious executive institution.[24]

Pressure to address the problem through the adoption and utilization of modern pollution devices does not just come from domestic health concerns. China's trading partners are becoming more outspoken, focusing world attention on the degree to which the Chinese freedom to pollute provides its manufacturers with an unfair price advantage.

Economist Chen Kexin, an official at China's Ministry of Commerce, told the *New York Times* that "the shortfall of environmental protection is one of the main reasons why our exports are cheaper." He suggested that the environmental laws and inexpensive power, more than low labor costs, enabled Chinese steel to underprice its competition. He added that "this is hardly an 'edge' that we should be proud of."[25] More than 80 percent of business executives in China apparently agree there is a connection between the stringency of China's environmental regime and the competitiveness of Chinese products; according to a recent poll, only 18 percent of Chinese companies believe that they could do well economically if they adopted sound environmental practices.[26]

2. The Size of the Steel Industry in China and the U.S.

China's economy has grown at an extraordinary rate since the country instituted new economic reforms in 1978, averaging almost ten percent per year.[27] In comparison, U.S. growth averaged only three percent during the same period, narrowing the previously wide gap between the two economies.[28] In fact, by the middle of the next decade, economists predict China will overtake the U.S. economy in terms of purchasing power.[29]

Central to this growth has been steel production.[30] China surpassed U.S. steel production in 1996 and is still widening this lead, now producing over four times as much steel as the U.S.[31] China's 2006 crude steel output was 423 million tons, an 18 percent increase from the year before. It accounted for one-third (33.8 percent) of the world production that year, producing about 50 percent more than the combined output of the U.S. (98.6 million tons), Japan (116.2 million tons), and Russia (70.8 million tons).[32] China was responsible by itself for 78 percent of the increase in the world's production of steel from 2000 to 2005.[33] In 2007 China continued to increase its production, reaching a production level of almost 490 million tons, a level that is nearly quadruple the 2000 level of 127.2 million tons.[34] Earlier this year it was projected that in 2008 total production in China would reach 540 million tons.[35] At the same time, exports have increased 450 percent between 2000 and 2007, a year in which it exported 62.7 million tons of finished steel overseas.[36]

The study also concluded that only one percent of China's urban population of 560 million now breathes air that would be considered safe to breathe in the European Union.

Experts had predicted that these trends would continue,[37] but the adverse economic conditions in the world have already impacted steel production in China. In October, a number of leading steelmakers, such as Baosteel, Shougang, and Angang, decided to cut their production by 20 percent in response to falling demand. Additionally, more than 40 percent of small and medium sized steel companies have been shut down in the provinces of Hebei and Henan, which contain a significant number of the country's steel facilities.[38] In light of these events, the China Iron and Steel Association predicted towards the end of 2008 that steel production would barely rise for the year, compared with previous forecasts of growth between 5 to 10 percent.[39] However, China's economic stimulus package is expected to increase domestic demand for steel, so its impact on total steel production remains unclear.[40]

In addition to the effect the global economic troubles will have on production levels of steel in China, current conditions may also affect the amount of overall pollution the Chinese steel industry produces. On the one hand, economic conditions may cause the Chinese government to relax its enforcement of the pollution laws, including efforts to close down small and inefficient steel mills.[41] On the other hand, the expected reduction in worldwide demand for steel will mean lower production levels that in turn means that the overall level of pollution will be less. In addition, more of the smaller and less efficient steel mills may be forced by the less friendly business environment to close, and the government may take advantage of the adverse economic conditions to close down some of these mills whose output is less needed. This would lead in turn to a less fragmented industry with an increased proportion of the country's steel production coming from larger and more efficient mills.[42] Thus the net effect of the current global economic troubles on the amount of pollution produced by the Chinese steel industry is unclear.

In the U.S., the steel industry is smaller and employs many fewer workers than was the case in the past. With these lost jobs often come the disruption of families and the disintegration of entire communities. In the early 1960s, American steel companies employed about 600,000 workers. Today, the U.S. industry employs at most 180,000.

Job losses were accompanied by technological innovations that have improved productivity of steelworkers, so that the productivity in the U.S. steel industry is now among the highest in the world. Worker-hours required to produce each ton of finished steel dropped from more than sixteen worker-hours in the mid-1950s to less than two worker-hours currently.

From a long term perspective, such increases in productivity should be good news for U.S. steel companies and workers. Any U.S. industry that wants to survive in an increasingly globalized economy and become more competitive with foreign companies, including those in China, must increase its productivity. However, the way China writes and enforces its environmental standards, while not the only factor, contributes to any advantage that Chinese industry enjoys in competition with the U.S. and other countries. Importantly, differences between Chinese and U.S. environmental policies are likely to have a particularly pronounced effect for the steel industry. In a study of the effect a country's environmental regulations has on trade in five pollution-intensive industries, researchers determined that steel was the only one of the five industries where more stringent regulations were associated with reduced steel exports from that country.[43]

3. The Environmental Record of the Chinese and U.S. Steel Industries.

China's steel industry is the third largest contributor in China of SO_2, nitrogen oxides (NO_X), particulate matter (PM) (measured as dust or soot in China) and other substances that are causing health problems of epidemic proportions.[44] While steel production equals a little over 3 percent of the country's GDP, the industry's production of wastewater, PM, and SO_2 emissions account for 10 percent, 15 percent, and 10 percent, respectively, of the country's total emissions or discharges in these areas.[45] By comparison, the most recent National Emissions Inventory (NEI) released by the Environmental Protection Agency (EPA) in 2007, reflecting 2002 emission levels, indicates that the annual PM emissions of the U.S steel industry were 25,579.9 net tons (2.1 percent of total U.S. PM emissions).[46]

The chart that follows compares the emission record of the Chinese steel industry with these numbers from the EPA on the U.S. steel industry.[47] On a per ton of steel basis, the emissions of these key pollutants in China are between almost three and twenty times greater than in the U.S.

Pollution Per Ton of Steel Produced		
	China (2006)	U.S. (2002)
SO_2	3.53 kg	0.70 kg
PM	4.94 kg	0.25 kg
NO_x	1.89 kg	0.65 kg

Moreover, since 1990, the U.S steel industry has reduced it's per ton CO_2 emissions far more than the Kyoto Protocol would have required.[48] The U.S. steel industry is already an international leader in the worldwide effort to combat global warming. This is occurring even though the U.S., like China, does not currently regulate emissions of CO_2 and other GHGs.

4. The Environmental Impact of Differences in the Nature of the U.S. and Chinese Industry.

Three principal differences between the way the Chinese and U.S. steel industries are organized and operate have a significant effect on the nature and effectiveness of the pollution control regime in each country.

a. Structure of the industry.

Economic problems triggered a series of transformations within the U.S. steel industry that began roughly in the 1960s and have been ongoing since then. From 1999 to 2003 alone, more than thirty companies, responsible for more than half U.S. production capacity, sought the protection of the bankruptcy laws. Many, but not all of these companies, eventually resumed production after they were reorganized under the bankruptcy laws.[49]

The turmoil in the steel industry produced significant economic dislocation, but also produced a leaner industry capable of supporting large financial investments in energy efficiency and pollution control technology. Ownership of the U.S. steel industry also became concentrated, making enforcement of anti-pollution regulations less difficult. There are around 35 companies in business today in the U.S.

Massive amounts of hazy pollution on the main street of Xian City, a major tourist attraction in China.

manufacturing steel mill products from raw materials. They operate a total of fewer than 100 facilities.[50] Some companies own up to 19 plants, whereas most companies are relatively small and own only one plant. The industry is also no longer dominated by integrated steel mills that make steel from iron ore, as production of steel from recycled steel in electric arc furnaces (EAFs) have become widespread. In 1997 basic oxygen furnaces (BOFs) accounted for 56.3 percent of total production and EAFs accounted for 43.7 percent of total production. In 2006, BOFs accounted for 42.9 percent of total production and EAFs accounted for 57.1 percent of total production.[51]

While steel production equals a little over 3 percent of the country's GDP, the industry's production of wastewater, PM, and SO2 emissions account for 10 percent, 15 percent, and 10 percent, respectively, of the country's total emissions or discharges in these areas

Unlike the U.S. steel industry, the overwhelming majority of steel companies in China operate integrated mills. This important difference significantly complicates the industry's efforts to reduce pollutants to levels equal to the U.S. industry that relies more on EAFs. The share of total production accounted for by small steel mills is still growing in China, despite the central government's efforts to reduce their number. Small steel mills producing less than 2 million tons each make up the fastest growing section of the Chinese steel industry in recent years. In 2006 combined output by small mills, each with annual production under 2 million tons, increased almost 30 percent, from 82.9 million tons to over 107 million tons, while mills producing over 10 million tons increased their output by just under 11 percent.[52] These 800 small mills accounted for about one-fourth of total steel production.[53] The large number of small steel mills, often with limited resources, low efficiency, and minimal or zero pollution control measures, works against adoption of new technology and the efficient enforcement of anti-pollution measures.

The top ten steel companies in 2007 together produced about 180 million tons of steel, about 40 percent of China's total steel output for that year.[54] Many of the larger steel companies in China are owned by the government, while this is not true for many of the smallest mills. Among the largest 110 steel enterprises, a 2004 survey by China's National Bureau of Statistics found that 31 are state-owned; 53 have some degree of private ownership including shareholder-owned, limited liability, joint venture or privately owned enterprises; 7 are collectives; 8 are Hong Kong/Macau/Taiwan-owned; and 1 is foreign-owned.[55] In addition to the 38 that are state-owned enterprises or collectives (the latter referring to enterprises owned by townships and villages), the state may have considerable government investment in enterprises identified as privately owned.

Out of the top ten steel companies in 2006, nine were majority state owned by either the provinces or the central government.[56] In fact, without counting the one privately owned company, Jiangsu Shagang, the government owned an average of 70 percent of the nine top producing companies in 2006. This trend appears to be continuing despite some reshuffling of the rankings, as among the ten largest enterprises in 2007, the state was a majority stakeholder in nine, while just one was privately owned.[57]

Importantly, as the State Assets Supervision and Administration Commission reported at the end of 2006, steel companies that are owned by the central government are expected to become "heavyweights" in the steel industry.[58]

b. Use of energy.

Even the most efficient steel production requires large amounts of energy. Producing this electricity is in itself one of the chief sources of steel-related pollution. Since 1990, the U.S. steel industry has cut its energy intensity—the amount of energy required per ton of steel—by more than 27 percent.[59] Not coincidently, the decrease in energy intensity began back in the 1970s as energy costs began their meteoric rise and strict federal pollution control laws were enacted. One of the reasons for reduced energy use in the U.S. is the increased reliance on EAF facilities to produce steel, as EAFs require significantly less energy than do the more traditional BOFs and blast furnaces.

The Chinese steel industry, in contrast, has significantly higher energy intensity levels, and is also increasing its total use of energy due to the continued expansion in steel production levels. The World Bank concluded that Chinese steel producers consume, on average, 20 percent more energy per ton of steel than the international average.[60] The China Iron and Steel Association estimated that in 2007 the industry would use 11 percent more power than in the previous year and would account for ten percent of the country's total use of energy.[61] This is significant because around 70 percent of China's energy comes from burning coal that has a high sulfur content not stringently controlled by China's environmental standards.[62] By way of contrast, the U.S. industry, according to 2002 figures, relied on coal and coke for 51 percent of its energy consumption.[63]

As a major user of energy, the Chinese steel industry has been a part of a well-publicized program of the central government to reduce energy usage called The 1000 Key Enterprises Energy Efficiency campaign. The campaign, directed by the National Development and Reform Commission (NDRC), started in 2006 with the goal of reducing coal consumption by 100 million tons by 2010.[64]

The top 1000 enterprises produce not only steel but also power, textiles, chemicals, construction materials, coal, petroleum and petrochemicals, non-ferrous metals, and paper. The program to improve energy efficiency in certain steel mills will have the indirect effect of reducing pollution from the steel industry. However, there is no indication that the campaign directly sets any pollution-related targets, and since the program applies to 1000 enterprises in all industry sectors, it is likely to apply only to a few of the over 900 steel companies in China.

Related to the 1000 Key Enterprises campaign is an effort of the NDRC to eliminate some of the smaller and less efficient steel mills, many of which are also not in compliance with environmental standards. According to China's Vice Premier Zeng Peiyan, small steel mills are 10-15 percent less energy efficient than large companies. In producing each ton of steel, they are also two times as water intensive and emit three times as much SO_2 as the large steel companies.[65] This effort by the Chinese government to reduce the number of small, less efficient mills is discussed in Chapter VI.

Perhaps as a result of these efforts, the energy efficiency of large and medium sized steel mills in China has improved to some degree. In 2005, the comprehensive energy consumption of the big and medium-sized steel enterprises was 741.05kg standard coal per ton, or 20.32 percent less than in 2000.[66]

At the end of August 2008 the National People's Congress completed action on broad new legislation to increase energy efficiency, reduce usage of water, reduce pollution, and promote recycling throughout all industries.[67] The new law anticipates the issuance of specific direction from governmental agencies on the equipment that can be used, as well as the recycling of material that must be implemented. It also authorizes penalties for enterprises that fail to comply with these directives, and provides tax incentives for those enterprises that do comply. Section 21 specifically addresses the steel industry, stipulating that enterprises (including steel) should replace oil-burning generators and boilers with non-oil burning alternatives such as units that burn natural gas or clean coal. Those that fail to comply with any specific requirements that implement this provision will be subject to a penalty between 50,000 yuan and 500,000 yuan ($7,143 to $71,429).

The law is very general in nature, and relies upon the subsequent adoption of specific regulations to impose and enforce specific requirements. It is too early to know how the general mandates in the new law will actually be implemented by a new coordinating body anticipated in the law, and what actual effect it will have. It nevertheless represents one more manifestation of the efforts of the central government to reduce energy usage and to thereby reduce levels of pollution in the steel industry. Overall, the government has set a target of reducing energy consumption per unit of GDP by 20 percent between 2005 and 2010, and to reduce overall emissions of major pollutants during the same period by 10 percent.[68]

c. Recycling.

As one recent academic study points out, "Steel is never really consumed."[69] Because steel never loses any of its inherent physical qualities, it can be recycled indefinitely, thus becoming what the study calls "a closed loop industrial ecosystem."[70] The only major technological problem can be removing impurities, materials such as copper or tin that might have been added to the old steel but which may not be wanted in the new steel.

In fact, all things being equal, making a ton of recycled steel produces only 30 percent of the pollution produced by a ton of new steel produced from iron ore. The U.S. steel industry relies heavily on recycled steel as EAF use in the U.S. has become more dominant. The EAF process uses more than 80 percent old steel to produce new steel. Even the BOF process in the U.S. uses between 25 and 35 percent old steel to produce new steel.[71]

To fully appreciate the significance of recycling, one need only focus on the basic processes that must occur if iron ore is to be transformed into steel: mine the iron ore, extract the iron, and then smelt this iron in blast furnaces along with limestone and coke, a hard carbon substance that is created by heating coal to a very high temperature for at least eighteen hours in the absence of air. All of these processes generate significant quantities of pollution, and none of these steps occurs if recycled steel is used.

The recycling of steel has gained only a tentative foothold in China. Somewhere around 10.5 percent of China's total steel production comes from the EAFs.[72] Part of the reason that EAFs do not dominate the Chinese steel industry, as they do in the U.S., is that China does not have enough steel scrap to recycle. In fact, China has to import a significant amount of steel scrap from overseas to feed its EAFs. In 2006, all the EAFs in China produced 44.2 million tons of steel, barely over 10 percent of the country's 420 million output that year.[73]

In China, the growth of steel scrap supply has fallen far behind the growth in the output of steel.[74] This suggests that integrated steelmaking using BOFs that rely heavily on coal will, out of necessity, continue to dominate the Chinese industry for the foreseeable future. China's plans for new blast furnaces, which usually do not use recycled steel, further indicates that reliance on BOFs will continue. China now has about 900 blast furnaces. There are another 280 in construction and 30 more are well along in their planning stages.[75]

The Chinese steel industry, in contrast, has significantly higher energy intensity levels, and is also increasing its total use of energy due to the continued expansion in steel production levels. The World Bank concluded that Chinese steel producers consume, on average, 20 percent more energy per ton of steel than the international average.

Continued reliance on integrated mills imposes an environmental price, of course, especially due to the reliance on coal for cokemaking and sintering and other key stages in the BOF steelmaking process, and the heavier energy demands of integrated mills.

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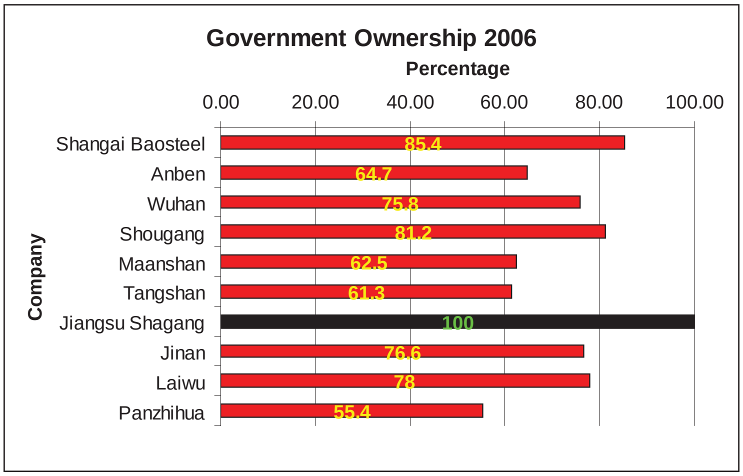

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Company	**Ownership**	**2007 Output (millions of tons)**
1. Shanghai Baosteel Group	Government	28.6
2. Anben (Anshan-Benxi)	Government	23.6
3. Shagang Group	Private	22.9
4. Tangshan Iron & Steel Group	Government	22.8
5. Wuhan Iron and Steel	Government	20.2
6. Maanshan (Magang Group)	Government	14.2
7. Shougang	Government	12.9
8. Jinan Steel	Government	12.1
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Polluted Wu Jiang River, Chong Qing, China.

Chapter II: The Process for Developing Pollution Control Regulations in China

Pan Yue had limited power.

He sent an investigative team. Their initial report, issued a few months later, documented widespread violations of environmental laws:

…none of the investigated companies received approval by local environmental bureaus; almost no pollution control facilities were installed, while those installed were not operating properly; most of the production facilities were those that should be phased out according to government policy; most of the companies' air pollutant emissions significantly exceeded environmental standards.[1]

The economic stakes were high. Every time the price of steel on the international market rose, Tangshan's steelmaking capacity had enjoyed a huge spurt in growth.

Happy to demonstrate why he was known as the creator of regulatory "hurricanes," Pan criticized the local government for "strongly embracing local protectionism" and for choosing, at best, to simply remain "idle" as the steel companies poisoned more and more people.[2]

Tangshan's city government responded quickly. It dispatched teams of enforcers to every steel company named in Pan's press release, shut down electricity for these companies, and oversaw the dismantling of facilities with the most inefficient equipment. Local government officials also forced the named steel companies to install dust removal equipment before being allowed to resume operations.[3]

To those unfamiliar with environmental regulation in China, this seemed to be good news. Action was being taken. Abuses were ending. But other people knew better.

Understanding what happened in Tangshan must begin with China's pollution control regime. At first glance, the Chinese regulatory system for pollution resembles the U.S. system. Both have a federal system driven in large part by national regulations, with state/provincial officials playing a crucial role. This seeming resemblance makes it tempting to see China's environmental regulation problems as simply a failure to replicate U.S.-type regulatory measures. But, China, quite obviously, has its own ways of proceeding. Even as it experiences an economic and social revolution at the hands of industrial technology and worldwide trade, it has its own historical and cultural context within which to formulate and implement laws that protect the environment.

For example, most scholars who study Chinese environmental law emphasize the importance of central planning in China's civil law tradition, which dates back millennia.[4] China's government is structured at all levels in a way that often encourages officials to give economic plans derived from such central planning priority over environmental goals. As a result, environmental laws and regulations adopted by the central government in China may not have as much impact at the local level as in the U.S.

As Dan Guttman and Yaqin Song of the Center for Industrial Development and Environmental Governance of Tsinghau University in Beijing noted, "In both the USA and China, environmental governance is shaped by ideas about social stability, about the conflict between environmental protection and economic growth, and about the forces of cooperation and competition… [But] different visions of stability affect the transplantation of governance concepts between systems. For example, in China it may seem to be a contradiction when private citizens claim they represent the public interest. In America, however, it is common for nongovernmental groups to appear at a public hearing and each say they represent the public interest. From China's perspective, this may appear to be a source of needless and confusing transaction costs."[5]

The following reviews how the structure of the environmental laws and the way government is organized to implement them differ in China in important ways from the U.S., as well as how those differences may impact the effectiveness of environmental laws in China, for in the final analysis what is most important is whether each country's particular approach to the environmental challenges it faces is effective.

1. Chief Institutions and Laws Regulating the Environment.

In its present form, China's central government exercises less direct control over environmental matters than in the U.S., and the ministry focused on environmental matters has far fewer resources and less legal authority than the comparable U.S. agency.

a. Chinese Laws and Agencies.

One of the basic national policies enshrined in China's constitution is that the "state protects and improves the living environment and the ecological environment, and prevents and controls pollution and other public hazards."[6] The legislative foundation for environmental regulation in China in turn is the *Environmental Protection Law of the People's Republic of China* (hereafter the Environmental Protection Law), adopted as provisional legislation in 1979 and enacted as final legislation in 1989.[7] As China's fundamental law on the environment, it includes various principles, targets and procedures. A number of substantive laws, addressing specific environmental issues, flow from the basic Environmental Protection Law. The three most important ones for purposes of this report are *Law on the Prevention and Control of Atmospheric Pollution* (hereafter the Air Pollution Prevention Law), *Law on the Prevention and Control of Water Pollution* (hereafter the Water Pollution Prevention Law), and *Law on the Prevention and Control of Environmental Pollution by Solid Waste* (hereafter the Solid Waste Law).[8] As discussed in the report, there are also a number of regulations or guidelines issued pursuant to these basic laws, as well as separate procedural laws addressing such issues as the performance of environmental assessments and access of the public to information about the environment.

A number of bodies have a role in enacting and implementing the environmental laws in China. The National People's Congress (NPC) in China writes, debates, and enacts all laws. Although the NPC has legislative responsibilities like the U.S. Congress, numerous factors limit its actual role in setting China's environmental policies.

The State Council, China's top executive body, shapes most legislative priorities for the NPC. As a result, the NPC tends to reflect the internal deliberations and decisions of the State Council, although recently there have been some signs of change.[9] The State Council also has the authority to promulgate regulations that may play a crucial role in interpreting and implementing the broad language included in an environmental law that the NPC enacts.

Selected by the leadership of the Communist Party and headed by China's Prime Minister, the State Council represents a narrower constituency than the NPC. Dominating the State Council are ministries and committees, such as the National Development and Reform Commission (NDRC), which have a strong economic growth mandate.

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Several departments under the State Council regulate activities affecting the environment. Probably the most important in terms of establishing plans and setting targets is the NDRC. It is directly responsible for implementing some programs that impact the environment such as the central government's energy efficiency program. China's national environmental agency, formerly the State Environmental Protection Administration (SEPA) and now the Ministry of Environmental Protection (MEP), implements major environmental regulations in relation to pollution, and works with Environmental Protection Bureaus (EPBs) operating at the local levels. The MEP is the highest administrative body directly responsible for environmental protection. This report's chief focus will be on the MEP and to some degree the NDRC.

Although SEPA was established in 1998 as a ministry, it did not have a permanent seat in the Council until March 2008, when it was elevated in status and renamed MEP.[10] It is now one of 27 major ministries and commissions of the Cabinet.[11] Prior to that time SEPA's Administrator participated in State Council meetings only when members discussed environmental matters.[12]

According to a university expert interviewed for this report, the MEP has made few institutional changes since the reorganization early in 2008. However, it has grown in stature, and as another expert mentioned in an interview, this reorganization should increase the influence it has on environmental policy.

Despite its new standing, the MEP's authority remains severely limited. As Pan Yue, Deputy Minister of SEPA, noted in an interview with the press last year, "In terms of the administrative measures in our arsenal, we don't have the power to close down offending companies or to remove the local government officials who should be held accountable, or even to perform our management functions of environmental monitoring and enforcement of environmental protection laws in a top-down manner."[13]

The MEP is also limited in its manpower, with only 200 to 300 employees. Its U.S. counterpart, the Environmental Protection Agency (EPA) has about 9,000 employees in Washington, D.C. alone.[14] Like other Chinese government agencies, the MEP bolsters its staff by making use of employees of research institutes and other entities that may be affiliated in some way with the government agency. In the case of the MEP this includes the Nanjing Institute of Environmental Science, which employs around 200 researchers.[15] Called *shi ye dan wei,* these affiliated entities make personnel available who may unofficially carry out some of the functions of the MEP, including in its small regional offices. Even if these individuals were officially employed by the MEP, the size of the EPA workforce still dwarfs the far smaller MEP, especially considering the amount the EPA itself spends each year on outside consultants and research studies.

Other Chinese departments may have some smaller or more indirect regulatory role in the environmental area. This includes the Ministry of Water Resources and the Ministry of Construction, which originally contained SEPA before it became an independent agency.

In deliberations within the central government NDRC can exercise greater influence than MEP or other agencies over environmental issues. NDRC makes economic plans countrywide, including environmental strategies, and it has more influence within the State Council than the MEP. For example, NDRC is responsible, although in consultation with the MEP, for setting national total emissions control targets for every Five Year Plan. This plan then has to be approved and promulgated by the State Council. In the past NDRC has occasionally exercised its greater influence to reverse in the State Council decisions by SEPA imperiling economic projects previously approved by NDRC.[16]

Thus, the central government's direction of environmental policy is the responsibility of a relatively weak legislative body, a small central environmental agency, other ministries with broader mandates, including NDRC, and a State Council containing ministries from across the government.

In addition to the laws of the central government, provinces and local jurisdictions within provinces may also have their own environmental rules. These laws cannot be less stringent than any standards adopted by the central government, but they may be more stringent. For example, Jiangsu province, one of the more highly industrialized and more prosperous provinces in China, has environmental standards and enforcement programs that in some respects are stricter than those of the central government.[17]

b. U.S. Laws and Agencies.

The U.S. environmental regulatory system has its roots in major federal statutes, primarily the Clean Air Act (CAA), the Federal Water Pollution Control Act (FWPCA or "Clean Water Act,"), and the Resource Conservation and Recovery Act (RCRA). These federal statutes establish an overall approach and provide policy directions to the EPA, an independent regulatory agency created in 1970. The EPA's Administrator is appointed by the President, subject to U.S. Senate approval.[18] As of 2008, the EPA's 18,000 employees work in ten regional offices and more than a dozen research centers, as well as its headquarters office.

Although many other government departments share responsibilities for environmental issues, the EPA remains the major government agency that administers air, water, hazardous and solid waste programs. The EPA is responsible for setting up national standards that serve as benchmarks. Most regulations that implement federal environmental statutes—e.g. those that specify emissions limits on air pollution or effluent limits on water pollution—come directly from the EPA, or from states with EPA approval. The EPA has monitoring and enforcement capacity all across the country; it also has hundreds of research scientists. State and federal courts often defer to the EPA's expertise, and Congress often delegates the resolution of politically difficult environmental questions to the agency.

2. Role of Provincial/State and Local Governments in China and U.S.

In China and the U.S., the national environmental agencies delegate much of their power to local governments, but in the U.S. the state and local governments are more closely bound to the direction of the EPA than China's counterpart agencies are bound to the direction of the MEP.

a. Role of Provincial and Local Governments in China.

Under the Chinese system, sub-national legislative and administrative measures must be consistent with national legislation, and the sub-national agencies are supposed to discharge their responsibilities as envisioned by national laws.[19]

On the local level, most responsibilities for environmental regulation rest with the EPBs which oversee the implementation of national and local environmental regulations and standards. EPBs also exist at the municipal and district/counties levels. Overall, there are around 2,500 EPB offices, and EPB officials account for the vast proportion of the 60,000 environmental officials who currently work for the central and local government.[20]

Each EPB reports to both an upper level department in the same functional area and to the government of a geographical area. For example, the municipal EPB reports to the provincial EPB and at the same time to the mayor's office. The EPBs have several affiliated offices including Environmental Monitoring Centers (for environmental quality and pollutant emissions monitoring), Inspection Units (for enforcement of regulations and collection of discharge fees), and Research Institutes (for technical and research affairs). These offices are staffed, managed and funded largely by local governments.

The MEP has limited direct influence over EPBs, although it provides them with guidance on the implementation of policies and regulations. Only recently, the MEP has acquired a role in the selection of the heads of local EPBs.[21]

Despite the significant number of environmental officials working at the local level, historically EPBs have been weak institutions.[22] The structure of local governments helps explain, at least in part, why EPBs have difficulty fully implementing environmental regulations. EPBs are overseen by municipal policy committees, which are composed of all major municipal agencies and are often headed either by the mayor or deputy mayor.[23]

Since the municipal policy committees include a substantial number of industrial and commercial representatives, there can be frequent interference by these groups to prevent implementation of environmental measures.[24] This was highlighted in a 2003 study by Chinese professors of EPBs in various provinces. Although only a snapshot of conditions at a particular time and place, the study illustrates the range of effectiveness EPBs achieve across China. The study found that the Guangzhou EPB in the Guangdong province, the richest province in China, faced strong resistance to greater involvement by the public in environmental governance because of industry influence, despite the fact that the EPB has made substantial efforts to propagate environmental values, handle pollution problems, and convey citizens' complaints to the municipal government.[25] In contrast, because of the cooperation of a mayor who had placed a priority on environmental issues, the Dalian EPB of Liaoning Province was in a superior bargaining position with the other, traditionally more powerful, government authorities.[26]

China's decentralized administrative system also means that EPB financial resources come directly from local and municipal governments.[27] Even though policy directives are issued by MEP or NDRC, in all cases it is the local government that provides environmental agencies with their annual budgetary funds, approves institutional advancements in rank, determines increases in personnel, and even allocates resources.[28] Because of the fact that EPBs are so financially dependent on local governments, it is these administrations, not the central government, that are the most influential in determining the EPB's environmental policies and enforcement.[29]

Many local governments tend to make short-term decisions to achieve economic benefits because of the emphasis local governments place on development, high employment rates, and increased gross domestic product (GDP) numbers.[30] Officials employed by the local EPB may reflect this attitude in the actions they take implementing the environmental laws of the central government. Such officials, wishing to advance their careers, may have greater incentives to promote economic growth than to protect the environment. Advancement may come more from achieving measures of "economic growth" than from success in reducing pollution.[31]

As one observer has noted, "EPB officials' salaries, office space, and cars are all determined by the local governments. Because of this, EPB officials are particularly susceptible to pressure from senior officials within the local government. In some cases, these local officials have personal ties with enterprise directors and try to broker lower discharge fees for the polluting enterprises. In other cases, local officials may pressure EPB officials to limit or ignore the fees because of concerns for social stability."[32]

The emphasis of provincial and local officials on economic growth stems from the decision of government reformers in the late 1970s to decentralize, and to create strong incentives for local officials to pursue economic growth.[33] Economic targets are often implemented through agreements signed with appropriate agencies at the provincial and local level.[34] A related reform gave local governments' property rights over the increased income of local businesses, turning these governments into semi-business corporations and government officials into what one scholar calls "the equivalent of a board of directors."[35]

As a result, provincial or local governments may not recognize that central government policies sometimes favor balancing growth with environmental protection. In other instances, provincial or local officials may neglect serious pollution problems because of their direct financial connections with factories or their personal relationships with the factories' owners.[36]

The drafting of new emission/effluent standards for the steel industry now underway is being handled through the collection of comments exclusively from government bodies and the industry.

According to a top environmental official of the central government, the economic priorities of local governments have played an important role in the country's environmental problems. "The main reason behind the continued deterioration of the environment is a mistaken view of what counts as political achievement. The crazy expansion of high-polluting, high-energy industries has spawned special interests. Protected by local governments, some businesses treat the natural resources that belong to all the people as their own private property."[37]

Rising interest by the central government in such non-economic goals as pollution control is exerting pressure in an opposite direction. According to one expert interviewed for this report, provincial and local officials are evaluated partly on the basis of their implementation of their environmental agreements with the central government and their environmental targets in the various applicable plans. But this may not be enough to overcome history and the importance local regions still place on economic goals.

The current global economic troubles illustrate the effect economic concerns can have on environmental programs. Although the overall impact of the adverse economic conditions is still unclear, there are some early indications that the downturn has reduced the effectiveness of efforts by both the central and local governments to enforce its environmental regulations and programs. As the president of the Hong Kong Chamber of Commerce in China observed in a recent article, officials have "relaxed enforcement this year."[38] Amid job losses, many facilities targeted by the government because of pollution violations remain open. For example, in the central Chinese city of Wuhan, a steel factory that was scheduled for closure in 2007 because of air pollution has not been asked to fix the problem or curtail operations. According to the research director of the Guangzhou Academy of Social Sciences, funding has also been pulled from environmental projects, such as an automatic wastewater and air-testing system for factories in Guangdong's provincial capital.[39] While an expert from the Chinese Academy of Social Sciences said that China could boost its economy by focusing on clean energy, green construction, and other environmentally friendly businesses, it is unclear whether the government will do so under current economic conditions.

b. Role of State and Local Governments in the U.S.

In the U.S., the EPA has considerably greater control over the implementation and enforcement of its programs. The agency enters into agreements with states to delegate environmental powers to the local level. In the vast majority of cases, states enter into such agreements because they wish to exercise local control over the programs and because EPA offers federal funding. In a typical delegation, states submit to the EPA proposed programs that provide binding commitments to carry out the federal environmental goals. The states need to demonstrate that they have enacted all of the necessary laws and standards, and that they have committed sufficient amounts of financial and personnel resources to implement, monitor, and enforce these laws and standards.[40] For example, under the CAA, states must provide State Implementation Plans (SIPs) for federal review.[41] The EPA provides funds and technical assistance to help the states develop and implement the SIPs.[42]

The EPA oversees implementation of a state's delegated regulatory authority. If a state fails to implement the program, then the EPA has the authority to withdraw support or initiate enforcement actions against violators.[43] Failing to meet the stringent federal requirements for the SIP program may also subject a state to the loss of federal highway funds, trigger implementation of an EPA-created "federal implementation plan," and other sanctions.[44]

Similar rules govern the EPA-state relationship under the FWPCA. The EPA has veto power over individual permit decisions made by the states, although it actually exercises this power only in reaction to what one scholar calls "outrageous or preposterous decisions."[45]

As a result of increased reliance on the state and local governments to implement the country's environmental laws, the number of environmental officials below the federal level has grown significantly since the 1970s. Currently, more than 52,000 employees are performing environmental compliance and enforcement duties, in addition to the 18,000 EPA employees working at the federal level. This reflects a 10 percent increase in employees at the local level over the past 5 years.[46]

3. The Interests Consulted in Adopting Rules and Standards.

a. The Decision Making Process in China.

China's law entitled *Measures on the Management of Environmental Standards*, enacted in 1999, established a six-step, standard-making process that at the outset provided little, if any, opportunities for public participation.[47] The regulation does not mandate any public participation procedures in the six-step process. The drafting of new emission/effluent standards for the steel industry now underway is being handled through the collection of comments exclusively from government bodies and the industry. The process illustrates the limited number of interests that may participate in the process of developing environmental rules in China.

In 2003, SEPA started to consider changes to the emissions standards for air and effluent standards for water applicable to the steel industry. Chapter IV discusses in detail the proposed changes in the standards.

There has been no input from the general public on these proposed changes to the standards. Instead, SEPA assigned the task of drafting new standards to five institutes associated with the Chinese steel industry. This included Sinosteel, a state-owned company that performs metallurgic R&D and manufactures steel making equipment for the Chinese industry, and two of the largest Chinese steel companies in 2007, Anshan Steel and Baosteel. Baosteel was the largest Chinese steel company in terms of production in 2007, and Anshan Steel is part of Anben, the second largest steel company in 2007. These large Chinese companies associated with the steel industry have advocated adoption of more stringent standards. In doing so the large companies involved were aware that their proposals for more stringent standards could lead to the phasing out of some of the smaller and less well-financed steel companies currently competing with the large enterprises.[48]

Only in September 2007 did SEPA circulate the proposed new standards, now in its third draft, for comment. Though the drafts are publicly available, comments were only solicited from certain government departments and members of the industry, including industry associations and individual companies.[49]

After complaints were made about the failure of the government to adequately consider the impact on public health in preparing environmental rules, the government included provisions "encouraging appropriate public participation" in the 2002 Law of the People's Republic of China on Environmental Impact Assessment.[50] In response, SEPA produced "Interim Measures for Public Participation in Environmental Impact Assessment," to provide for different forms of public participation. Additionally, the media has begun to play an increasingly important role in highlighting environmental problems, including news made available over the internet.

Even with an increased role for the media and some new legal requirements for public participation, the general level of openness and receptiveness to public concerns in environmental decision-making remains quite low compared to the U.S. For instance, the new provision "encouraging public participation" only applies to the process of preparing environment impact assessments. It does not change the more closed process for adopting particular environmental standards under the 1999 law noted earlier.[51] Furthermore, pressure from the news media and nongovernmental organizations in China is sporadic. And while public hearings are held frequently, they are more likely to provide an opportunity for stakeholders to express their views than to provide an opportunity for detailed, substantive analysis of the proposals.[52]

The absence of the general public's input into the making of environmental standards is further complicated by the inability of the general public to gain access to much of the key environmental data. The Environmental Protection Law of the People's Republic of China, for example, mandates that the government should regularly issue public reports on the general environmental situation.[53] Indeed, the Chinese government does publish annual reports on environmental conditions, and these reports are available to the public. But key information such as air quality, acid rain pollution, and urban river water quality is kept "available only to senior staff of environmental protection departments."[54] The government classifies much of the important data as confidential.

Aware of the weakness of its system, the State Council in 2007 adopted Regulations on Open Government Information, effective May 2008. It is too soon to know how effective this change will be, but it is interesting to note that SEPA was the first government agency to announce rules last year implementing the new requirement.[55]

With respect to information about accidents leading to significant environmental pollution, public release of information has been significantly delayed in the past, thereby significantly undermining the ability of the public to monitor the adequacy of existing environmental policies. Pan Yue, deputy minister of the MEP, said in 2007 that although there are general articles in current environmental laws mandating the release of pollution information, the requirements are usually vague and lack details such as "who should release the information" and "what are the penalties for not doing so."[56] This often leads to delays in the disclosure of sometimes serious pollution accidents.

One prominent example of this was the 2005 Songhua River toxic spill, in which large amounts of highly toxic benzene were discharged into a major river in Northeast China after an explosion in a chemical plant. It was five days after the incident that local environmental monitoring stations received information about the situation,[57] and six days after the incident that the public was informed.[58]

MEP has adopted, effective May 1, 2008, administrative rules called "Measures on Open Environmental Information." They require local authorities and factories to disclose any environmental violations, accidents, and lack of cooperation with government officials.[59] It is too soon to know what effect the rules will have on the ability of the media and the press to learn about environmental accidents, especially since as departmental rules they have less authority than regulations issued by the State Council.

Lack of both data and opportunity to use that data to challenge particular administrative action or inaction by Chinese authorities has numerous effects, such as minimum public awareness and diminished public pressure on Chinese regulators and steel plant operators. The MEP's Deputy Minister Pan has noted the absence of public participation, and expressed the hope that it would increase in the future. He told one publication, "Relying on the force of environmental protection and a few other agencies is far from enough; we need broad public participation, because the public are the biggest stakeholders in the environment."[60]

b. The Decision Making Process in the U.S.

By contrast, the U.S. environmental regulatory system pivots around the multiple opportunities for public participation; congressional oversight; legal actions; and public disclosures of emissions, ambient air and water quality, and environmental impact data. The process offers multiple "access points" to decision-making, leading to a high level of public participation and better-informed rulemaking.[61]

The CAA demonstrates the relatively transparent nature of environmental policymaking in the U.S. There is significant public scrutiny and oversight, through citizen and environmental group participation in the promulgation of federal pollution standards under the Administrative Procedure Act (APA), as well as citizen petitions and lawsuits in the federal courts against federal agencies that are allegedly not complying with the APA in setting standards.[62] An example is the high levels of public participation and transparency that accompanied the recent EPA rulemaking on revisions to the PM and ozone National Ambient Air Quality Standards (NAAQS) revisions. The EPA received thousands of comments from state and local government agencies, industry, environmental groups, and individual citizens.[63] Similarly, U.S. citizens can comment on individual steel plant preconstruction and operating permits being issued under Title V of the CAA (see Chapter III) and they can mount judicial challenges to those permits.

The wide availability of environmental data in the U.S. allows active public involvement in implementing and assessing the country's environmental rules. EPA assembles and maintains a large national database called the National Emissions Inventory (NEI) based on monitoring of actual emissions. Further, U.S. law requires individual steelmaking facilities to disclose publicly in toxic release inventories (TRI) the nature and amount of hazardous air emissions.[64] As a result, the public can determine precisely whether any facilities have failed to reduce their hazardous air emissions as required by law.

U.S. citizens, under the APA, are also entitled to all the decision-making documents and data in the EPA administrative record for a particular rulemaking, and can obtain further information in the possession of the government through the Freedom of Information Act (FOIA).[65] The public can also easily obtain historical and current steel plant data and local/regional ambient air quality data through the NEI to determine air pollution trends or spikes. Many U.S. steel plants choose to publicly disclose the capabilities of the pollution control technology employed at their plants, as well as the amount of pollution reduction actually achieved by these technologies. Additionally, since 1986, in the event of certain accidental releases of pollutants above specified amounts the facility must promptly notify the appropriate local, state, or federal authorities so that measures can be taken to protect public health and the environment.[66]

Thus, transparency and public participation play an important role in not only the development, but also the implementation, of environmental laws in the U.S.

4. Relative Importance of Health and Cost Considerations.

China's Air Pollution Prevention Law states in Article 1 that one of the law's objectives is to promote human health, but Article 1 also lists promoting sustainable development of the economy as another objective. Nothing in the law explicitly requires health data to be given particular weight, or even considered, in the making of ambient quality standards and emissions standards. Instead, the Chinese law explicitly requires the regulatory agencies to take "economic and technological factors" into consideration when preparing emissions and discharge standards.[67] This encourages the heavy involvement of the industry that may be regulated, and development-minded government ministries.

Again, the contrast with the U.S. is significant. Since the 1970s, Congress has explicitly recognized in the laws it has passed that in many cases public health and the environment must be protected regardless of compliance costs—no matter how significant these costs may be. Indeed, certain standards are based primarily on health concerns, especially for hazardous air pollutants that have been scientifically determined to pose health risks serious enough to require "maximum achievable control technology" (MACT).

These MACT standards were developed to control hazardous air pollutant emissions from significant "major" sources in designated manufacturing industries through installation of technically achievable emissions control equipment. For example, EPA's MACT for controlling hydrochloric acid (HCl) produced from the steel pickling process states that whatever technology a steel company chooses it must meet specific HCl concentration limits or have an HCl collection efficiency of 99 percent. EPA will not consider the cost of compliance when determining an appropriate MACT level of emission reduction.

Successive U.S. laws and regulations have increasingly forced acquisition of advanced pollution emissions control equipment and have deemphasized the costs and economic impacts of acquiring such equipment. This has held true with regard to national standards such as the primary NAAQS,[68] and with respect to specific standards applied to the U.S. steel industry; e.g. the mandated advanced

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Waste water pollutes a beach in Xiamen.

pollution control technology through New Source Performance Standards (NSPS);[69] and the National Emissions Standards for Hazardous Air Pollutants (NESHAPs).[70]

5. Role of Courts in China and the U.S.

The Chinese judiciary does not get involved with administrative decision-making, as the concept of citizen petitions and judicial standing to contest administrative actions by Chinese agencies is still a nascent legal concept. This limited judicial role dates back to China's Confucian tradition in which parties strive to resolve disputes through third-party mediation and conciliation instead of lawsuits. Courts in China are not supposed to interpret laws. Furthermore, they are not independent of the local People's Congress, which appoints the judges.[71] In the end, the Chinese Communist Party sets policy and serves as China's "ultimate arbiter of power," not the courts.[72] The Party defines the overall legislative agenda, vets key pieces of legislation, and influences court decisions.[73] The power to interpret environmental laws remains with the legislative and executive agencies. MEP plays an important role in interpreting the laws and regulations, although ultimate authority remains with either the NPC or the State Council, depending on which body first adopted the language in question.

In the U.S., federal and state courts often play an active role by reviewing a wide range of government actions. Environmentalists, industries and other interested parties can use federal and state courts to challenge—and even stop—government actions such as environmental regulations or specific facility permits. As discussed below, public interest groups play an important role in triggering court review of agency action in the environmental area.

6. Role of Public Interest Groups.

Public interest groups have started to become more active in China, one of many changes triggered by the country's deteriorating environment. Some of the groups are sponsored by a government agency, but there are others active in the environmental area that are not connected with any government agency.

However, this is not comparable to the active role that public interest groups play in the U.S. in the legislative and rulemaking process, and in the media's consideration of environmental issues. Public interest groups have made especially effective use of the courts. Under the APA, any person "adversely affected or aggrieved by agency action" can challenge in federal court the action of the EPA or another federal agency.[74] Section 509 of the FWPCA and Section 307 of the CAA provide for challenges in federal appellate courts to actions the EPA may have taken that violate the substantive obligations in the applicable statutes or the procedural requirements of the APA.[75] This allows for judicial review of EPA actions not only by industry members affected by a new standard, but by public interest groups or other members of the public who can demonstrate injury from the agency's action. Since 1970, the federal courts have recognized the right of members of the public with standing to bring such suits.[76] In addition to challenges of agency action under the APA, Section 505 of the FWPCA and Section 304 of the CAA give citizens the right to sue the polluters themselves in federal court, rather than the EPA, for violations of clean water or clean air standards.[77] Such so-called citizen suits are unknown in China.

The ability of U.S. citizen groups to petition the EPA, and to seek judicial review regarding NAAQ standard-setting or the periodic NAAQ reviews, has created a permanent legal and political counterweight to industry efforts to obtain relief from increasing pollution control expenditures. For example, environmental groups have frequently—and successfully—sued the EPA for failing to issue or review NAAQs or NESHAPs on a timely basis, or for failing to issue stringent enough standards.[78] To date, in China public interest groups interested in environmental issues have not developed the same influence over environmental policies as in the U.S.

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Chapter III: The Structure of the Pollution Control Regime in China

Government regulators continued their efforts in Tangshan, utilizing the anti-pollution weapons that exist in China's law books.

They began, for example, to enforce rules that set minimum capacities for blast furnaces and sinter machines. Smaller machines tend to be less efficient and to spew forth more pollution. They are also usually more difficult for regulators to locate and monitor.

Regulators found at least a half-dozen blast furnaces with capacities lower than 65 m3 and three basic oxygen furnaces with capacities lower than 15 tons—all below specified limits. They ordered that these factories be shut down.[1]

None of the investigated companies had received the required approval certificates from environmental agencies; one had certifications on display but they were not authentic.

That was, perhaps, the most striking aspect of the steel companies' behavior: most did not even pretend to make an effort to comply with environmental laws.

The Chinese and U.S. systems of environmental standards share two fundamental characteristics: (1) national ambient air quality standards (NAAQs)[2] and water quality standards[3] that establish limits on the total amounts of pollutants that may be released into the environment; and (2) industry-specific emissions standards for air and water pollutants that control the specific "source" of emissions.[4] However, there are major differences in the way that the regulatory regime in the two countries is structured and enforced, and these differences account for significant variations in the actual stringency of the regimes in the two countries.

1. Overall Differences in System of Operating Permits.

The emissions/discharge permit is a key element of the U.S. environmental regulatory regime under both the Clean Air and Clean Water Acts (CAA and FWPCA), and it constitutes a key difference between the U.S. and Chinese environmental regime. U.S. regulators employ permits to force the installation of state-of-the-art control technologies (see discussion in Chapter V). China started experimenting with its discharge permit and registration system in the early 1980s for pollution discharges.[5] It remains, however, a less developed and less effective mechanism than in the U.S. for specifying the standards applicable to a particular facility and for ensuring compliance with those standards.

a. Overview of the Chinese Permit System.

While China first attempted to implement a pollution permit program in the 1980s for water discharges, further development of a system of operating permits has been limited over the last several decades.

Prior to the year 2000, several pilot programs attempted to use permits to regulate facilities that discharged wastewater, but these permits focused only on the concentration of pollutants in the water. An amendment to Article 10 of the Water Pollution Prevention Law in 2000 provided for the adoption of permits for water designed to cap a facility's total discharges.[6] However, the law only stipulated that governments above the county level should issue permits capping discharges if polluting enterprises exceeded the approved total discharge quantity for a certain area.[7] Additionally, in 2001, a trial law for water pollutant discharge permits, *Measures for the Administration of Key Water Pollutant Discharge Permit for the Huai River and Tai Lake Basins*, was issued for the Huai River and Tai Lake basins, which are some of the most heavily polluted regions in China.[8] In 2004 SEPA first developed a pilot program for an integrated pollutant discharge permit system in the cities of Hangzhou, Shenzhen, Sheyang, Wuhan, Tangshan, and Yinchuan.[9]

More recently, in February 2008 an amendment to the Water Pollution Prevention Law was adopted that provides the legal basis for a nationwide permit system capping the amount of discharges that each permit holder can make. It remains to be seen, however, how and when such a permit system will be adopted across the country.[10] The Ministry of Environmental Protection announced in July 2008 that the implementation of the system will be delayed, as more time is needed to gauge "public opinion."[11] There is currently no timetable for their implementation.[12]

U.S. regulators employ permits to force the installation of state-of-the-art control technologies. China started experimenting with its discharge permit and registration system in the early 1980s for pollution discharges. It remains, however, a less developed and less effective mechanism than in the U.S. for specifying the standards applicable to a particular facility and for ensuring compliance with those standards.

With respect to a discharge permit system for air pollution, a pilot permit program was attempted in sixteen cities beginning in 1991 to regulate enterprises emitting smoke, dust, and sulfur dioxide.[13] Yet despite the implementation of this pilot program, when the Air Pollution Prevention Law was revised in 1995, no pollutant discharge permit system was adopted for air.[14]

In the most recent revision of the Air Pollution Prevention Law in 2000, China's central government did propose that provincial governments could designate certain areas which would be subject to total pollutant emissions limits, but only if they were failing to meet prescribed air environmental quality standards.[15] However, this provision was struck from the bill before it became law.

Instead, the final act established a permit system that would cap the SO_2 emissions in two control zones: the Acid Rain Control Zone and the Sulfur Dioxide Control Zone.[16] These zones make up 11 percent of China's landmass and 175 cities, with the sulfur dioxide zones in the northern portion of the country, and the acid rain control zones largely in the southeast portion of the country.[17] Major cities and provinces covered under the Sulfur Dioxide Control Zone include Beijing, Tianjin, Jinan, Zhengzhou, and the Hebei, Shandong, Shanxi, and Henan provinces. Major cities and provinces covered under the Acid Rain Control Zone include Shanghai, Wuhan, Guangzhou, Hong Kong, and the Hunan, Hubei, Jiangxi, and Guangdong provinces.[18] Together, these zones account for 60 percent of China's total emissions of SO_2.[19]

But while Environmental Protection Boards (EPBs) now have the authority to cap emissions at the facility level for SO_2 in these specific regions, permit systems are still in a developmental phase in many places, though officials indicate that they are working hard to meet the new limits.[20]

Beyond the Acid Rain and Sulfur Dioxide control zones, there have been additional attempts to pilot permit programs in the last few years which would not only cap the total emissions of a facility but also allow for the trading of emission credits. In such permits, a facility needing authority for additional emissions could trade credits with another facility that has the authority to emit more emissions than it requires. One such pilot program was initiated by the U.S. public interest group Environmental Defense with the Chinese public interest group Beijing Environment and Development Institute, State Environmental Protection Agency (SEPA) and the EPBs in Shandong, Shanxi, Jiangsu, and Henan provinces. The intent of the program is to study and set up a market based emissions trading instrument to reduce SO_2 pollution and mitigate acid rain problems.[21]

One Chinese scholar recently termed the current status of implementing operating permits "troubling."[22] Overall, operating permit systems have only been implemented in some regions and with respect to a limited number of companies. In many regions, permits are not even issued for the concentration limits that apply to each facility.[23] And in places where discharge permits are implemented, they frequently do not cover a substantial number of polluters. For example, in Shanghai, where 20,000 companies are eligible for a permit, only 3,157 have actually been issued permits.[24] One city issued no pollutant discharge permits for three straight years in the past decade, while in many provinces the enterprises that have been issued discharge permits total less than 20 percent of all polluting facilities.[25] Some EPBs are filling out permits limiting emission of a pollutant only after determining facilities' actual levels of pollution, thereby undermining the point of the permits as a way to limit a facility's total amount of pollution.[26]

Even when permits are issued, the lack of specificity about the discharge permit program in national laws has impeded their effectiveness. Often, a permit may be as short as one page, far shorter than the typical U.S. permit.[27] Article 15 of the Air Pollution Prevention Law and Article 20 of the Water Pollution Prevention Law include just two sentences mandating that "the state runs a discharge permit system." This must serve as the entire legal backing for discharge permit and registration. Crucial aspects such as which regulatory authority administers the permits, what must be included in the permits, and how to manage the permit are left unspecified.

Additionally, implementation measures needed by provincial environmental bureaus often cannot pass the provincial People's Congress[28] because of the absence of explicit directions from national laws and the lack of well-defined guidelines that address such issues as the jurisdiction of the province and its authority. This lack of statutory direction for the permitting system also negatively impacts the willingness of individual companies to seek and obtain discharge permits.

b. Overview of the U.S. Permit system.

Since the enactment of the 1990 amendments to the CAA requiring certain stationary sources to obtain permits from state and local authorities, these authorities have issued over 16,000 permits.[29] Each operating permit has considerable detail, bringing with it a high level of compliance obligations and costs.[30] For example, a typical State of Ohio Title V permit for an integrated steelmaking facility specifies monitoring, recordkeeping and reporting requirements for the facility; lists scheduled equipment maintenance and malfunction reporting; allows inspectors to enter the facility and examine equipment and records; details the applicable emissions limitations for each source (e.g. visible particulate matter (PM), fugitive dust and opacity[31] levels, and sulfur dioxide (SO_2)); restricts the duration of steelmaking operations; and specifies the emissions control technology for each emissions source and the operation and maintenance of control technology (e.g. baghouse and electrostatic precipitator).[32]

Individual U.S. steel plant permits negotiated with state regulatory authorities frequently impose compliance obligations that are more stringent than those imposed under the federal New Source Performance Standards (NSPS) or National Emissions Standards for Hazardous Air Pollutants (NESHAPs) maximum achievable control technology (MACT) standards. For example, California permits for certain steel facilities require real-time emissions reporting to local air pollution control authorities.[33] Other states impose other additional requirements.[34]

An important feature of the CAA Title V permitting process is the periodic renewal of permits by the state, which typically occurs every five years. These permits may be renewed without modification, or State regulatory officials can use the renewal process as an opportunity to require changes in the permits to reflect new requirements. A renewed permit may therefore sometimes include stricter pollutant reduction targets on steel facilities in areas that are in excess of ambient air pollutant standards. For example, in a renewed permit for a facility of the United States Steel Corporation in Indiana, new requirements included the installation of additional equipment.[35]

Another important feature of the permit is that it may contain an overall limit on the total amount of pollutants that may be generated by the facility.[36] If additional production would result in pollution in excess of the amount authorized in the permit, the facility must either invest in more effective equipment that reduces the pollution it generates per ton of production, or it will have to forego the increased production.

c. Permits for New Facilities.

While on paper China, like the U.S., imposes additional permit requirements on newly-constructed facilities, the Chinese regulatory regime is not comparable to the U.S. regime. New facilities in the U.S. must undergo pre-construction review of the potential environmental impact of their operations. The new plant's owners must model air emissions to estimate the amount of pollutants that the plant could emit, the distances and locations those pollutants will be transported, and whether these emissions will significantly worsen the local area's NAAQ attainment. U.S. federal and state regulators analyze data from continuous emissions monitors and perform complex computer modeling to identify the most important sources of air pollution, and then develop regulatory regimes to control those sources. State regulators approve individual preconstruction and operating permits tailored to the specific steelmaking equipment and pollution control technologies at each steelmaking facility.[37] The state approves most permits only after input from the public about the terms that should be included in the permit. Finally, the necessary regulatory requirements are incorporated into the state implementation plans (SIPs) so that the states can achieve attainment of NAAQs.

Under the FWPCA, individual steel facilities' actual and potential discharges are calculated and modeled along with other industrial users' discharges, and the appropriate level of control technology and pretreatment is included in facility operating permits.[38] Furthermore, when U.S. publicly owned treatment works (POTWs) receive steelmaking water discharges, a detailed permit is negotiated with the POTW to ensure that a particular industrial user does not overtax or otherwise endanger the functioning of the POTW.

In China, the *Law of People's Republic of China on Environmental Impact Assessment* (EIA) mandates that projects with significant impact on the environment must conduct environmental impact assessments.[39] Article 13 of the *Iron and Steel Industry Development Policy* released by the National Development and Reform Commission (NDRC) further emphasizes that newly-constructed projects should "strictly follow the approved EIA reports and are prohibited from operating if their emissions exceeds environmental standards and total emissions control targets."[40]

Responsibility for acting on permit applications under this law is divided between the Ministry of Environmental Protection (MEP) and various levels of the Environmental Protection Bureaus (EPBs). The responsibility of the MEP includes reviewing and acting on permit applications of companies, including steel companies, owned by the central government. It also reviews and acts on permits in a region in which the central government has imposed regional permit restrictions for a limited period of time because of the region's major environmental problems. In well-publicized actions in early 2007, SEPA first used the regional permit restrictions to address problems in the steel, power generation, and a few other industries in particular areas, including Tangshan.[41] The permitting authority allows MEP and the EPBs, if they so choose, to condition issuance of new construction permits on the applicant remedying environmental violations at its existing facilities.

In recent years SEPA has tightened its review of permit applications for new construction. In 2006 it rejected around 110 projects because of their environmental impact, while in 2007 the agency rejected 187 projects.[42]

Overall, however, the enforcement of the EIA law is still uneven. Projects may submit impact assessments after construction has already begun or been completed.[43] Other industrial projects ignore the requirements altogether. In the case of Tangshan, for example, a 2007 investigation by SEPA revealed that 80 percent of its more than 70 steel companies had never undergone any environmental impact assessment.[44]

The "Three Simultaneous Steps" (*santongshi*) program mandated by the Management Measures on the Environmental Protection of Construction Projects further seeks to ensure that any construction of a new facility includes adequate pollution control equipment.[45] In addition to any requirements imposed under the EIA, this law requires that the design, construction, and operation of a new industrial enterprise (or an expansion of an existing facility) must be synchronized with the design, construction, and operation of its pollution control facilities. The operation of the pollution control facilities are required to be tested and approved by the EPB before the new facility is allowed to start production. If project operations begin without the approval from the local EPB, a penalty of up to 100,000 yuan (about $14,000) could be imposed.

However, a 2001 report by the Organisation for Economic Co-operation and Development (OECD) concluded that in many instances the sanctions have not been applied. Moreover, there are "many departures" from the above-mentioned procedures, especially by small companies.[46] At the same time, the report recognizes that the "Three Simultaneous" requirement has played an important role in stimulating investment in pollution-abatement facilities at industrial enterprises, especially at new factories.

2. Monitoring and Modeling Data.

The formulation and enforcement of environmental regulations benefit in crucial ways from accurate, complete and timely data. However, the monitoring of pollution data in China is less widespread than in the U.S., and this in turn prevents effective modeling to control the pollution.

a. Monitoring in the U.S.

State and local regulators in the U.S. continuously monitor ambient air quality, e.g. ozone "red alert" days, to determine how stationary and mobile sources of pollution are impacting air quality on specific dates and over time.

In addition, the gathering, transmission and disclosure of data by the facility, including steel plants, to public officials and their constituents is a key part of the U.S. air pollution regulatory regime.

The National Hazardous Pollutant Emissions Standards (NESHAPs) require various controls on emissions and mandate the kind of monitoring systems that must be installed to ensure compliance.[47]

Each state in its permit specifies the extent to which each steel mill must monitor emissions of non-hazardous criteria pollutants. The frequency varies according to the pollutant and the steelmaking process to which it applies. In the steel industry heavy reliance is placed on periodic and parametric monitoring, requiring monitoring on anywhere from a daily, weekly, monthly or yearly basis. Whatever the frequency, U.S. law requires that "each permit issued under [Title V] shall set forth…monitoring requirements to assure compliance with the permit terms and conditions."[48] For example, if a standard limits emissions of a pollutant to a certain amount *per day*, a standard that requires *annual* monitoring would not assure compliance with the standard and would be prohibited by law.[49]

There are several different technologies that steel facilities can use to ensure continuous compliance with emission standards, including Continuous Emissions Monitoring Systems (CEMs), Continuous Opacity Monitoring Systems (COMs), Continuous Parameter Monitoring Systems (CPMs), and Bag Leak Detection Systems.[50] The use of each of these technologies varies depending on the facility process in question and the pollutant which needs to be monitored. In each case emission monitors must be installed in each "emission unit."[51] The applicable permit specifies how the data must be maintained and reported.

The formulation and enforcement of environmental regulations benefit in crucial ways from accurate, complete and timely data. However, the monitoring of pollution data in China is less widespread than in the U.S., and this in turn prevents effective modeling to control the pollution.

"Continuous" measurements provide data under all operating conditions.[52] These data can be used both by the facility and by regulatory agencies and can be accessed by the public.[53] Because access to continuous monitoring data provides significant advantages to environmental control agencies and can help identify noncompliance, federal and state requirements for continuous monitoring have been steadily increasing since the 1970s.[54]

Detailed standards govern the use of each kind of continuous monitoring equipment a facility may use. A CEM system continuously measures the concentration of pollutants emitted into the atmosphere in exhaust gases from combustion or industrial processes.[55] One cycle of operation includes sampling, analyzing, and recording the data. It must be completed every 15 minutes for criteria and hazardous pollutants, except for opacity, which has a shorter cycle.[56] Like CEMs, COM systems are installed in a stack or duct and accumulate data on a pre-determined schedule, but they employ a shorter data collection interval than CEM systems and must take readings every ten seconds.[57] CPM systems measure variables such as pressure or temperature.[58] Baghouse leak detection systems are intended to continuously take readings on the structural integrity of the fabric dust collectors in baghouses over intervals ranging from five to fifteen seconds.[59]

Facilities negotiate in advance with environmental officials the exact use that will be made of monitoring equipment, and may agree to very stringent continuous monitoring requirements to expedite the permitting process. For example, some facilities may be required to have automatic cutoff systems that will stop the release of pollution if operating conditions deviate from established limits, or they may agree to real-time transfer of data to facility operators or environmental protection officials.[60]

b. Monitoring in China.

The Air Pollution Prevention Law mandates that the EPBs monitor ambient air quality in general.[61] As a result, local governments monitor ambient air quality and water quality in various parts of the country. As of 2006, there were 40 provincial monitoring stations, 396 municipal level monitoring stations and 1,886 country level monitoring stations.[62] The rules require that the EPB's monitoring stations prepare monthly briefings, as well as quarterly and annual reports, assessing environmental quality issues for submission to the appropriate EPB.[63]

The requirements applicable to the stationary source of pollution itself are for the most part very general and vague. Except for certain "key" facilities, there is no meaningful requirement that all industrial sources monitor their particular emissions on a regular basis. The Air Pollution Prevention Law does not require facilities to monitor their own pollutants. Moreover, the Measures for the Administration of Environmental Monitoring, dating from September 2007, state that "Pollution dischargers should conduct pollution self-monitoring in accordance with the requirements of government bodies responsible for environmental protection and national technical guidelines. If the pollution discharger does not have the capacity to conduct environmental monitoring, it should commission certified environmental monitoring bodies to conduct monitoring for it and it should bear all the costs."[64] Yet the "national technical guidelines" referenced in the provision do not provide specific requirements. The failure to establish any specific rules for monitoring, or sanctions for failing to do so, undermines the effectiveness of these 2007 Measures for the Administration of Environmental Monitoring.

There are no specific rules indicating how often a facility should monitor its emissions. According to one academic expert, no applicable document will specify in normal circumstances how many times per year the emissions must be monitored.[65] The lack of specificity about the monitoring requirements makes it difficulty to determine whether the facility is in compliance on a sustained basis. As a result, there is no assurance that the Chinese facility will remain in compliance on a sustained basis. In the view of the above expert this is an important difference from the requirements applicable to the U.S. steel industry. Facilities may monitor their emissions only when it is in compliance with applicable standards, or when inspectors are present.[66]

Enterprises indentified as "key" may be subject to somewhat more specific requirements to monitor emissions on a continuous basis. The Water Pollution Prevention Law stipulates that key enterprises (*zhongdian paiwu danwei*) should install monitoring equipment.[67] A 2005 regulation promulgated by SEPA (Measures on the Automatic Monitoring of Pollution Sources, *wuranyuan zidong jiankong guanli banfa*) seeks to implement this provision by specifying requirements for the installation and maintenance of continuous pollution monitoring equipment by these key enterprises.[68] The 2005 rule does not state how frequently the key enterprises subject to the law should take samples to comply with the requirement for continuous monitoring.

Therefore, even if a steel facility is identified as a key enterprise for these purposes, it is not clear what effect the 2005 measure would actually have on the amount of monitoring that facility performs. In addition, the regulation gives local environmental protection bureaus discretion in identifying which key enterprises will be subject to the requirements, based on their "capability" to install the equipment.[69] Under such provisions, a number of steel facilities, especially smaller ones with limited resources are likely to be exempted from having to install any continuous monitoring equipment.

Monitoring standards contained in guidelines applicable to steel facilities, "Testing Protocol for Soot Emission of Boilers" (GB5468-91), fail to address some of the key technical issues such as the temperature at which the test should be operated, or in the case of basic oxygen furnaces (BOFs) the point in the process that the sample is taken, even though in the case of particulate matter (PM) that will have a significant effect on amount of PM caught.[70]

Besides the absence of any specific provision requiring facilities to monitor their emissions on a continuous basis, steel companies in China may not employ such equipment because of the expense of purchasing and maintaining it. Local environmental bureaus generally do not have adequate resources to assist companies in purchasing the monitoring equipment, and Chinese companies have been reluctant to acquire and operate the monitoring equipment, especially medium to small companies and those in the country's less developed regions.[71]

Nevertheless, some areas of China have progressed further with respect to monitoring requirements than other parts of the country. In Jiangsu province a pilot program is underway to encourage installation of equipment to monitor sulfur dioxide (SO_2) emissions from electric utility plants. Under the program, the plant is required to purchase and maintain the equipment. In addition to this, the Jiangsu provincial government has invested about 5 million RPB (about $714,285) to build a system that would enable provincial officials to receive the monitoring data automatically. The data obtained through this method will be compared to the data collected by inspectors sent to the same facilities. To date 33 continuous monitoring systems have been installed.[72]

Overall, however, continuous monitoring systems are not in place at most industrial facilities in China except for a few major ones in big cities, such as Beijing, and a few provinces such as Jiangsu. Even in Beijing and Jiangsu, continuous monitoring is largely confined to the utility sector.

Even for those facilities that have installed continuous monitoring systems, the proper maintenance of the equipment can be a challenge. A survey of such monitoring equipment in the Chinese utility industry found that 45 percent were either operating improperly or were not operating at all. Only 41 percent could display monitoring data.[73]

Such poor performance of continuous monitoring systems can be attributed in part to a lack of proper maintenance and technical knowledge. As will be discussed in Chapter V, this is part of a more general problem: most Chinese companies have not yet devoted the resources necessary to operate and maintain in good working order pollution control or pollution monitoring equipment. The problem is particularly acute for technology such as some forms of CEMs that may be complex and require particular expertise. In addition, the high-humidity, high-soot-content (150-200 mg/m^3) of the emissions at many Chinese facilities can seriously impede the functioning of such monitoring equipment. These systems work best when soot emission levels are lower than 50 mg/m^3, as they are in the U.S.[74]

If the monitoring equipment is either not installed or not properly operated and maintained, then the nature and duration of Chinese steel plant air emissions are simply unknown. This makes it difficult to adopt meaningful standards. It also makes enforcement of standards difficult, as will be discussed in Chapter VI.

3. Obstacles to China using effective ambient standards to overcome the limitations of its "concentration" standards.

China's pollution regime focuses heavily on regulating the concentration of pollutants from a specific outlet, e.g. a smokestack or wastewater pipe. Under this approach, however, even if all the facilities follow the concentration limits, the total amount of the pollutants may still be large enough to severely deteriorate the ambient quality of air and water. Reliance on concentration limits can lead facilities to take measures to reduce the concentration of the pollutant without reducing total emissions or discharges. For example, facilities may dilute wastewater with uncontaminated water before discharging the wastewater.[75]

The U.S. system deploys a more comprehensive set of controls, including limitations on emissions discharged per ton of product, hourly rates of emissions and monthly average emissions levels, so that industrial facilities are obliged to invest more resources in keeping overall pollution levels constantly low over time, rather than simply reducing the concentration levels of pollutants. For example, the Integrated Iron and Steel NESHAP, whose standards will be described in detail in Chapter IV, not only sets concentration limits for PM emissions (pollutant in terms of grain/dry standard cubic foot), but also other forms of limits such as emission intensity (pollutant in terms of lb/ton of product) and opacity requirements. If the amount of pollution permitted by ton of product is limited, a steel mill can not increase total emissions by diluting the concentration of the emissions. With respect to the development of stacks, Section 123 of the CAA explicitly limits the way in which utilities and other industrial sources of pollution construct tall stacks to control emissions. The law makes it clear that air dispersion technology is not an acceptable way of satisfying SIP emissions limits.[76]

China has begun to address the limitations of relying upon concentration standards in its Pollutant Total Amount Control program (*zongliang kongzhi*).[77] The program seeks to ensure ambient quality improvement by reducing the total amount of key pollutants emitted or discharged nationwide, and then allocating individual quotas to sources throughout the country.

In China, as earlier in the U.S., the first major focus of pollution reductions from stationary sources has been on acid-rain causing SO_2 emissions. In the Tenth Five Year Plan, covering the years 2001-2005, the target for nationwide annual SO_2 emissions was established at 18 million tons for the year 2005. This figure represented a 10 percent reduction from the 2000 level.[78] To implement the program Chinese regulators must allocate a portion of the total target to each of the 32 provinces, directly controlled municipalities and autonomous regions that are essentially administrative regions. These large regions do not necessarily have the same pollutant levels within their boundaries. The allocations are in turn assigned to individual facilities within the region by local governments.[79]

In adopting its nationwide goal for total SO_2 tonnages and then allocating it across the country, Chinese regulators face a number of particularly large obstacles that undermine the effectiveness of the SO_2 control program. As discussed previously, China lacks accurate monitoring data of actual emissions from industrial sources. As a result, the Chinese regulators often have to depend on self-reported emissions estimates from companies in calculating their control targets.[80] Chinese researchers have pointed out that insufficient monitoring and lack of actual emissions data for facilities have made it difficult to calculate an accurate baseline for total emissions control targets.[81] In the absence of this baseline information regulators are unable to accurately model the existing SO_2 emissions, or to determine what effect would be achieved from certain specific reductions in facilities and regions throughout the country. Without such models concentration-based emissions standards may not improve ambient air quality.[82]

By way of comparison, in the U.S. federal and state regulators perform complex region-by-region computer modeling to identify the most important sources of air pollutants and to develop ambient air programs to control these sources. This work enables regulators to make informed judgments on the measures needed to bring each criteria pollutant in each region within the prescribed limits established under the CAA. The results are incorporated into the SIPs and implemented by the states.

As part of this program the Environmental Protection Agency (EPA) has designated 247 separate air quality control regions, compared to the 32 regions in China. Geographic boundaries have been established for the U.S. regions after modeling the criteria pollutants, so that ambient pollution levels for each criteria pollutant within individual regions are relatively uniform.[83] This enables accurate judgments to be made about attainment or non-attainment levels for each air quality control region.

4. The Discharge Fee System in China.

In China, industrial facilities can pay for the right to continue to pollute up to certain levels by paying discharge fees. This is separate from the more limited system of operating permits discussed above. In the U.S. states charge administrative fees in connection with the issuance of permits, but such fees are not of significant size, and they are not used as an enforcement tool. Instead, U.S. regulations require companies to pay for pollution control technology to prevent emissions of the pollutant in the first place.

The original aim of the Chinese system was to internalize the cost of pollution that the polluters impose on the society, thereby providing an incentive for them to invest more in pollution control equipment. The system has existed since the late 1970s and has undergone significant changes in key aspects such as the rate of fees, the threshold for levying fees, the method of collection, and the use of fees collected. The basic idea, however, remains the same: require polluters to pay for their actions so that they will have the economic incentive to invest in pollution reduction and to acquire pollution control technologies.

In reality the discharge fee system may not reduce pollution in many cases, for it can actually encourage the polluters to pay for the right to pollute. The central government in 2003 increased the discharge fees, but as discussed below some of the weaknesses of the pre-2003 system remain. Prior to 2003, senior Chinese environmental officials observed that the system may have actually encouraged higher emissions.[84] This is largely due to the serious structural flaws, which scholars have termed "irrationalities" in the fee system.[85] The first irrationality is the amount of the fee, which may be set "far lower than the cost of pollution control equipment, even lower than the operating cost of the equipment."[86] In some cases, the fee is only 50 percent of the operating cost of the pollution control equipment. This discourages polluters from buying pollution control equipment or operating any controls they may have. For example, an EPB official in Wuhan, Hubei noted that many polluters in his city prefer to pay the fee rather than operate their pollution control equipment because the fees cost only half as much.[87]

Another irrationality is the restriction of the fee to a very limited set of pollutants, rather than all the pollutants from a specific facility, thus discouraging companies from controlling emissions of secondary pollutants. Originally, the fee focused only on the single pollutant from a specific outlet; e.g. SO_2 from a smokestack, which had the highest rate of discharge. This discharge rate, known as "the emissions factor," is calculated for each pollutant based on the amount and type of that pollutant. The pollutant with the second highest emissions factor; e.g. nitrogen oxides (NO_X), was excluded from the imposition of fees. Thus, if a smokestack emits SO_2, NO_X and carbon monoxides (CO) at the same time, with SO_2 having the highest "emissions factor," only SO_2 emissions were considered in the levying of the discharge fee.[88]

In 2003, these rules were changed to improve several aspects of the discharge fee system. For instance, the new rules impose fees on each of the three pollutants with the highest emissions. Pollutants that are not ranked among the top three are still not addressed. Furthermore, while originally only discharges that exceeded air emissions or water discharge standards were subject to a fee, a new system now charges facilities for the total amount of emissions.[89] These pollutant-specific discharge fees are calculated based on both the total amount of discharge and the degree to which each discharge exceeds the applicable concentration standard.

Although the 2003 changes improved the discharge fee system, problems remain. One persistent issue is the relatively low level of the fees. The new rules raised the level of fees, but they are "still significantly lower than the cost of pollution reduction."[90] Also, collection of all the fees may not occur. One professor who is an expert in China's environmental laws estimates that the total amount actually collected throughout the country for *all* pollutants (air, water, solid waste and noise) was less than what he estimated should be collected for SO_2 and CO emissions alone. He indicated that local government officials do not want to collect too much money for fear of the adverse effect this would have on the local economy.[91] The central government itself has reported that it typically collects about 30 percent of the total fees actually owed.[92]

The following examples reflect the general pattern of discharge fees now paid by the steel industry, as they include different provinces and steel companies ranging from 20 million tons per year production to much smaller operations.

- In 2007, Baosteel (China's largest steel company, with 2007 crude steel output of 28.6 million tons) was charged 36,137,193.00 yuan (about $5 million) in discharge fees, which amounts to 1.26 yuan per ton of steel (18 cents per ton).[93]

- In 2006, Wuhan Steel (China fifth-largest steel company, with 2006 crude steel output of 13.76 million tons) was charged 40,199,663.40 yuan (about $5.7 million) in discharge fees, which amounts to 2.92 yuan per ton of steel (42 cents per ton). [94]

- In 2006, Hangzhou Steel (a medium-sized steel company, with 2006 crude steel output of 3.32 million tons) was charged 5,504,160.00 yuan (about $0.8 million) in discharge fees, which amounts to 1.66 yuan per ton of steel (24 cents per ton). [95]

- In 2006, Suzhou Steel (a small steel company, with 2006 crude steel output of 1.09 million tons) was charged 7,550,525.00 yuan (about $1 million) in discharge fees, which amounts to 6.93 yuan per ton of steel ($1 per ton).[96]

In reality the discharge fee system may not reduce pollution in many cases, for it can actually encourage the polluters to pay for the right to pollute.

The numbers suggest that no direct relationship may exist between the discharge fee paid and the size of a company's operations. While more production can potentially increase total emissions, the larger steel mills are more likely to have more advanced pollution control technology. As a result, the largest mills had some of the lowest costs per ton for discharge fees, while some of the smaller mills paid the highest discharge fees per ton of steel.

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- Emission Standard of Air Pollutants for Coke Ovens (GB16171-1996)
- Emission Standard of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers (GB13271-2001)
- Discharge Standard of Water Pollutants for Iron and Steel Industry (GB13456-92)
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Chapter IV: Pollution Control Standards and Emissions in China

On January 12, 2007, nearly three years after "Hurricane Pan's" first press conference, a group of Chinese journalists accompanied SEPA inspectors to Baoye Steel in Tangshan.[1] *They wanted to see firsthand how Pan's enforcement action was going.*

"People were busy, metals were hot, dust and soot were all over the sky," one journalist later wrote.

Government inspectors conducted on-the-spot tests of air quality. It took only a few minutes. Not surprisingly, the tests yielded very clear results: the steel company's emissions of some very dangerous chemicals far exceeded China's national standards. The test was simple and straightforward, and the numbers were clear and unambiguous.

When told about these results a few minutes later, the head of the company sighed. Smoke from his factory billowed out behind him and a tinge of chemicals burned into his nose as he breathed. "Those test results cannot be right," he calmly told the inspectors. "All our operations meet the emissions standards."

The Chinese central government acknowledges that a significant upgrade of air and water pollution standards for the steel industry is needed. These standards have not been upgraded since the water pollution effluent standards for steel were established in 1992, and air pollution emission standards for coke ovens and industrial furnaces in general were adopted in 1996. As discussed in Chapter II, the Chinese government in September 2007 circulated for comment a set of proposed new emissions/effluent standards for the Chinese steel industry. This proposal applies only to the steel industry, rather than to coke ovens and industrial furnaces generally, and contains new standards for only some pollutants addressed in the 1996 standards. The 1996 standards would continue to apply to the steel industry with respect to the other pollutants not addressed in the proposed new standards.

Three major Chinese companies associated with the steel industry, Anshan Steel (now part of Anben Steel), Baosteel, and Sinosteel, participated actively in the drafting of the proposed new steel standards.[2] To date, there is no indication when these proposed regulations will be promulgated. Until the new standards are adopted, the current pollution-control standards for the Chinese steel industry remain in effect.

This chapter first compares the standards of the Chinese central government for hazardous air emissions from steel mills to those in the U.S., and the separate standards for cokemaking. It then compares the following standards in the two countries: (i) emissions into the air for other pollutants, (ii) discharge of pollutants into the water, and (iii) disposal of solid wastes. As detailed below, the review indicates that the Chinese standards currently in place regulate fewer pollutants, and are in most instances less stringent than comparable U.S. air and water standards. If the proposed new air standards are adopted in China, a significant gap is likely to remain between U.S. and Chinese air standards. For the reasons discussed below, the comparison between the proposed new Chinese water standards and the existing U.S. standards is more difficult to assess, but it seems likely that a gap will still remain even if the new water discharge standards are adopted and enforced. The chapter concludes with a discussion of the role of the steel industry in both countries in emitting greenhouse gases (GHGs).

dreamstime

Steel plant in China.

1. Regulation of Hazardous Air Emissions in the U.S.

In the 1960s and 1970s, scientists around the world began to document how exposure to a wide variety of industrial pollutants could have significant adverse effects on human health and the environment. Extensive studies were done by U.S. governmental and nongovernmental research institutions to show the pathways by which humans are exposed to air pollutants, and to assess the health risks from these pathways.[3] For example, high levels of particulate matter (PM) can cause respiratory illness and death, especially in sensitive populations such as the young and old. The health effects of metal and volatile organic compounds that are identified with steel-related pollutants include "chronic and acute disorders of the blood, heart, kidneys, reproductive system, and central nervous system."[4]

In the 1970 revisions to the Clean Air Act (CAA), Congress mandated emissions limits on hazardous air pollutants to protect the public health "with an adequate margin of safety," but relatively few pollutants were identified and regulated by the Environmental Protection Agency (EPA) at that time.[5] Also in the 1970 Act, Congress required that EPA develop national emissions standards for hazardous air pollutants (NESHAPs). In the 1990 amendments to the CAA, Congress enacted a list of 188 airborne chemical compounds that it deemed to be toxic or hazardous, and directed EPA to take specific steps to address emissions containing these "air toxics."[6]

Following the 1990 amendments, EPA began studying the steel industry's air emissions, and started developing NESHAPs that would govern both basic oxygen furnaces (BOFs) and electric arc furnaces (EAFs) steelmaking. These programs complemented and paralleled the development of pollution control programs for nonhazardous "criteria" pollutants discussed below.[7]

EPA produced a "profile" of the steelmaking industry in 1995 that listed and analyzed the most common hazardous emissions from the various stages of the steelmaking process.[8] The focus has been on metals and volatile organic compounds that present health and environmental risks. Examples of hazardous pollutants that can be associated with steelmaking include hydrochloric acid, nickel compounds, manganese compounds, hydrogen fluoride, xylene, toluene, lead compounds, benzene, cyanide compounds, chlorine, and ethylene glycol. Starting in 2001, EPA proposed a series of NESHAPs to cover all of the major sources of HAPs in steelmaking, and between 2003 and 2006 EPA formally adopted the NESHAPs governing all major elements of the steelmaking process.[9] Restrictions on the emissions of particulate matter (PM) is a key part of the NESHAPs, as it provides a way to control some of the metallic particulates associated with steelmaking, but separate standards govern other pollutants as well. PM emissions may also be subject to additional restrictions under each state's program to control ambient air conditions.[10]

The next section of this chapter analyses the important hazardous pollutants that are regulated by both the U.S. and proposed Chinese standards directed specifically at the iron and steel making industry. It therefore does not address the differences that may exist between the U.S. and Chinese standards for other hazardous pollutants identified by EPA.[11]

2. Comparison of Standards and Emission Levels for Hazardous Pollutants.

In most stages in the steelmaking process—sintering, ironmaking (blast furnaces), steelmaking and pickling—some key Chinese and U.S. standards for hazardous pollutants can be directly compared, although the two countries do not regulate all the same pollutants at each stage.[12] Where there exist comparable U.S. and Chinese standards the charts below identify the current NESHAPs in the U.S., the current emissions standard in China, and the emissions standard that would take effect if China adopted the new standards currently proposed. The comparisons of U.S. and Chinese emissions standards in the charts are taken directly from the comments large steel companies filed on the proposed changes to the applicable standards.[13]

The key points from these charts are:

- Present Chinese emissions standards are significantly less stringent than U.S. standards. China's proposed new emissions standards—with a few exceptions—continue this pattern.

- The present Chinese standards contain no detailed requirements for continuous or periodic monitoring, even though such monitoring has been an essential element of U.S. air pollution programs since the 1980s. U.S. standards are built around detailed monitoring requirements, including the installment and operation of continuous parameter monitoring systems (CPMs) or leak detection systems. The proposed Chinese standard tries to address the problem by requiring new facilities to install continuous monitoring equipment following the 2005 *Measures on the Automatic Monitoring of Pollution Sources*.

- Neither China's current nor proposed rules governing hazardous emissions impose any requirements for testing the performance of pollution control equipment and related monitoring systems. The U.S. NESHAPs require steel industry companies to report emissions and conduct regular performance tests to assure regulators that emissions control technologies and monitoring equipment are working properly. The U.S. steel industry has been subject to performance testing since the introduction of New Source Performance Standards (NSPS) for BOFs and EAFs in the 1980s.

- Data on plant emissions and testing is provided to the EPA and the public to allow for transparency in the NESHAP process. Chinese steel mills are not subject to comparable requirements, except perhaps to test, on a one-time basis, the performance of new pollution control equipment in new facilities.

a. Agglomerating (Pelletizing and Sintering).

Pelletizing and Sintering[14] convert iron ore and other iron-rich materials into an agglomerated product that is ready for the blast furnace. This process generates emissions of PM mostly from raw material handling, windbox exhaust, sinter discharge ends and the sinter cooler.[15] The following chart compares current PM emissions standards that are applicable to the sintering stage in the U.S. and China, along with the changes that would take place if new PM standards applicable to sintering were adopted in

China.[16] For comparison purposes, the concentration limits in the NESHAPs (in the form of "grain/dry standard cubic foot" or "gr/dscf") have been converted to "milligram/cubic meter" (mg/m^3), the measuring standard used by Chinese regulators:

Comparison of PM emissions standards (Unit: mg/m^3)				
PM Emissions Limitations		U.S. NESHAP	China (Current)[17]	China (Proposed)[18]
Sinter Machine	Existing	45.8 (discharge end)	150	90
	New	22.9 (discharge end)	100	50
Other processes in agglomerating	Existing	18.3 (ore crushing, handling, finished pellet handling)	150	70
	New	11.5 (ore crushing, handling, finished pellet handling) 22.9 (sinter cooler)	120	30
Opacity Requirement		Yes	No	No
Monitoring Requirements		CPMS; Bag leak detection system or COMS;	No	New facilities are required to install continuous monitoring equipment
Reporting Requirements		Compliance Reports	No	No
Performance Test Requirements		No less than twice during each term of title V permit	No	No

As the chart demonstrates, Chinese steel producers are currently subject to less stringent PM emissions controls on sintering than are their U.S. counterparts. Current Chinese concentration limits for PM emissions from existing sinter machines, for example, are around three times greater than those found in the U.S. NESHAPs, and around five times greater in the case of new sinter machines.

Actual emissions from steel plants reflect what the regulatory standards require. Even the most advanced steel mills in China emit PM at far higher levels of concentration than their U.S. counterparts. According to a nationwide survey of large-medium sized Chinese steel companies (involving 137 samples from 25 facilities),[19] the average PM emissions level from sinter machines is 131.5 mg/m^3, which is almost three times the U.S. limit for existing sinter machines and six times the limit for new machines. The same survey shows that the average PM emissions level of sinter machines at Anshan Steel (part of Anben Steel, the second largest steel company in China,) reached 109.2 mg/m^3. Such a level would exceed the U.S. standard for existing facilities by more than 100 percent.

b. Ironmaking (Blast Furnaces).

Sintered materials are fed into blast furnaces where iron oxides in the ore are converted into iron with the help of high temperature gases containing carbon monoxide (CO). Blast furnaces generate significant amounts of PM, which is usually emitted during tapping, a process in which molten iron and slag are removed from the furnace.[20] In modern U.S. facilities, the PM emissions are captured, usually in baghouses. The following chart compares current PM emissions standards that are applicable to ironmaking in the U.S. and China,[21] along with the changes that would go into effect if China adopted its new PM standards:

Comparison of PM Emissions Standards (Unit: mg/m^3)				
PM Emissions Limitations		U.S. NESHAP	China (Current)[22]	China (Proposed)[23]
Casthouse	Existing Facility	22.9	150	100
	New Facility	6.9	100	30
Raw Material Preparation	Existing Facility	18.3(ore crushing, handling, finished pellet handling)	150	60
	New Facility	11.5(ore crushing, handling, finished pellet handling)	120	30
Opacity Requirements		Yes	No	No
Monitoring Requirements		CPMS; Bag leak detection system or COMS;	No	New facilities are required to install continuous monitoring equipment
Reporting Requirements		Compliance Report	No	No
Performance Test Requirements		No less than twice during each term of title V permit (for devices with non-baghouse control) No less than once during each term of title V permit (for baghouse controlled device)	No	No

For existing facilities, the current U.S. standard is more than six times as stringent as the Chinese standard, and more than 14 times as stringent in the case of new facilities. If the proposed new Chinese emissions limitations are adopted, the U.S. standard would still be more than four times as stringent.

Actual emissions concentration levels from the ironmaking process are significantly higher in China than in the U.S. Data collected from 14 large-medium sized Chinese steel companies show that the average PM emissions level from baghouses applied to the casthouses is 50.04mg/m3, and emissions from electrostatic precipitators exceed 106mg/m3.[24] These levels are several times higher that the levels permitted under U.S. law. In some cases, PM emissions from the casthouse reach 180mg/m3 (Xuanhua Steel), a figure that is almost eight times the U.S. limit for existing sources and twenty-five times the U.S. limit for new sources.

Modern baghouse technologies can maintain PM emissions levels at very low levels for casthouses, as reflected in the U.S. standards, but the current Chinese standard only requires a PM control level between 100-150mg/m3.[25] With these standards, Chinese companies have little incentive to acquire expensive pollution control equipment. Even at Chinese steel mills with PM control technologies, filters and broken bags are often not changed and leaking bag junctions are not fixed because of the weaker standards.[26] There is little reason for Chinese steel mills to stop operations and make expensive repairs when a Chinese steel mill's PM emissions are within existing PM standards.

c. Steelmaking.

Pig iron from blast furnaces is refined in BOFs using high purity oxygen blown into the BOF to produce steel with a desired carbon content and temperature. Significant PM emissions occur during oxygen blowing. The charging, tapping and hot metal transfer processes are also sources of PM emissions.[27] This chart compares current PM emissions standards applicable to the steelmaking stage in the U.S. and China, along with the changes that would take place if new PM standards applicable to steelmaking were adopted in China.[28] The chart distinguishes between "primary" and "secondary" emissions for BOF furnaces.[29] It also compares the separate emissions standards applicable to EAFs, since the standards apply at the steelmaking stage to EAFs even though the earlier iron making and sintering standards are not applicable to the EAF process.[30]

Comparison of PM Emissions Standards (Unit: mg/m³)				
PM Emissions Limits		U.S. NESHAP	China (Current)[31]	China (Proposed)[32]
Hot metal transfer, skimming, and desulphurization operation)	Existing	22.9	150	35
	New	6.9	100	20
BOF Primary Emissions	Existing	68.7 (closed hood) 45.8 (open hood)	150	100
	New	68.7 (closed hood) 22.9 (open hood)	100	80
BOF Secondary Emissions	Existing	22.9	150	35
	New	11.9	100	20
EAF Emissions	Existing	11.5	200	35
	New	11.5[33]	150	20
Tundish	Existing	22.9 (pouring station)	150	35
	New	4.6 (pouring station)	120	20
Opacity Requirements		Yes	No	No
Monitoring Requirements		CPMS; Bag leak detection system or COMS;	No	New facilities are required to install continuous monitoring equipment
Reporting Requirements		Compliance Report	No	No
Performance Test Requirements		No less than twice During each term of title V permit, no less than twice for devices without baghouse control and no less than once for baghouse controlled devices.	No	No

As the chart shows, the current Chinese standard for steelmaking is less than half as stringent as its U.S. counterpart in terms of primary emissions limitations for existing BOFs for closed hood, and less than one-third as stringent for open hood. For EAFs, the current Chinese emissions standard allows more than 17 times the emissions that are permitted by the U.S. standard. Although the Chinese proposal would substantially increase the stringency of the standards, they would still be around two to three times less stringent than the U.S. standard for EAF emissions. In the meantime, actual emissions levels in China at the steelmaking stage reflect the less stringent Chinese standards now in effect. A nationwide survey of large-medium sized Chinese steel companies (involving 16 companies, 41 samples) showed that some of the steel companies (e.g. Nanjing Steel) had a BOF primary emissions level as high as the permitted maximum levels of 150mg/m^3.[34]

d. Pickling.

Pickling is an important part of the forming and finishing process after hot metal from the BOF or EAF furnaces have completed casting. Acid pickling often involves hydrochloric, sulfuric, and combination acid pickling operations to remove oxide scale; hydrochloric pickling is the most common. Stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids or a combination of acids. Alkaline cleaners may also be used to remove mineral oils, grease, and animal fats and oil (used in some rolling solutions) from the steel surface prior to cold rolling.[35]

Hydrochloric acid (HCl) emissions, usually in the form of mist, are significant sources of air pollution from the pickling process. The following chart compares current emissions standards that are applicable to pickling in the U.S. and China, along with the changes that would take place if new standards for pickling were adopted in China:[36]

Comparison of HCl Emissions Standards (Unit: mg/m^3)				
HCl Emissions Limits		U.S. NESHAP	China (Current)[37]	China (Proposed)[38]
HCl (Pickling lines)	Existing	27.3	150	20
	New	9.10 (Continuous) 27.3 (Batch)	100	10
HCl (Hydrochloric acid regeneration plants)	Existing	37.9	150	50
	New	18.2	100	30
Monitoring Requirements		For wet scrubbers: systems for the measurement and recording of the scrubber makeup water flow rate and, if required, recirculation water flow rate For non-wet scrubbers: systems for the measurement and recording of the appropriate operating parameters	No	New facilities are required to install continuous monitoring equipment
Reporting Requirement		Reporting results of performance tests Progress reports Periodic startup, shutdown, and malfunction reports	No	No
Performance Test Requirement		Yes	No	No

As the chart demonstrates, current Chinese standards for HCl emissions are four to eleven times more lenient than the U.S. limits. Moreover, there are no monitoring, reporting and performance testing requirement that are specific to the pickling process. By contrast, the U.S. industry is subject to much tighter regulatory controls specifically tailored to the pickling process.[39]

e. Cokemaking.

Cokemaking is a key step in the BOF steelmaking process. Coal is heated to high temperatures in an oxygen-deficient atmosphere to remove the volatile components. The product, coke, is then used in blast furnaces to provide the source of carbon to reduce iron ore to iron and to facilitate the free flow of gases within the furnace shaft.[40]

The Chinese central government acknowledges that a significant upgrade of air and water pollution standards for the steel industry is needed. These standards have not been upgraded since the water pollution effluent standards for steel were established in 1992, and air pollution emission standards for coke ovens and industrial furnaces in general were adopted in 1996.

Cokemaking is "one of the steel industry's areas of greatest environmental concern."[41] Coke oven emissions, mainly including PM, volatile organics compounds (VOCs), and CO are generated by different operations such as charging, pushing, quenching, combustion and purifying.

The new proposed emissions standards for the steel industry in China do not include a standard for cokemaking, and as a result the separate standards that now apply to steelmaking and cokemaking in all other industries would continue to apply. The MEP has been considering changes to the standards governing cokemaking in the steel industry and all other industries since 2004, when it assigned responsibility for researching the matter to the Shan Xi Research Academy of Environmental Science. To date, however, no proposed changes to the standard have been proposed.[42]

There is no accurate way to quantitatively compare the Chinese standards for cokemaking to the U.S. standards, as the two countries essentially regulate different emissions. Current Chinese emissions standards regulate fugitive emissions at the top of the ovens, with different standards established for "machinery" coke ovens and "non-machinery" coke ovens.[43] Although measuring fugitive emissions from the top of the ovens is only an indirect way to measure emissions, the Chinese standards take this approach because many Chinese coke ovens lack ground-level dust control facilities.

Beginning in 2005, Chinese standards included the requirement that newly constructed cokemaking facilities should install ground level pollution control devices. But the same document states that such new cokemaking facilities should still follow the emissions standards applicable to existing facilities discussed above, so the effect of the new requirement is unclear.[44]

In contrast, U.S. regulators have set more precise emissions limits based on emissions from the control devices at the ground level.[45] On their face, the maximum permissible levels in the Chinese standards appear more stringent than the U.S. maximums, but this is because fugitive concentrations at the top of the oven that the Chinese standard measures are naturally lower. Consequently, the numbers in the standards of the two countries cannot be compared to each other in a meaningful way.

Despite the inability to compare the numerical standards adopted by the U.S. and China, U.S. standards for coke ovens contain a number of requirements that are not applicable to coke ovens in China. The Coke Oven Batteries NESHAP,[46] the Coke Ovens Pushing, Quenching and Battery Stacks NESHAP,[47] and the NESHAP for Benzene Emissions from Coke Byproduct Recovery Plans,[48] have had a significant impact on cokemaking. In a negotiated settlement with EPA, the steel industry "agreed to daily monitoring, installation of flare systems to control upset events, and the development of work practice plans to minimize emissions in exchange for some flexibility in how the industry demonstrates compliance."[49]

The U.S. standards set detailed emissions limits for coke oven doors, topside port lids, offtake systems and charging operations; process vessels, storage tanks, and tar-intercepting sumps; capture systems and control devices applied to pushing; and battery stacks and quenching. The NESHAPs set federal emissions limits on PM during the coal charging and pushing phases of cokemaking. They limit the total dissolved solids (TDS) in the water used for quenching. They also require that benzene, benzo(a) pyrene, and naphthalene in the water used for quenching not exceed the applicable site-specific limit approved by the permitting authority. U.S. work-practice standards also mandate proper operational procedures to restrict emissions from coke ovens, as well as fugitive emissions from the pushing and soaking phases.

In contrast, the current Chinese standard only sets concentration limits.

3. Comparison of Standards and Emissions for Sulfur Dioxide (SO_2) and Nitrogen Oxides (NO_x).

In addition to the NESHAPs requirements, Congress specified in 1970 the health and environmental criteria that EPA was to use in identifying and regulating the six most important non-hazardous air pollutants. These six "criteria" air pollutants are SO_2, NO_X, PM, lead, ozone and carbon monoxide (CO). EPA was required to establish National Ambient Air Quality Standards (NAAQS), attainment of which would be accomplished through State Implementation Plans (SIPs).[50]

U.S. law has progressively strengthened emissions controls on non-hazardous criteria air pollutants. Steel facilities may be regulated for both hazardous pollutants under NESHAPs and for criteria pollutants through operating permits, which are issued to individual steel facilities by state environmental authorities as part of the CAA's SIP process. These operating permits often specify emissions rates/limits (usually in the form of lb/hour) set for each of the relevant criteria pollutants (most commonly NOx, SO_2 and PM), and they tend to be more stringent in areas that are having trouble attaining the national ambient air quality standards. For example, a permit for a steel mill in a non-attainment area may require the control of NO_x emissions through the use of low NO_x burners in the BOF and other technology to control NOx emissions in the sintering stage.

New or modified steel facilities that produce more than 100 tons of criteria pollutants annually are regulated pursuant to the industry specific criteria developed under the NSPS program.[51] The steel industry NSPS imposed a new set of more stringent PM and opacity requirements than previously existed for new and modified major sources. Also, new and modified sources that cause a significant increase of net emissions of a regulated criteria pollutant trigger New Source Review obligations that require the installation of state of the art emissions control technology.

In China, authorities rely on a "Pollutant Total Amount Control" system for major pollutants such as SO_2 in an effort to control ambient air quality, but it is not combined with strict enforcement mechanisms.[52] As discussed in Chapter III, this system to protect ambient air quality is ineffective due in part to the lack of modeling and accurate monitoring data at the level of the specific facility. Its enforcement also suffers from insufficient legal basis in national laws and insufficient penalties for violations of the targets.

While the U.S. establishes requirements in permits for the use of certain technology to control criteria pollutants, the Chinese rely on concentration limits, rather than specific technologies. This makes direct comparisons with the U.S. difficult. In practice, the Chinese pollution concentration limits now in place appear to have little effect on the steel industry. Indeed, the explanation of the proposed emissions standards openly acknowledges that the current Chinese standard governing SO_2 emissions at the sintering stage is seriously insufficient. The domestic industry's average SO_2 emissions level at this stage is around 880mg/m^3, while the current standard sets a limit between 1430-4300mg/m^3, which means that most of the Chinese steel companies do not have to purchase any new pollution control technology to comply with the standard.[53] This is true even though sintering is the biggest source of SO_2 emissions from the Chinese steel industry.[54]

The only limit on NO_X in current Chinese emissions standards is for certain boilers in all industries. These standards, which are not specific to the steel industry, set a concentration limit of 400mg/m^3 for NOx from oil-burning and gas-burning boilers, but there are no concentration limits applicable to the coal-burning boilers that are used in many steel mills in China.[55]

The proposed emission standards under consideration do contain NOx concentration limits for boilers used in iron making and for sinter machines. For boilers, the proposed NOx concentration limit would be 350mg/m^3 for both existing and new facilities; for sinter machines, the proposed NOx concentration limit is 500mg/m^3 for existing facilities and 300mg/m^3 for new facilities.[56] However, in setting concentration limits for NO_X emissions, the drafters of the proposed standards noted that it is difficult to create a meaningful standard because there is a very limited amount of emissions data to rely upon. This is because many Chinese steel companies do not monitor emissions of NO_X, so no accurate inventory of emissions is available upon which a regulatory program could be developed and enforced.[57]

The absence of meaningful emissions limitations to date for non-hazardous pollutants has resulted in high levels of emissions of SO_2 and NO_X from the Chinese steel industry. Estimates of total SO_2 emissions from all sources in 2005 increased by 27.8 percent from the 2000 level.[58] In 2006 the steel industry emitted an estimated 1.49 million tons of SO_2, which was 7.3 percent of the country's total industrial SO_2 emissions that year—making the industry one of the three most significant overall contributors to China's SO_2 emissions. Chinese steel's SO_2 emissions increased by an estimated 10.4 percent from the prior year.[59] Using the industry's 2006 crude steel output (422.6 million tons), the industry emitted 3.53 kg of SO_2 per ton of steel production. The Chinese industry also emitted 0.8 million tons of NO_X (7.1 percent of national emissions), resulting in NO_X emissions of 1.89 kg/ton of steel.[60]

Present Chinese emissions standards are significantly less stringent than U.S. standards.

There is evidence that some of the larger enterprises have significantly reduced their emissions of SO_2 and other pollutants, while emissions from other steel mills have worsened. According to the China Iron and Steel Association, between 2000 and 2006 a limited number of "key large and middle-size enterprises" that are members of the Association reduced their emissions of SO_2 from 5.6 kg per ton of steel to 2.7 kg per ton of steel in 2006.[61] This was below the industry average of 3.54 kg per ton of steel in that year, but still almost 4 times greater than the average rate for all steel mills in the U.S.

The Chinese Iron and Steel Association notes that many other steel mills were not as successful in controlling SO_2 and other criteria pollutants. It has recognized that over the past 10 years "pollution from the small-size backward iron & steel enterprises continues to worsen."[62]

While 2007 figures for the steel industry alone are not yet available, in June 2008, the Ministry of Environmental Protection (MEP) announced that during 2007 overall SO_2 emissions declined 4.66 percent from the 2006 level, marking the country's first "turning point" of a major pollutant.[63] But the applicability of the overall results to the steel industry, the accuracy of the numbers, and the sustainability of such reductions is unknown.

Emissions levels in the U.S. are considerably lower. National Emissions Inventory (NEI)[64] data show that SO_2 emissions of the U.S. steel industry are 70,796,960 net tons (about 0.70 kg per ton of steel) and NO_X emissions are 66,101,070 net tons (about 0.65 kg/ton of steel) for 2002.[65]

There has been significant progress in the U.S. in the reduction of acid rain by limiting the acid rain precursors SO_2 and NO_X produced by major industrial sources such as steel and electric utilities. In China, acid rain is a large and growing problem. One third of the country's land is affected by acid rain.[66]

4. Development of Standards for Discharge of Water Pollutants.

With respect to the steel industry, air pollution receives the most attention from regulators because as much as 80 percent of the pollution created by steelmaking is emitted into the air. But water pollution is a significant component of steel production as well, and is subject to regulation in both countries.

The steel industry uses water to cool equipment, remove scale from steel products, and provide a source of steam power generation. Water is a medium in wet scrubbers for air pollution control,[67] and is used in the steelmaking process to carry pollutant residues of suspended solids, oil, ammonia nitrogen and phenols.

The growing trend in the world steel industry is to recycle and reuse most of the water in the production process. For water that does get discharged, both U.S. and Chinese regulators have established effluent standards to limit the nature and amount of pollutants that could harm human health or the environment.

a. Development of U.S. Standards.

In the U.S., the development of regulations and control systems for water pollution occurred over the past three decades, roughly paralleling the same period during which expansion in air pollution regulation took place. During this period, federal and state researchers and regulators have repeatedly tested water quality levels throughout the U.S., identified existing and new industrial sources of water pollution, and assessed the risks to human health and the environment of water pollution.

There are two prongs to wastewater regulation under the Clean Water Act (FWPCA): water quality standards that are based on pollutant levels in the receiving water body, and industry-specific effluent limitation guidelines that are technology based. Starting in 1982, a series of increasingly stringent water pollution control regulations and permit requirements have compelled the U.S. steel industry to install more advanced water treatment technologies.[68] The capital expenditures and operational costs of water pollution control technologies have been a driving force in leading U.S. companies to reduce water discharges and recycle as much water as possible.[69]

As mandated by FWPCA, EPA has set technology-based effluent limitations, guidelines and standards for the steel industry that limit pollutants discharged from different production stages of the steelmaking process either directly to waterways or indirectly through publicly owned treatment works (POTWs).[70] Industrial sources are required by the POTW to agree to specific pollutant limits, and/or to pre-treat used waters piped to the POTW.

U.S. effluent limitation standards apply to steel facilities that discharge directly to bodies of water under federal jurisdiction, and they are implemented through individual permits issued under the National Pollutant Discharge Elimination Program (NPDES). Similarly, the federal pretreatment standards are incorporated into discharge permits for facilities that discharge to POTWs rather than directly into bodies of water. These permits contain detailed monitoring, testing and reporting requirements that put the pollution source under strict regulatory control. The substantive effluent standards for U.S. steel companies are production-based—that is, the standards specify the maximum amount of specific pollutants that may be discharged to the water per ton of steel that is produced.[71]

The standards require the application of one of several different levels of water pollution control technology depending on the circumstances, e.g. best practicable control technology currently available (BPT), the best available technology economically achievable (BAT), or the best conventional technology (BCT). Steel facilities have also limited water discharges by making changes in their production processes, and by implementing best management practices for their facilities. When steel companies build new facilities or modify existing facilities, they may be subject to more stringent NSPS similar to the air pollution NSPS.[72]

b. Development of Chinese Standards.

In China, a national effluent standard for the steel industry has existed since 1992.[73] Unlike the U.S., however, China does not impose effluent limitations tied to the amount of steel produced; rather, the effluent standards are based on concentration limits in the water discharged for eight pollutants, broken down by each steel production stage. Concentration limits are based upon the quality of the receiving body of water. Policy-makers in China recognize that the current water pollutant discharge standards lag behind comparable standards in developed countries such as the U.S.[74] Indeed, some Chinese companies can meet the existing water pollution control standards without treating their wastewater.[75] Further, to date the Chinese regime lacks the specific permit-driven requirements that are a part of the NPDES permitting system in the U.S., although as discussed in Chapter III, the central government continues to consider the development of a permit system for the discharge of water.[76]

The less stringent Chinese standards have resulted in significantly polluted water discharges from steel mills. According to survey results released together with the proposed effluent standard,[77] some larger Chinese steel mills, such as Wuhan Steel, discharge wastewater with the concentration of suspended solids as high as 185 mg/L (equivalent to about 1.85 kg/ton of product).[78] This is approximately ten times the U.S. effluent limits. Yet Wuhan Steel is technically complying with the current Chinese standard.

The Chinese government is now considering changes to the standards applicable to the steel industry. As with the development of new air pollution standards, the proposed new Chinese water pollution standards have been developed in close coordination with the Chinese steel industry.

5. Comparison of Specific Standards for Water Pollutants.

An analysis submitted to the Chinese government by Sinosteel in connection with the consideration of new standards for the industry compares existing U.S. and Chinese standards for water pollution.[79] Because of the distinctions between the U.S. production-based and Chinese concentration-based standards, it is more difficult to make reliable comparisons between wastewater standards in the two countries than it is for air pollution standards. The Chinese standards measure the amount of the pollutant per liter of water discharged, while the U.S. standards measure the amount of pollutant that can be discharged into the water per ton of product produced. In order to convert the Chinese concentration standards to limits per ton of product, it is necessary to estimate the amount of wastewater discharged per ton of product in China. The lesser the amount of water assumed to be used per ton of water, the lower the amount of pollutant discharge per ton of steel, assuming compliance by the Chinese steelmaker with the applicable concentration standard. The comments submitted by Sinosteel compared the existing Chinese standards to U.S. standards by presuming that 10 cubic meters ($10m^3$) of water would be discharged per ton of product. For the proposed new regulations, the proposal assumed that there would only be $2m^3$ of water discharged per ton of product, although the submission by Sinosteel did not actually make a comparison between the proposed Chinese standards and U.S. standards.[80]

According to China's National Development and Reform Commission (NDRC), $6.56m^3$ of wastewater on average was discharged per ton of product in 2006 in the steel industry.[81] This is considerably below the $10m^3$ per ton of steel that the Chinese analysis assumed in the case of the existing standards, but considerably above the $2m^3$ per ton assumed in the case of the proposed standards. To reach this latter goal the Chinese industry would have to reduce its use of wastewater to less than one-third of its 2006 level.

The charts that follow therefore supplement the numbers contained in the industry's analysis of China's water standards by providing one comparison to U.S. standards using the rates of water usage assumed in the submission from Sinosteel ($10m^3$ for the existing standard and $2m^3$ for the proposed standard), and another comparison based on the actual average usage of wastewater per ton of steel produced in 2006 ($6.56m^3$).

The charts compare effluent limits for direct point source discharges of five key water pollutants in China and the U.S. The current Chinese standards apply to mineral selection, cokemaking, sintering, iron making, steel making, hot and cold steel rolling, and continuous casting. In addition to amending the actual effluent limits, the proposed revisions to China's standard distinguish between new and existing facilities, and amend the processes to which they apply by adding ferrousalloy but deleting mineral selection, cokemaking, and continuous casting.

The U.S. standards in some cases consist of a range of numbers depending on the particular technology used to perform the process specified (e.g. pickling), and in that case the highest and lowest number in the U.S. standard is included to indicate the range. The processes included in the U.S. standards, which may not correspond fully to the applicability of the Chinese standard in all cases, are noted in each instance. There is no chart for pH since in both countries water discharged is required to fall within the pH range of 6.0 to 9.0.[82]

Overall, the charts show that in the substantial majority of all the applicable standards, except possibly in the case of the chromium VI standards, the current and proposed Chinese standards are less stringent than existing U.S. standards, using a conversion rate of $6.56m^3$ of water usage per ton. The degree to which the U.S. standards are more stringent than China's standards would be greater if the conversion rate of $10m^3$ of water usage per ton was used in the case of China's existing standards, and less if the conversion rate of $2m^3$ of water per ton was used in the case of China's proposed standards.

a. Oil Discharges

The U.S. standard for oil discharges exceeds the current standards in China assuming a conversion rate of $6.56m^3$ of water per ton produced. Using the same conversion rate, China's proposed standards would remain less stringent than U.S. standards in all cases except in hot plating, and in the case of alkaline washing the high end of the one day standards in the U.S. would be in excess of the proposed Chinese standard.[83] The required 30 day average for these pollutants in the U.S. would be in all cases more stringent than the Chinese standard.

Effluent Limits – Oil		
China[84] Unit: kg/ton of product		
Current	Proposed	
0.08 at 10m^3 of water/ton	0.01 (existing) and 0.006 (new) at 2m^3 of water/ton	
0.05 at 6.56m^3 of water/ton	0.03 (existing) and 0.02 (new) at 6.56m^3 of water/ton	
U.S. Unit: kg/ton of product		
Stage	Maximal Level in 1 day (BPT)	Average level in 30 days (BPT)
Cokemaking	0.0327	0.0109
Sintering	0.0150	0.00501
Continuous Casting	0.0234	0.0078
Hot Rolling	0.0109-0.0894	--
Pickling	0.0113-2.45	0.00375-0.819
Cold Rolling	0.000522-0.0417	0.000209-0.0167
Alkaline washing	0.0313-0.0438	0.0104-0.0146
Hot plating	0.0751-16.3	0.0250-16.3

b. Suspended Solids.

For discharges of suspended solids, the U.S. industry is subject to a regulatory limit more stringent than the Chinese standard assuming a conversion factor of 6.56m^3 of water per ton, except in the case of certain technologies that may be used in steel rolling. Using the same conversion rate, China's proposed standards would remain less stringent except in the case of the U.S. standards that apply to certain types of steel rolling.[85]

Effluent Limits - Suspended Solids								
China Unit: kg/ton of product								
Current				Proposed				
0.7 at 10m^3 of water/ton				0.1 (existing) and 0.04 (new) at 2m^3 of water/ton				
0.46 at 6.56m^3 of water/ton				0.33 (existing) and 0.13 (new) at 6.56m^3 of water/ton				
U.S. Unit: kg/ton of product								
Stage	BAT		BPT		BCT		NSPS	
	1 day	30 days	1 day[86]	30 days[87]	1 day	30 days	1 day	30 days
Cokemaking			0.253	0.131	0.253	0.131	0.172	0.0894
Sintering			0.0751	0.025			0.02	0.00751
Ironmaking			0.0782	0.026			0.0117	0.00438
Steelmaking			0.0312 -0.078	0.0104 -0.026			0.0073 -0.0321	0.00261 -0.0115
Steel Rolling			0.00125 -0.532	0.00063 -0.228			0.00117 -0.532	0.00063 -0.228

c. Zinc

For zinc discharges, the U.S. standard is more stringent than either the current or proposed Chinese standard using the conversion rate of 6.56m^3 of water per ton, with the exception of the high end of the range of U.S. discharges allowed in connection with certain technologies used in the pickling or hot plating process. Other applicable technologies that may be used in the pickling and hot plating process are subject in the U.S. to more stringent standards than in China.

Effluent Limits – Zinc						
China Unit: kg/ton of product						
Current			Proposed			
0.02 at 10m3 of water/ton			0.004 (existing) and 0.002 at 2m3 of water/ton			
0.01 at 6.56m3 of water/ton			0.01 (existing) and 0.007 (new) at 6.65m3 of water/ton			
U.S. Unit: kg/ton of product						
Stage	BAT		BPT		NSPS	
	1 day[88]	30 days[89]	1 day	30 days	1 day	30 days
Sinter	0.000676	0.000225			0.000676	0.000225
Ironmaking (Air Heating)	0.000394	0.000131			0.000394	0.000131
Pickling	0.000225 -0.0491	0.000751 -0.0164	0.000751 -0.0164	0.000751 -0.0164	0.000225 -0.0491	0.000751 -0.0164
Cold Rolling	0.0000063 -0.000501	0.0000021 -0.000167	0.0000063 -0.000501	0.0000021 -0.000167	0.0000063 -0.000501	0.0000021 -0.000167
Hot Plating	0.00150 -0.327	0.000500 -0.109	0.00150 -0.327	0.000500 -0.109	0.00150 -0.327	0.000500 -0.109

d. Cyanide and Chromium.

The situation is somewhat different for cyanide and chromium. The current Chinese standard for cyanide is the same as, or more stringent than, the U.S. standard, using the conversion rate of 6.56m^3 of water per ton, for one to three of the six categories that apply in each case to cokemaking, sintering, iron BF, and continuous salt bath descaling, although the majority of the U.S. standards are more stringent. The Chinese government has not included any change in the cyanide standard in its proposed revisions to the water discharge standards.

Chromium VI is particularly difficult to compare because of the large range of discharge limits specified for each of the U.S. standards to account for the different technologies that may be used. At the high end of permitted discharges for most of the U.S. standards, the current and proposed Chinese standards are more stringent, based on a conversion rate of 6.56m^3 of water per ton, except for the standards for cold forming (cold rolling mills and cold worked pipe and tube). The low end of permitted discharges in the U.S. are more stringent than the current or proposed Chinese standard, except in the case of the 1 day standards for salt bath descaling (oxidizing and reducing) and acid pickling (other than new sources).

The smoggy late afternoon skies of Shanghai.

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Effluent Limits – Cyanide						
China Unit: kg/ton of product						
Current			Proposed			
0.005 at 10m³ of water/ton			0.001 (existing) and 0.001 (new) at 2m³ of water/ton			
0.003 at 6.56m³ of water/ton			0.003 (existing) and 0.003 (new) at 6.56m³ of water/ton			
U.S. Unit: kg/ton of product						
Stage	BPT		BAT		NSPS	
	1 day	30 days	1 day	30 days	1 day	30 days
Cokemaking	0.0657	0.0219	0.00297	0.00208	0.00297	0.00208
Sintering			0.00300	0.00150	0.00100	0.000501
Iron BF	0.0234	0.00782	0.00175	0.000876	0.000584	0.000292
Salt bath descaling, oxidizing (Batch)	0.00102	0.000339	0.00102	0.000339	0.00102	0.000339
Salt bath descaling, oxidizing (Continuous)	0.00569	0.00190	0.00569	0.00190	0.00569	0.00190

Effluent Limits - Chromium VI						
China Unit: kg/ton of product						
Current			Proposed			
0.005 at 10m³ of water/ton			0.001 (existing) and 0.0002 (new) at 2m³ of water/ton			
0.003 at 6.56m³ of water/ton			0.003 (existing) and 0.0007 (new) at 6.56m³ of water/ton			
U.S. Unit: kg/ton of product						
Stage	BPT		BAT		NSPS	
	1 day	30 days	1 day	30 days	1 day	30 days
Salt Bath Descaling (oxidizing)	0.00138 -0.00709	0.000551 -0.00284	0.00138 -0.00709	0.000551 -0.00284	0.00138 -0.00709	0.000551 -0.00284
Salt Bath Descaling (reducing)	0.00136 -0.00759	0.000542 -0.00304	0.00136 -0.00759	0.000542 -0.00304	0.00136 -0.00759	0.000542 -0.00304
Acid Pickling (Combination acid pickling)	0.000960 -0.0819	0.000384 -0.0327	0.000960 -0.0819	0.000384 -0.0327	0.000167 -0.0819	0.0000667 -0.0327
Cold Forming (Cold rolling mills)	0.0000209 -0.00167	0.0000084 -0.000668	0.0000209 -0.00167	0.0000084 -0.000668	0.0000209 -0.00121	0.0000084 -0.000484
Cold Forming (Cold worked pipe and tube)	0.0000209	0.0000084	0.0000209	0.0000084	0.0000209	0.0000084
Hot Coating	0.000150 -0.0327	0.0000501 -0.0109	0.000150 -0.00490	0.0000501 -0.00163	0.0000376 -0.00490	0.0000125 -0.00163

6. Treatment of Solid Waste.

The problem of what to do with past and current disposal of solid and hazardous wastes is a major environmental and financial issue for steel companies in both countries. Standards in China are considerably less stringent, however, and they do not include any requirement to remedy the past inadequate disposal of hazardous wastes.

In the U.S. less than 10 percent of the industry's solid wastes are released in an untreated state.[90] This includes hazardous solid waste. Data from the EPA's Toxic Release Inventory (TRI) shows that the U.S. steel industry manages and transfers more than 90 percent of the solid wastes registered under the TRI, mostly through recycling (either on-site or off-site), and also through treatment and disposal.[91] These statistics reflect the progressively more stringent solid waste standards that have been imposed on the U.S. steel industry.

Figures released by the Chinese steel industry show that Chinese steel companies generated a total of 430.56 million tons of solid wastes in 2006; 136.80 million tons were from ferrous metals mining and selection, 291.49 million tons were from ferrous metals smelting and pressing and 2.27 million tons were from the manufacture of metal products.[92] The *China Environmental Statistics Yearbook,* based on slightly higher total numbers, states that 234.54 million tons (54.5 percent) of those solid wastes were reused, 58.88 million tons were temporarily stored, 136.52 million tons were disposed of (e.g. incinerated, landfilled, etc.) and 2.38 million tons were released into the environment.[93]

The *Yearbook* also reported that of the 176.65 million tons of steel slag generated by the industry in 2006, 162.14 million tons, or 91.8 percent, were reused. This is much higher than the 54.5 percent rate of reuse by the industry for all solid waste noted above, and other experts have questioned this number. They estimate that the steel slag reuse rate was only 50 percent in 2005 (65 percent for blast furnace slag and 10 percent for steel slag).[94] Stated government targets for reuse also indicate that the current use is well below 91.8 percent. The 2006 "Resource Reuse Special Plan" (*ziyuan zonghe liyong zhuanxiang guihua*) released by the NDRC sets a national target for steel slag reuse rate at 86 percent, a goal that would not be achieved until the year 2010.[95] The lower estimates are also more consistent with figures for the national rate of waste treatment.[96]

a. U.S. Regulation of Solid Waste.

In the U.S., solid wastes generated from the steel mills, mainly in the form of sludge, slag and dust, are governed by federal and state solid and hazardous waste regulations that were developed at approximately the same time as the CAA and the FWPCA. Solid waste disposal regulation has been largely delegated to the states under the Solid Waste Disposal Act and the Resource Conservation and Recovery Act (RCRA).[97]

Certain by-products of the steelmaking process, such as baghouse dust from electric arc furnaces, are classified in the U.S. as hazardous wastes,[98] and disposal is costly and burdensome. In 1984, Congress significantly strengthened the RCRA's waste management provisions,[99] establishing a cradle-to-grave system governing hazardous waste from the point of generation to disposal.[100] The law requires industrial polluters to dispose of such wastes in a safe (and increasingly costly) manner, and to pay for cleanups of sites contaminated with hazardous wastes. The mandatory tracking system in the U.S. for hazardous wastes ensures transparency and accountability for industrial generators.

Nonhazardous solid wastes must be stored and disposed of in accordance with state and local ordinances, and fees for the transportation and disposal of solid waste disposal can be significant.[101]

b. Chinese Regulation of Solid Waste.

The Solid Waste Law, first enacted in 1995 and amended in 2004, sets the general legal framework for solid waste management in China, including industrial solid waste.[102]

At the time this law was enacted, Chinese lawmakers lacked what one Chinese scholar now calls "the necessary basic information detailing both the research on the pollution mechanism of solid wastes and the availability of disposal technology methods for solid waste."[103] These data gaps, similar to those Chinese authorities faced with respect to air and water pollution, have led to less stringent standards, inadequate enforcement, and noncompliance with solid and hazardous wastes laws in China.

One serious problem with the Chinese solid waste regulatory regime is the absence of detailed implementing regulations accompanying the Solid Waste Law, which sets very broad principles for solid and hazardous waste management. The lack of specificity makes it difficult for Chinese companies to implement waste minimization and disposal practices in their daily operations.

For example, there are only two four-page standards in China regulating the disposal and storage sites of solid waste and hazardous waste.[104] These standards are entirely descriptive in nature, and far more general and vague than the extensive U.S. regulations. There are hundreds of pages of U.S. regulations governing the release, collection, storage, transportation, disposal, and recycling of solid/hazardous wastes.[105]

China's discharge permit fee was extended to solid or hazardous waste generation, storage and disposal in 2003. Under the current law, however, steel mills pay a discharge fee only if they discharge solid waste in excess of the applicable standards, with the fee calculated according to the tonnage discharged.

c. Legacy Costs.

Chinese laws do not provide for Superfund-equivalent liability for past, improper disposal of hazardous wastes. Only U.S. producers bear the significant costs that stem from legal obligations for the remediation of contaminated facilities and landfills that are associated with pre-environmental era practices such as dumping hazardous material.

The Chinese government may now be considering various liability and compensation plans to address the problem. Until the government adopts a remediation plan, however, Chinese law will likely continue to defer these costs to the future.

7. Carbon Dioxide (CO_2) Emissions: The Next Focal Point.

This chapter has focused on areas that are now subject to regulation in either the U.S. or China, or both—hazardous and non-hazardous air pollutants, water pollution, and solid wastes. However, GHGs—particularly CO_2—are increasingly a focus of national and worldwide attention.

Neither the U.S. nor China is currently subject to the specific targets and timetables contained in the 2005 Kyoto Protocol regulating GHGs. In the case of the U.S. this is because it has not ratified the agreement. China has ratified the agreement, but by its terms the agreement does not require China to reduce its emissions. Neither country currently imposes any regulatory restrictions on emissions of these gases. Under the particular rules of the Kyoto Protocol, however, it is possible that the Chinese steel industry will be able to turn its high levels of CO_2 emissions into a benefit by participating in the Kyoto Protocol's Clean Development Mechanism.[106]

The extent that specific targets and timetables apply to the U.S. or China may change in the future. There is growing recognition in both countries that climate change is a serious problem, and a growing consensus that man-made sources, including steel production, contribute to the problem. Thus, it is useful to briefly review the greenhouse gas emissions by the steel industries in each country, and to identify regulatory mechanisms that are presently under active consideration (at least in the U.S.).

a. CO_2 Emissions in the Chinese Steel Industry.

In 2007 the Netherlands Environmental Assessment Agency concluded for the second year in a row that China had passed the U.S. to become the world's single largest emitter of CO_2.[107] The Chinese steel industry is a major contributor to China's high level of overall CO_2 emissions. This is because the steel industry is so energy-intensive, and because it relies so heavily on coal as a feedstock. In particular, major CO_2 contributions stem from the use of coke in the blast furnaces. Far lower amounts of carbon are produced when steel is recycled because melting down and reshaping scrap steel in an EAF does not entail the chemical and physical transformations that are at the core of ironmaking and cokemaking. Accordingly, the integrated steelmaking process—a process that is far more widespread in China than in the U.S.—contributes the largest share of CO_2 emissions from steelmaking. Moreover, there has been a significant resurgence of small, inefficient steel mills in China in recent years, which has also contributed to the CO_2 problem.[108]

The figures in China tell the story. According to the International Iron and Steel Institute (IISI), China accounts for approximately 50 percent of the world's steelmaking CO_2 emissions.[109] This means that the Chinese steel industry's output of CO_2 is roughly equal to that of all the other steelmaking countries *combined*. Since China currently accounts for approximately 33 percent of the world's steel production, it also means that China's pro rata share of the world's CO_2 emissions is approximately 50 percent higher than would be warranted by its current production levels.

Since China currently accounts for approximately 33 percent of the world's steel production, it also means that China's pro rata share of the world's CO2 emissions is approximately 50 percent higher than would be warranted by its current production levels.

This conclusion is supported by statistics from the IISI which indicate that Chinese steel producers emitted 2.5 tons of CO_2 for each ton of steel manufactured in China in 2005.[110] For the global steel industry, IISI reports that average CO_2 emissions were 1.7 tons for each ton of steel produced.[111] The American Iron and Steel Institute (AISI) and the Steel Manufacturing Association (SMA) suggest that the figure of 2.5 tons per ton of steel understates the actual level of Chinese steel CO_2 emissions.[112] These two groups, in recent testimony submitted to the U.S. House of Representatives, suggested that the true number is closer to four tons of emissions for each ton produced in China, compared to the worldwide average of 1.7 tons per ton of steel.[113]

b. CO_2 Emissions in the U.S. Steel Industry.

In contrast to the upward CO_2 emissions trends in China, in the U.S. steel industry CO_2 emissions are on a significant downward slope. In 2002, CO_2 emissions from the industry dropped by approximately seven percent.[114] American steel producers emit, on average, only a little more than 1.2 tons of greenhouse gases for each ton of steel produced in the U.S.[115] This figure is less than half the 2.5 ton level of CO_2 emissions in China that IISI reports, and is less than one-third the rate that AISI and SMA believe CO_2 is actually being emitted in China. The Peterson Institute for International Economics has reached a similar conclusion: it estimates that Chinese steel facilities emit 1.5 tons of CO_2 per ton of steel more than their U.S. counterparts.[116]

The U.S. industry's restructuring, particularly its wide adoption of EAFs, has contributed to the GHG reductions in a major way. Additionally, voluntary programs in the U.S., such as Climate VISION and other energy efficiency initiatives, have assisted U.S. steel companies in reducing their carbon footprints. Climate VISION is a public-private partnership initiated by the Department of Energy working to contribute to the goal of reducing GHG emissions by 18 percent over ten years, without sacrificing economic growth.[117] Through this program, the steel industry has pledged to increase average energy efficiency 10 percent by 2012.[118]

In the U.S., Congress has considered legislation to compel the steel industry—and virtually all other manufacturing industries—to sharply curtail their GHG emissions. In June 2008, the U.S. Senate debated the Climate Security Act (S. 3036), which imposed a cap-and-trade system on GHG emissions, and required overall emissions levels to be reduced from current levels by nearly 20 percent by 2020, and by more than 70 percent by 2050.[119] In addition, the legislation sought to ensure that U.S. steel producers would not be competitively disadvantaged; it contained a provision that would force American importers to purchase credits in order to import goods produced in countries with substandard environmental regulation.

Although the U.S. Congress failed to pass legislation to control GHG emissions in 2008, it is widely expected to resume consideration of the legislation in 2009. Both the person the country elected in November 2008 as its next President, Senator Obama, and his Republican opponent in the election have supported legislation to reduce GHG emissions.[120] The AISI and SMA, in recent testimony before the House Energy and Commerce Committee, stated that the industry "is part of the solution to the climate change debate, not the problem" and has recommended that any climate change legislation take account of carbon-intensity—emissions of GHGs per unit of a particular product produced. The groups also urged that the same emissions reduction requirements be imposed on imported steel as would apply to domestically-produced steel.[121]

As of this writing, no comparable legislation to impose mandatory limits on GHG emissions is under consideration in China by the National People's Congress. In June of 2007, however, China announced a National Climate Change Program in order to address GHG issues, focusing on areas such as renewable energy and increased industrial efficiency. China has set a goal under the National Climate Change Program to reduce energy intensity throughout the country by 20 percent before 2010.[122] It anticipates controlling GHG emissions through reductions in the use of energy in key industries, including steel. The 1000 Key Enterprises Energy Efficiency Program discussed in Chapter I of the report is one aspect of the overall National Climate Change Program. The National Climate Change Program, however, lacks specific provisions to implement the program and achieve its targets, and some analysts have been skeptical of China's ability to meet its goals.[123] Indeed, China has not yet met its annual target under the program, and Premier Wen Jiabo and the State Council warned in 2008 that achieving energy intensity and emissions reductions remained "an arduous task."[124]

It does not appear that public opinion in China is strongly in support yet of actions to curb GHG emissions. Only 24 percent of Chinese citizens think that global warming is a very serious problem, the lowest percent of any country in the world, according to a survey by Pew.[125] Nevertheless, the Chinese steel industry is participating in a dialogue on global warming with the steel industry from the U.S. and other countries under the auspices of the IISI.[126] The Chinese government and industry representatives are also participating in discussions on GHG in the Asia Pacific Partnership on Clean Development and Climate.[127]

1 Zhao Xiaojian, "The Environmental Hurricane that Never Ends," *Southern Weekend*, (January 26, 2007), http://www.infzm.com/content/3309. (Text in Chinese)

2 SEPA Document (2007) No.735 http://www.zhb.gov.cn/info/gw/bgth/200710/t20071018_111545.htm and SEPA Document (2008) No.34 http://www.zhb.gov.cn/info/gw/bgth/200801/t20080117_116442.htm. (Text in Chinese)

3 The American Lung Association, "Particle Pollution Fact Sheet," (2007), http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=50324.

4 66 Fed. Reg. 36836 (July 13, 2001).

5 42 U.S.C. § 7409 (b)(1).

6 Pub. L. 101-549 Section 301(b)(1).

7 42 U.S.C. § 7412 (b)(3)(b). NESHAPs cover air pollutants for which "emissions, ambient concentrations, bioaccumulation or deposition of the substance are known to cause or may reasonably be anticipated to cause adverse effects to human health or adverse environmental effects."

8 EPA Office of Compliance Sector Notebook Project, *Profile of the Iron and Steel Industry*, (Washington, D.C.: Office of Compliance, September 1995).

9 40 CFR Part 63, Subparts EEEEE, FFFFF, and YYYYY.

10 Pub. L. 101-549, Title III. See 40 CFR Part 63 for list of 188 air toxics. For purposes of the U.S. NESHAPS, "PM" is used to cover metal particulates that are part of the emissions from any steel mill and are controlled as a HAP. Particulate matter generally is controlled as a non-hazardous criteria pollutant; as discussed later in this chapter, this may subject U.S. steel companies to additional controls on PM pollutants under the SIP depending on whether the facility is in an attainment or non-attainment area.

11 For example, lead can be a significant byproduct of steelmaking. In October 2008 the EPA substantially tightened lead regulations, adopting an air quality standard of 0.15µg/m3. This is 10 times more stringent than the 1.5µg/m3 standard that was previously in place. See 40 CFR Parts 50, 51, 53 and 58 and Environmental Protection Agency, "Final Revisions to National Air Quality Standards for Lead," (October 15, 2008). Since steel making can be one of the major industrial sources of lead, the new regulations will have particular relevance to the U.S. steel industry. Currently, the Chinese ambient air quality standard for lead is 1.5µg/m3 per three month period and 1µg/m3 annually. (GB-3095-1996, Ambient Air Quality Standards). The point-source standards for lead are contained in concentration standards that apply to all kilns and furnaces in a variety of industries (GS 9078-1996). China may revise these standards at some point in the future, but the proposed new standards specifically for steelmaking do not include new standards for lead as it does for some of the other pollutants now governed by GS9078-1996. In the meantime, some reports have raised questions whether current lead regulations are fully enforced. See Lee, Debbie, "Growing up in a Leaded Environment: Lead Pollution and Children in China," *Woodrow Wilson International Center for Scholars,* (May 2008).

12 In some cases the two countries may adopt different approaches to regulate hazardous pollutants. For example, in the pickling process the U.S. NESHAP focuses on HCI, while the proposed Chinese standard addresses as well chromium acid mist, sulfuric acid mist, and alkaline mist. An example of U.S. standards for pollutants which have no exact counterpart in the Chinese standard are naphthalene in cokemaking (40 CFR Part 63, Subpart CCCCC) and volatile organic hazardous air pollutants (VOHAP) for Iron and Steel Foundries (40 CFR Part 63, Subpart EEEEE). The Chinese regime does not distinguish between hazardous and non-hazardous PM, and instead of using the term PM refers to soot (*yanchen*) and dust (*fenchen*). Under the U.S. regulatory regime soot and dust are regulated through opacity requirements that are separate from the PM requirements.

13 The only exception is the pickling process chart which has been revised to include the U.S. NESHAP, which had been omitted from the Chinese comments, and the U.S. standard that the Chinese comments gave for EAF in the steelmaking process has been corrected. The charts have also been simplified by deleting comparisons to EU and Japanese standards as well as U.S. standards, and supplemented by the addition of information on the monitoring, reporting, and performance test requirements contained in each standard.

14 The EPA defines sintering as "the process that agglomerates fines (including iron ore fines, pollution control dusts, coke breeze, water treatment plant sludge, coke breeze, and flux) into a porous mass for charging to the blast furnace. Through sintering operations, a mill can recycle iron-rich material, such as mill scale and processed slag. Not all mills have sintering capabilities. The input materials are mixed together, placed on a slow-moving grate and ignited. Windboxes under the grate draw air through the materials to deepen the combustion throughout the traveling length of the grate. The coke breeze provides the carbon source for sustaining the controlled combustion. In the process, the fine materials are fused into the sinter agglomerates, which can be reintroduced into the blast furnace along with ore. Air pollution control equipment removes the particulate matter generated during the thermal fusing process. For wet scrubbers, water treatment plant sludge is generally land disposed waste. If electrostatic precipitators or baghouses are used as the air pollution control equipment, the dry particulates captured are typically recycled as sinter feedstock, or are landfilled as solid waste." See EPA Office of Compliance Sector Notebook Project, *Profile of the Iron and Steel Industry*, supra note 8.

15 Margolis, Nancy and Brindle, Ross, *Energy and Environmental Profile of the U.S. Iron and Steel Industry,* A Report Prepared for the U.S. Department of Energy, (Energetics, Incorporated, August 2000), 41.

16 A comparison of PM standards applicable to Agglomerating (pelletizing and sintering) is complicated by the range of processes covered by these terms, and the ways in which they are regulated, in the U.S. and China. In the U.S., PM emissions from a range of sintering operations at steel facilities are largely regulated by the Integrated Iron and Steel NESHAP (40 CFR Part 63, Subpart FFFFF), while emissions from pelletizing that occurs at mines are subject to the Taconite Iron Ore Processing NESHAP (40 CFR Part 63, Subpart RRRRR). According to its explanation of the proposed PM standards for steelmaking and how they compare to U.S. standards, the Chinese industry included the separate U.S. standards for taconite iron ore processing under the chart's second category for "other processes in agglomerating." The current Chinese emissions standard (GB 9078-1996) for "sinter machine" governs emissions from sintering and pelletizing. According to the Chinese industry's explanation, it has included under the chart's second category for "other processes in agglomerating," several other processes involving the treatment of raw iron ore that it believed most comparable to taconite iron ore processing in the U.S., including the reception, storage and transportation of raw materials, breaking or crushing of the iron ore, mixing, and cooling. See "Explanatory Report on the Drafting of Emissions Standard for Air Pollutants from Iron and Steel Industry – Sintering (Pelletizing)," Anshan Steel Group, (September 2007), 28,

http://www.sepa.gov.cn/info/gw/bgth/200710/W020071018462849458710.pdf. (Text in Chinese)

17 Emissions Standard of Air Pollutants for Industrial Kilns and Furnaces (GB 9078-1996). Here, the Level II limits, which apply to most Chinese steel companies, are listed to represent the current Chinese standard. Level I limits only apply in "Nature Conversation Regions" that are roughly comparable to wilderness or national parks in the U.S. All steel mills are located in Level II or Level III regions, but since Level II standards are stricter than Level III standards, Level II standards are used.

18 "Explanatory Report on the Drafting of Emissions Standard for Air Pollutants from Iron and Steel Industry – Sintering (Pelletizing)," Anshan Steel Group, supra note 16. (Text in Chinese)

19 Ibid., 31-32.

20 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 42-45, supra note 15.

21 In the U.S., the Integrated Iron and Steel NESHAP (40 CFR Part 63, Subpart FFFFF) is the main standard governing PM from the blast furnaces. The current Chinese standard (GB9078-1996) regulates emissions from blast furnaces, and the new set of proposed standards includes one that specifically addresses the ironmaking process.

22 Emissions Standard of Air Pollutants for Industrial Kilns and Furnaces (GB 9078-1996). Here, the Level II limits, which applies to most Chinese steel companies, are listed to represent the current Chinese standard.

23 "Explanatory Report on the Drafting of Emissions Standard for Air Pollutants from Iron and Steel Industry – Iron Making," Sinosteel Tiancheng Environmental Technology Company, (September 2007), 36-38, http://www.sepa.gov.cn/info/gw/bgth/200710/W020071018462849552438.pdf. (Text in Chinese)

24 Ibid., 23.

25 Ibid., 7.

26 Ibid., 14.

27 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 53, supra note 15.

28 In the U.S., the BOF process is governed by the Integrated Iron and Steel NESHAP (40 CFR Part 63, Subpart FFFFF) and the Iron and Steel Foundries NESHAP (40 CFR Part 63, Subpart EEEEE), while EAFs are governed by the Electric Arc Furnaces Steelmaking Facilities NESHAP (40 CFR Part 63, Subpart YYYYY). They establish emissions limits for PM and require detailed monitoring, reporting and performance tests. The current Chinese standard (GB9078-1996) regulates emissions from BOFs and EAFs.

29 From a regulatory standpoint, any PM emissions from the basic oxygen furnace generated during the steel production cycle which are captured and treated in the furnace's primary emissions control system are primary; secondary emissions are PM that escape from open and closed hoods, lance hole openings, and gaps or tears in ductwork to the primary emissions control system, which are not controlled by a primary emissions control system. See 40 CFR Part 63, Subpart FFFFF, NESHAP for Integrated Iron and Steel Manufacturing Facilities.

30 40 CFR Part 63, Subpart YYYYY.

31 Emissions Standard of Air Pollutants for Industrial Kilns and Furnaces (GB 9078-1996). Here, the Level II limits, which applies to most Chinese steel companies, are listed to represent the current Chinese standard.

32 "Explanatory Report on the Drafting of Air Pollutant Emissions Standard for Iron and Steel Industry – Steel making," Baosteel Co., Ltd, (September 2007), 42, http://www.sepa.gov.cn/info/gw/bgth/200710/W020071018462849602454.pdf. (Text in Chinese)

33 The U.S. EAF emissions standard for new sources was incorrectly identified as 4.6mg/m3 in the "Explanatory Report" by Baosteel Co., Ltd. For the correct emissions limit, as included in the chart, see 40 CFR Part 63 Subpart YYYYY.

34 "Explanatory Report – Steel Making," Baosteel Co., Ltd, 26, supra note 32.

35 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 79-80, supra note 15.

36 Hydrochloric acid (HCl) emissions, usually in the form of mist, have been the regulatory focus of the U.S. NESHAP program governing the pickling process (40 CFR Part 63, Subpart CCC). In China, currently there is no industry/process specific standard for HCl emissions from the pickling process. They are governed by the more general Integrated Air Pollutant Emissions Standard (GB16297-1996). The proposed steel emissions standards lists HCl emissions produced during pickling under steel rolling.

37 Integrated Air Pollutant Emissions Standard (GB16297-1996).

38 "Explanatory Report on the Drafting of Air Pollutant Emissions Standard for Iron and Steel Industry – Steel Rolling," Baosteel Co., Ltd, (September 2007), 20, http://www.zhb.gov.cn/info/gw/bgth/200710/W020071018462849703337.pdf. (Text in Chinese)

39 U.S. NESHAP program governing the pickling process (40 CFR Part 63, Subpart CCC).

40 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 27, supra 15.

41 EPA Office of Compliance Sector Notebook Project, *Profile of the Iron and Steel Industry*, 47, supra note 8.

42 Song Guojan, Professor of the School of Environmental and Natural Resources Remnin University. Correspondence on October 7, 2008.

43 GB16171-1996. (Text in Chinese). Non-mechanized ovens are an outdated cokemaking process that does not make use of modern machinery and hardly exists in developed countries, but that is common in several forms in China.

44 NDRC, "Admittance Conditions for New Cokemaking Plant," (2004), http://www.nxqtx.cei.gov.cn/wangye/zhengcefagui/jiaohua.htm.

45 CFR Part 63, Subpart L; 40 CFR Part 63, Subpart CCCCC; 40 CFR Part 61, Subpart L.

46 40 CFR Part 63, Subpart L.

47 40 CFR Part 63, Subpart CCCCC.

48 40 CFR Part 61, Subpart L.

49 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 33, supra note 15.

50 42 U.S.C. § 7401 Sec. 110.

51 40 CFR Part 60.

52 GB3095-1996. (Text in Chinese)

53 "Explanatory Report – Sintering (Pelletizing)," Anshan Steel Group, 51, supra note 16. (Text in Chinese)

54 Shan Shanghua and Chunfeng Li, "Accelerating the Desulfurization of Sintering, Improving Regional Environmental Conditions," *Metallurgical Economics and Management,* No. 4, (2006), 9. (Text in Chinese)

55 GB13271-2001 "Emission Standard for Coal-burning, Oil-burning, Gas-burning Boilers." (Text in Chinese)

56 Ibid.; "Explanatory Report – Sintering (Pelletizing)," Anshan Steel Group, 46, supra note 16. (Text in Chinese); "Explanatory Report on the Drafting of Emissions Standard for Air Pollutants from Iron and Steel Industry – Iron Making," Sinosteel Tiancheng Environmental Technology Company, (September 2007), 29, 31, http://www.sepa.gov.cn/info/gw/bgth/200710/W020071018462849552438.pdf. (Text in Chinese)

57 Ibid., 46.

58 "National Environmental Protection Eleventh Five Year Plan," State Council Document, No. 37, (2007). http://www.china.com.cn/policy/txt/2007-11/26/content_9293694.htm. (Text in Chinese)

59 The National Bureau of Statistics, The Chinese State Environmental Protection Administration, et al., *China Environmental Statistics Yearbook* 2006, Ministry of Environmental Protection (Beijing: 2006) 21-29. (Text in Chinese)

60 Ibid.

61 Huang Dao, "Energy Saving and Reducing Discharge in China Iron and Steel Industry: Overview," Presentation at IISI Expert Group Meeting on Climate Change, (Beijing: December 4-5, 2007).

62 Ibid.

63 Chen, Lydia, "Pollution emissions on wane in cleaner China," *Shanghai Daily,* (June 5, 2008), http://www.shanghaidaily.com/article/?id=362072&type=National.

64 Office of Air Quality Planning and Standards, "2002 National Emissions Inventory Data and Documentation," Environmental Protection Agency, (January 25, 2008), http://www.epa.gov/ttn/chief/net/2002inventory.html. The most recent National Emissions Inventory is NEI 2002, version 3, released by Environmental Protection Agency in September 2007.

65 The emissions data for the U.S. steel industry is under NAICS code 331111. The kilograms per ton numbers were calculated from total emissions of each pollutant, converted to kilograms, and then divided by the total amount of steel produced for 2002, 100,958,000, obtained from the American Iron and Steel Institute. See The American Iron and Steel Institute, *2006 Annual Statistical Report*, (Washington, D.C.: American Iron and Steel Institute, 2007), 73.

66 The World Bank, *China: Air, Land and Water*, (Washington D.C.: World Bank, 2001), 77.

67 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 23, supra note 15.

68 See Iron and Steel Manufacturing Point Source Category, 40 CFR 420 (1982); revised effluent limitation guidelines for the iron and steel facilities were promulgated in 2000 and finalized in 2002, 67 Fed. Reg. 64215 (Oct. 17, 2002).

69 Wrona, Leonard and Julie, Gillian, "Pollution Prevention in the Steel Industry: Toward a Zero Waste Plant," *Iron and Steel Engineer*, (1997).

70 40 CFR Part 420, Iron and Steel Manufacturing Point Source Category; 65 Fed. Reg. 819643 (December 27, 2000).

71 See, e.g., 40 CFR 420.12, 420.62.

72 The Environmental Protection Agency, "Effluent Limitation Guidelines: Iron and Steel," (December 14, 2007), http://www.epa.gov/guide/ironsteel/background.html.

73 GB13456-92. (Text in Chinese)

74 Sinosteel Wuhan Safety and Environmental Protection Research Institute, *Explanatory Report on the Drafting of Effluent Standard for Iron and Steel Industry*, (December 2007), 7, http://www.zhb.gov.cn/info/gw/bgth/200801/W020080117491669284165.pdf. (Text in Chinese)

75 Ibid.

76 Discharge Standard of Water Pollutants for Iron and Steel Industry (GB13456-92). (Text in Chinese)

77 Sinosteel, *Explanatory Report,* 20, supra note 74. (Text in Chinese)

78 This is based on the conversion method described in note 84 below.

79 Sinosteel, *Explanatory Report*, 47-49, supra note 74. (Text in Chinese)

80 Ibid.

81 "Energy consumption of China's steel industry down 8.8%," Xinhua (February 26, 2007), http://www1.cei.gov.cn/ce/doc/cenm/200702260663.htm

82 40 CFR 420.07.

83 If the proposed new Chinese standard applied to cokemaking and continuous casting, its standards for new facilities would be more stringent than, the one day U.S. standard in both cases, but the new Chinese standards as currently proposed would not apply to cokemaking or continuous casting.

84 The "kg/ton of product" figures in the oil effluent standard chart are converted from the original Chinese effluent standard (GB13456-92), which sets concentration levels (mg/L) for the pollutant. In order to make the conversion necessary to permit a comparison, an assumption must be made as to the quantity of wastewater produced per ton of product. The Chinese steel companies that prepared these charts assumed that 10 cubic meters of wastewater would be discharged for each ton of steel produced. Applying the conversion factor of 10 m3 results in the first number in the chart (in the oil effluent standard chart, this conversion results in a figure of 0.08 kilograms of oil discharge per ton of product). The figure in the second line of the chart – the figure of 0.05 kg/ton -- is derived by using the figure of 6.56 cubic meters of water discharged per ton of product in order to make the conversion. The 6.56 figure represents the actual average wastewater discharged per ton of product for the steel industry in 2006, according to the NRDC. See "Energy consumption of China's steel industry down 8.8%," Xinhua, supra note 81. In each case, the Chinese standard selected for comparison in the chart is the most stringent level of water pollution control used for steel plants discharging to the most sensitive bodies of water (Level I). The U.S. kg/ton of product numbers in the chart are from Sinosteel, *Explanatory Report,* 25-28, supra note 74. (Text in Chinese). The same methodology was used in comparing U.S. and Chinese standards for suspended solids, zinc, cyanide, and chromium.

85 If the proposed Chinese standard applied to cokemaking its standard for new facilities would be roughly equal to, or more stringent than, most of the U.S. standards, but the new Chinese standards as currently proposed would not apply to cokemaking.

86 The highest level in a single day.

87 Average level within 30 days.

88 The highest level in a single day.

89 Average level within 30 days.

90 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 16, supra note 15.

91 Ibid.

92 The National Bureau of Statistics, *China Environmental Statistics Yearbook* 2006, 21-29, supra note 59. (Text in Chinese)

93 Ibid.

94 Sun Shubin and Guilin Zhu, "Accelerating the Reuse of Slag is an Urgent Task for the Iron and Steel Industry," *Metallurgic Environmental Protection*, No.2, (2007), 13. (Text in Chinese)

95 NDRC Document (2006) No. 538. (Text in Chinese)

96 Wang Canfa, "Chinese Environmental Law Enforcement: Current Deficiencies and Suggested Reforms," *Vermont Journal of Environmental Law,* Vol. 8, Issue 2, (2007), 170, http://www.vjel.org/journal/pdf/VJEL10058.pdf. An NPC Standing Committee report indicates that the treatment rate of municipal domestic garbage in 2003 was only 58.2 percent, with most of the country's counties and towns disposing of solid wastes without any treatment.

97 42 U.S.C. § 6901-6992k.

98 42 U.S.C.§ 6921(b)(3)(A)(i); See also I*n re Leed Foundry*, Environmental Protection Agency Environmental Appeals Board, Docket 07-02 (February 20, 2008).

99 42 U.S.C. § 9601-9675.

100 Margolis, *Energy and Environmental Profile of the U.S. Iron and Steel Industry*, 25, supra note 15.

101 U.S. Environmental Protection Agency, “Chapter II: Managing Non-Hazardous Solid Waste,” *RCRA Orientation Manual 2006: Resource Conversation and Recovery Act*, (Washington, D.C.: (March 2006), http://www.epa.gov/epaoswer/general/orientat/rom2.pdf.

102 Available at: http://www.law-lib.com/law/law_view.asp?id=87771. (Text in Chinese)

103 Wang Canfa, “Chinese Environmental Law Enforcement,” 170, supra note 96.

104 GB18599-2001 and GB18597-2001. (Text in Chinese)

105 40 CFR 144-148, 260-299.

106 Under the CDM program, companies in Western countries subject to Kyoto have the opportunity to offset their own excess CO_2 emissions by paying companies in developing countries to install GHG controls in their facilities. Since it qualifies as a developing country, China has been able to participate in the CDM program in a number of industries. Existing steel plants in China, or new ones that are built without CO_2 controls, are eligible to receive funds to install CO_2 equipment from companies in other countries needing emissions credits under their own domestic laws.

107 The Netherlands Environmental Assessment Agency, “China contributing two thirds to increase in CO_2 emissions,” (June 13, 2008), http://www.mnp.nl/en/service/pressreleases/2008/20080613ChinacontributingtwothirdstoincreaseinCO2emissions.html. The International Energy Agency had predicted that China would surpass the U.S. in CO_2 Emissions by the end of 2007. See The International Energy Agency, “World Energy Outlook 2007: China and India Insights,” (Paris: OECD/IEA, 2007), 11.

108 Zhang Chunxia et al., “CO2 Emissions of Steel Industry and Its Mitigation Measures.” *2007 Compilation of Papers for the Annual Meeting of the Chinese Iron and Steel Industry,* 427. (Text in Chinese)

109 International Iron and Steel Institute, “A global sector approach to CO_2 emissions reduction for the steel industry,” (December 2007), http://www.worldsteel.org/?action=storypages&id=226.

110 Underlying IISI data indicate that these emissions per ton are specific to CO_2, not GHGs. For the calculation, see Slattery, Jim, “Climate Change: Competitiveness Concerns and Prospects for Engaging Developing Countries,” Testimony on Behalf of American Iron and Steel Institute and the Steel Manufacturing Association before the House Energy and Commerce Committee, (March 5, 2008), 3, http://www.steel.org/AM/Template.cfm?Section=Climate_Change_Focus&CONTENTID=23019&TEMPLATE=/CM/ContentDisplay.cfm.

111 International Iron and Steel Institute, “A global sector approach to CO_2 emissions reduction for the steel industry,” supra note 109.

112 Slattery, “Climate Change,” 3, supra note 110.

113 Ibid.

114 The New Steel and Steel Recycling Institute, “North American Steel Industry: Reducing Energy Consumption,” *American Iron and Steel Institute* (2007-2008), http://www.sustainable-steel.org/energy.html.

115 Slattery, “Climate Change,” 3, supra note 110.

116 Houser, Trevor, Rob Bradley, Britt Childs, Jacob Werksman, and Robert Heilmayr, “Leveling the Carbon Playing Field,” *Peterson Institution for International Economics* (Washington D.C.: World Resources Institute, May 2008), 47.

117 U.S. Department of Energy, “Climate VISION: Program Mission,” (August 22, 2008), http://www.climatevision.gov/mission.html.

118 Ibid. The projected increase in energy efficiency uses 2002 as a baseline.

119 Lieberman-Warner Climate Security Act of 2008 S.3036, 110th Congress, Session 2, (2008), http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:s3036pcs.txt.pdf.

120 Obama, Barack, “Barack Obama: New Energy for America,” *Obama for America*, (2008), http://www.barackobama.com/pdf/factsheet_energy_speech_080308.pdf. McCain, John, “Climate Change,” *John McCain 2008*, (2008), http://www.johnmccain.com/Informing/Issues/da151a1c-733a-4dc1-9cd3-f9ca5caba1de.htm.

121 Slattery, “Climate Change,” 4, supra note 110.

122 Laggett, Jane A., Jeffrey Logan and Anna Mackey, “China’s Greenhouse Gas Emissions and Mitigation Policies,” CRS Report for Congress, (September 10, 2008), 1.

123 Ibid., 2.

124 Ibid., 1.

125 Pew Global Attitudes Project, “Global Economic Gloom - China and India Notable Exceptions,” Pew Research Center, (Washington D.C.: June 12, 2008), 65, http://pewglobal.org/reports/pdf/260.pdf.

126 See for example: International Iron and Steel Institute, “A Global Sector Approach to CO2 Emissions Reduction for the Steel Industry,” (December 2007), 3.

127 See for example: Office of National Coordination Committee on Climate Change, “Asia-Pacific Partnership on Clean Development and Climate,” *China Economic Information Network*, (February 21, 2006), http://www.ccchina.gov.cn/en/newsinfo.asp?newsid=5393.

Chapter V: Pollution Control Technologies and Costs

Tangshan's steelmakers had saved huge amounts of money by minimizing their worries about pollution. For example, none of the steel companies were using pollution control measures for their basic oxygen furnaces, coke ovens and blast furnaces; most of the companies did not apply dust control measures at the casthouse stage; and companies had installed basic dust control facilities but were not using them.

When approached by a reporter for the Chinese news media, a director of a steel company located in Tangshan was unabashed about explaining the basic economics: for his million-ton-a-year-output company, the annual electricity usage was around 150 million kilowatt hours, for which nearly one-third was for dust removal facilities, which was itself only one of many pollution-control technologies in which Tangshan Steel could invest. Just paying the electric bill for dust removal would cost the company 20 million yuan (about $3 million) a year. With other costs such as maintenance and bag-changing, the annual saving for not worrying about dust removal reached 25 million yuan.[1] This savings could then be passed on to customers.

1. Description of Pollution Control Technology.

Modern equipment has been available to steel companies in Tangshan and the rest of China, just as it is available to steel companies around the world.

The following is a partial list of the pollution control equipment, available on the worldwide market, required to be used in steel production in the U.S.:

- Cyclones (or centrifugal collectors): Centrifugal collectors operate by separating dust particles from the gas stream. In a typical cyclone, a centrifugal force is created when the gas stream is spun rapidly. The centrifugal force throws the dust particles toward the wall of the cyclone, which then fall into a hopper located underneath.[2]

- Wet Scrubbers: A scrubbing liquid, which is usually water, comes into contact with a gas stream containing dust particles. Dust removal efficiency increases with greater contact between the gas and liquid streams. In general, all wet scrubbers have three basic operations: the gas-humidification process, which increases the size of fine particles so that they can be collected more easily; the gas-liquid contact process, which provides for contact between the particle and droplets; and the gas-liquid separation process, which enables dust particulates and water droplets to combine into larger particles and settle into a collector.[3]

- Electrostatic Precipitators: Electrostatic forces separate dust particles from exhaust gases using a number of high-voltage, direct-current discharge electrodes, which are placed between grounded electrodes. The contaminated gases flow through a passage formed by these two sets of electrodes, which produces negatively charged particles as they pass through an ionized field created by the electrodes. The charged particles are then collected using a grounded or positively charged electrode, and disposed of by rapping or vibrating the collecting electrodes either continuously or at a predetermined interval.[4]

- Baghouses: Fabric collectors, which are commonly known as baghouses, separate dust particulates from dusty gases through filtration. To capture the particulates, dust-laden gases pass through fabric bags made of woven or felted cotton, synthetic, or glass-fiber material in either a tube or envelope shape which act as filters. With a collection rate of more than 99 percent for very fine particulates, they are one of the most efficient and cost effective types of dust collectors available. The high efficiency of these collectors is due to the dust cake formed on the surfaces of the bags.[5]

- Solids removal: This process removes most solids using simple sedimentation techniques which recover solids as slurry or sludge. However, very fine solids and solids with densities close to the density of water are more difficult to separate from wastewater. In these instances additional filtration may be required. For example, certain salts or poly-electrodes may be used to agglomerate and then filter out the particles.[6]

- Oils and grease removal: Frequently, oils can be recovered from water surfaces simply by using skimming devices. However, additional treatment is often required for hydraulic oils and the majority of oils that have degraded to any extent, which have a soluble or emulsified component that is more difficult to remove.[7]

- Treatment of acids and alkalis: These wastes are often eliminated through neutralization under controlled conditions. However, this process frequently produces a precipitate that needs to be treated as a solid residue since it may be toxic. In other instances, gases may be generated which require separate treatment as well.[8]

- Treatment of metals or other toxic materials: Many materials such as zinc, silver, cadmium, thallium acids, alkalis, arsenic and selenium cannot be eliminated using biological processes unless the materials are very diluted. Instead, they are usually removed by altering the pH or treated with additional chemicals. In cases where the materials are resistant to these processes, they may require disposal through landfilling or recycling.[9]

The costs of these pollution control technologies can vary widely. For each facility, an individual piece of control equipment needs to be designed for the volumetric flow rate of a gas, specified to conditions of temperature, pressure and relative humidity. The cost range is further dependant on the concentration of the pollutant, the size of the control equipment needed, and the efficiency required; these can vary substantially from facility to facility.[10] For example, electrostatic precipitators, which account for some of the highest capital investments for pollution control technology, can range in cost from $2 million to $150 million.[11] Wet scrubbers can range in cost from $250,000 to $10.5 million;[12] Baghouses can total anywhere from $600,000 to $13 million.[13] Cyclones, which by themselves are usually not adequate to meet air pollution regulations, can cost between $2,500 and $90,000.[14]

As discussed in the next section, the electricity and personnel needed to operate and maintain the equipment is also a major expense. In fact, operation and maintenance of the equipment, rather than capital expenditures, is today the largest part of the annual pollution control budgets of most steel companies in the U.S. and China.

2. Comparison of Chinese and U.S. Costs of Operation and Maintenance.

The data show that U.S. steel companies probably expend approximately twice as much per ton of steel as their Chinese counterparts on the operation and maintenance of pollution control programs.

a. Costs in the U.S.

In recent years, the U.S. steel industry has replaced many of its least efficient production facilities, and at the same time there has been an increase in the number of modern electric arc furnaces (EAFs) in the industry. These changes have made pollution control less expensive because the process is more environment-friendly. This is the case even though EAFs pose their own particular costs. The dust generated by these facilities during the steelmaking process is regulated as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) because its high concentrations of lead and cadmium make it quite expensive to remove.[15] On average, EAF facilities pay from $150 to $200 per ton of dust to dispose of the dust in landfills, a cost that does not include any onsite treatment that may be required.[16]

Overall, U.S. industry continues to incur significant costs as federal and state regulations have continued to add new environment-related costs.

The following chart summarizes environmental operation and maintenance costs for four U.S. companies, based on figures reported in the companies' annual financial reports to the U.S. Securities and Exchange Commission. The chart traces the companies' expenditures during the decade of the 1990s and the first seven years of the current decade. The companies in the chart represent some of the largest steel companies in the U.S.— their operations, at least during the earlier part of this period, fell mainly on the integrated side. As of today, the operations of several of the companies listed have been absorbed into the operations of other companies, some of which are now headquartered in other countries.

The chart provides the expenditures per ton-of-steel, calculated by using the production numbers contained in the companies' annual reports.

Operation and Maintenance Expenses per Ton of Steel (U.S. $)

	U.S. Steel	**Bethlehem**	**AK Steel**	**LTV[17]**
1991	n/a	14.50	n/a	n/a
1992	n/a	12.38	n/a	n/a
1993	n/a	12.14	n/a	20.58
1994	n/a	11.73	n/a	15.27
1995	n/a	11.73	n/a	13.59
1996	n/a	12.23	12.23	11.62
1997	n/a	11.67	18.29	19.10
1998	n/a	11.18	21.34	19.75
1999	16.54	12.23	17.60	16.55
2000	17.07	10.40	14.40	15.00
2001	18.23	10.68	17.71	n/a
2002	14.82	10.56	18.91	n/a
2003	13.81	n/a	17.13	n/a
2004	13.96	n/a	15.85	n/a
2005	16.88	n/a	16.98	n/a
2006	17.43	n/a	20.34	n/a
2007	16.51	n/a	18.95	n/a
Average	**16.14**	**11.79**	**17.48**	**16.43**

The average of the average O & M expenditures of the four companies is $15.46 per ton of steel produced.

The Census Bureau has released recent aggregate data on the U.S. steel industry as a whole. The Census Bureau's report, Pollution Abatement Costs and Expenditures Report, is released every five years. The data from the most recent Census report, for the year 2005, shows that pollution abatement operating costs for steel mills in the U.S. (North American Industry Classification System (NAICS) category 331111) totaled \$1.167 billion. The breakdown is as follows: air, \$449.1 million; water, \$389.4 million; and solid waste, \$328.5 million.[18]

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Since U.S. production of crude steel was approximately 95 million tons in 2005, the U.S. industry on average spent \$4.73 per ton on air pollution abatement, \$4.10 per ton on water pollution abatement, and \$3.46 per ton on disposal of solid waste.[19] Altogether, industry expenditures came to about \$12.29 per ton of steel. This per ton figure is some \$3.17 less than the average per ton figure reported by the four companies, but that would be expected since the four companies operated mostly on an integrated basis during the years represented on the chart. The Census numbers represent an average of both integrated and minimills, which face lower environmental costs due to the nature of the EAF manufacturing process.

These numbers do not include the amount U.S. industry spent cleaning up polluted disposal sites under the Superfund law. This law imposes a continuing obligation on U.S. steel companies to remediate conditions caused by past disposal practices. These expenses can be significant. For example, from 1999 through 2007 U.S. Steel spent a total of \$233 million on remediation costs to satisfy its hazardous waste disposal obligations.[20] With respect to the industry as a whole, U.S. steel mills in 2005 spent a total of \$70 million on clean-up of superfund sites.[21] This is in addition to the operation and maintenance costs noted above for waste disposal. The vast majority of these expenditures were for operation and maintenance costs, totaling \$66.6 million (\$.70 per ton), with only \$3.4 million (\$.04 per ton) labeled as capital expenditures.[22]

b. Costs in China

There are frequent public reports indicating that the Chinese steel industry has made only limited expenditures in operating and maintaining pollution control equipment. For example:

- Blast furnaces with a capacity over 1000m^3 usually have cyclone dust collectors installed as their pollution control measure. But the effect of pollution control is generally poor, largely because the cyclone dust collectors, usually installed at the top of blast furnaces, are not maintained.[23]

- Many small steel companies, though using wet scrubbers for their basic oxygen furnaces (BOFs), maintain the equipment poorly.[24]

- Many companies fail to change broken bags on baghouses. This is another reason that high particulate matter (PM) emissions levels exist in China, even when bag dust collectors have been installed.[25]

As illustrated at the beginning of this chapter, media reports have revealed cases in which steel companies sometimes intentionally leave pollution control equipment idle to save energy costs. The director of a steel mill in Liaoning province acknowledged that dozens of baghouses at his company, which accounted for eight percent of the mill's electricity bill, were shut down to "save energy."[26]

This anecdotal information is consistent with Chinese government statistics. In 2006 the Chinese steel industry (including mining, smelting, processing and metal product manufacture) spent 9,950,921,000 yuan (about $1.42 billion) operating air pollution control facilities (including desulfurization) and 4,403,750,000 yuan (about $629 million) operating wastewater processing facilities in connection with the smelting and pressing of ferrous metals.[27]

The Chinese steel industry produced approximately 423 million tons of raw steel in 2006. Thus, the operational cost-per-ton of steel produced for air pollution control facilities was 23.54 yuan per ton (about $3.36 per ton) and 10.42 yuan per ton (about $1.49 per ton) for water pollution control. Together, the total operating and maintenance costs for the Chinese industry for air and water pollution control was $4.85 per ton, compared to $8.83 per ton in the U.S.

c. Other Operation and Maintenance Costs.

The Chinese numbers do not include the additional expense of paying permit discharge fees that, as discussed in Chapter III, are not directly comparable to anything that U.S. companies pay. However, these fees are not sufficiently large to make a significant difference in the comparative operating costs of Chinese and U.S. companies related to pollution controls.

Comprehensive statistics on actual discharge fees levied on the industry are difficult to come by. Only a few sub-national environmental bureaus publish actual discharge fee figures, and such figures are often incomplete.

Some Chinese experts estimated in 2004, however, that the annual discharge fee levied on the Chinese steel industry in 2000 was 270 million yuan (about $38.6 million).[28] Given total steel production in 2000 of 127.24 million tons, the amount of discharge fees the industry paid on average was $0.30/ton.

There are no readily available statistics indicating the amount the steel industry is now paying in discharge fees following the fee increases in 2003. As discussed in Chapter III, four municipal Environmental Protection Bureaus (EPBs) reported that a particular company in its jurisdiction paid discharge fees ranging from $1 per ton for the smallest mill to $0.23 per ton for the country's second-largest steel company. Although reported after the 2003 fee increases, these results still fit within the $0.14 to $1.40 per company range that experts estimated steel companies were paying per ton prior to the 2003 changes to the law.[29]

Figures for the amount all industries paid in discharge fees provide some indication of the increase in discharge fees after 2003. In 2003 the total discharge fees collected in the country was 7.3 billion yuan (just over $1 billion), while in 2006 discharge fees had doubled to 14.4 billion yuan (just over $2 billion).[30] However, in the intervening years the Chinese economy had increased significantly. This would naturally lead to increased discharge fees even in the absence of any rate hike.

If the same proportional increase occurred in the steel industry as in all industries, it would suggest that the amount of discharge fees has perhaps doubled from $.30 per ton to $.60 per ton. Nevertheless, this may overstate the increase because it does not take into account that total discharge fees for all industries doubled in part because of the expanding economy.

Even more difficult issues are presented by the absence of data indicating the amount the Chinese steel industry expends on the disposal of solid waste, including hazardous waste. As discussed in Chapter IV, the laws governing the disposal of solid waste in China are not well developed, and discharge fees are only payable if disposal exceeds a specified level. There are no laws in China imposing any financial responsibility on steel companies for remediating sites in which hazardous wastes were improperly disposed in the past. Thus the Chinese industry has no expenses comparable to the $70 million U.S.

industry spent in 2005 cleaning up disposal sites.

The absence of any statistics on the amount the industry expends on solid waste disposal supports the conclusion that the Chinese steel industry does not face significant costs in this area. This conclusion is consistent with the undeveloped state of the laws governing solid waste disposal and the absence of any laws governing the remediation of hazardous sites required of U.S. companies under Superfund. However, there is no way at this time to determine exactly what the Chinese steel industry may be spending on solid waste disposal.

d. Comparison of Overall Operation and Maintenance Costs.

Based on the Census numbers discussed above, in 2005 U.S. industry spent a total of \$8.83 per ton on operation and maintenance of equipment to control air and water pollution. The Chinese industry in 2006 spent \$4.85 per ton on air and water pollution operation and maintenance costs. In other words, the U.S. steel industry spent \$3.98, or over 80 percent more than the amount that their Chinese counterparts spent on operation and maintenance activities per ton of steel to control air and water pollution.

Statistics indicate that the U.S. steel companies also spend \$3.46 per ton on disposal of solid wastes in general, and another \$0.70 per ton for clean-up of Superfund sites, providing a total expenditure of \$12.99 per ton when these expenses are added to the operation and maintenance expenditures on air and water controls. In contrast China spends \$4.85 per ton as noted above on operation and maintenance expenses to control air and water pollution.

This difference does not include any adjustment for the amount Chinese industry spends on discharge fees and solid waste disposal in light of the absence of any available statistics for these operation and maintenance expenses in China. The discharge fees paid by Chinese industry are well under \$1 per ton, do not necessarily reduce the amount of pollutants emitted, and as much as 80 percent of the fee may be returned to the steel company, as discussed below. Therefore discharge fees have a very small impact on the expense of controlling pollution in China. With respect to the solid waste disposal costs, as noted above the law is not well developed, and the Chinese government does not even appear to keep separate account of the industry's costs in this area, suggesting the expenses incurred by Chinese companies are small.

Even if some adjustment were made for these two categories of possible expenses it is unlikely that they would significantly reduce the differential between U.S. and Chinese expenses. If Chinese costs were increased by \$0.60 per ton for discharge fees and \$1 per ton for solid waste disposal, and there is no way to confirm that this or any other estimated adjustment is correct, Chinese costs would still be only half of those costs U.S. industry incurs per ton of steel.

Regardless of how the exact amounts of the expenditures in the two countries are calculated, the differential is particularly striking because of the much heavier reliance in China on integrated steel mills. Integrated mills, because they do not use recycled steel as their raw material, incur more costs controlling pollutants than mills using EAFs. Given the heavier reliance in the U.S. than in China on EAFs, the per ton operation and maintenance expenditures in the U.S. should be less than the per ton operation and maintenance expenditures in China. Instead it is far more.

Based on the price of steel in the fall of 2008 of around \$900 per ton or more in the U.S., and the average price of steel in China around \$700 or more per ton, depending on the kind of steel product, the amount expended on pollution control in both countries is a relatively small portion of the total price of steel.[31] However, if China had spent on operation and maintenance pollution expenses in 2006 at the same rate as the U.S. spent in 2005, it would have had to spend on air and water controls alone about \$1.7 billion more than it actually spent.[32]

3. Capital Expenditures for Pollution Control Facilities.

In addition to expenditures on operation and maintenance, steel companies in both countries must make capital expenditures to purchase the equipment and facilities used to control pollution. The following compares capital expenditures in the U.S. and China.

a. Capital Expenditures in the U.S.

In the U.S., costs of pollution-control technology in the steel industry stem in large part from regulations that require a steady increase in engineering effectiveness.[33]

A Department of Energy report issued in 2000 estimated that over the past thirty years the U.S. steel industry invested $10 billion in improving its environmental record.[34] By a similar, but somewhat lower estimate, U.S. steel companies have spent a reported $7 billion, or an average of around $230 million a year, on anti-pollution efforts between around 1970 and 2000.[35]

Additionally, a report by experts at the Carnegie Mellon University estimated that the steel industry invested $6 billion in pollution control systems from 1976 to 1996, or around $300 million a year.[36]

These estimates of historic levels of expenditures in the U.S. industry approximate the more current numbers from the U.S. Census Bureau, which indicate that 2005 capital expenditures for pollution abatement was $241.1 million for steel mills (NAICS category 331111). The vast majority was spent on investments to control air pollution ($195.4 million). Equipment to control water pollution accounted for $22.9 million, and equipment for solid waste disposal amounted to almost the same amount ($22.8 million).[37]

Since U.S. steel production was about 95 million tons in 2005, this equates to around $2.54 in capital expenditures per ton of steel produced in that year.

b. Capital Expenditures in China.

Pollution-fighting in China has become a $20 billion annual industry that is growing by about 20 percent a year, according to the China Association of Environmental Protection Industry, a Beijing trade group and consulting firm. In 2003 Li Baojuan, deputy director of the industry association, predicted that "the next 5 to 10 years will be a golden era for environmental protection in China."[38]

Chinese laws, even though they are at the moment less stringent than those in the U.S., will likely require Chinese steel mills to invest substantially on pollution control technology and equipment in coming years. China is in the process of upgrading its pollution standards, as discussed in Chapter IV, and for many steel mills it will only be possible to meet these more stringent standards if they purchase additional pollution control equipment. The requirements applicable to new facilities, as discussed in Chapter III, also increase the purchase of pollution control equipment when new steel facilities are built. Further, the government is making efforts, as discussed in Chapter VI, to reduce the number of small steel mills, and to consolidate production in larger, more efficient steel mills. These larger steel mills are more likely to have the resources to purchase pollution control equipment.

Based on a wide variety of reports, actual expenditures on capital investment for environmental controls in the steel industry appear to be uneven, and depend in part on the size of the company. One Chinese environmental expert said in an interview for this report that China would have to increase its spending on pollution control technology three to four times to achieve emissions reductions equal to those in developed countries.

Statistics such as the following indicate the relatively limited capital investment the majority of the Chinese steel industries have made compared to the need.

- As of January 2006, 60 percent of the machinery coke ovens in China were not equipped with dust control facilities or were not effectively running their dust control facilities.[39]
- 50 percent of the desulfurization (coal gas cleansing) facilities for small and medium sized machinery coke ovens are not installed properly; and coke oven coal gas is generally not recycled.[40]
- According to a nationwide survey of large-medium sized steel companies (involving 25 facilities and 137 samples), 20 percent of facilities use multi-clone dust collectors – an outdated technology that is highly inefficient – to control PM emissions from the sintering stage.[41]
- According to a nationwide survey of 14 large-medium sized steel companies in China, most have not adopted pollution control measures for SO_2 and NO_X at the ironmaking stage.[42]
- Most of the older and smaller blast furnaces do not have any emissions control measures for the pressure relief process.[43]
- Many of China's small-scale steel companies use old and inefficient technologies. Smaller BOFs and EAFs usually do not have adequate dust control features. Some companies have installed dust control equipment, but often leave it idle.[44]
- During the transportation, processing, and storage of raw materials, small steel companies also do not apply any dust control measures, allowing serious levels of fugitive emissions to occur.[45]
- Because smoke from electric arc furnaces has a very high temperature, cooling devices or high-temperature-tolerance bags are important. However, inadequate investment often leads to broken bags that seriously impede pollution control.[46]

In recent years the rate of capital expenditure in both the U.S. and China has been roughly similar on a per ton basis. However, it would be expected that the rate of investment in China would be significantly greater because most of China's industry still does not have advanced pollution control technology, and because China's steel industry is in the process of catching up with its more-established U.S. counterparts, which for many years have been spending substantial sums on pollution control equipment.

The lack of adequate investment in modern equipment is not limited just to the middle-sized or small mills. According to a report being prepared for publication by an environmental expert in Beijing, Benxi Steel, now part of one of China's leading steel groups, Anben Steel, is also beset by pollution problems largely due to outdated technologies and the lack of advanced pollution control measures. The company is still running a 75m^2 sintering machine, 3.3m and 4.4m coke ovens, and a 380m^2 blast furnace, all of which are listed by the government as outdated facilities that need to be phased out. The company's A and B coke ovens have been operating for somewhere between 18 and 34 years. The oven bodies are very old, which leads to serious fugitive emissions and waste gas leakage. Two coke ovens have not installed any dust control equipment. None of the company's 15 boilers have desulfurization facilities installed.[47]

Aggregate numbers on overall capital expenditures for environmental controls by the Chinese steel industry are scarce. A publication issued by the Chinese steel industry in 2000 estimates that the industry invested a total of 2.72 billion yuan (about $389 million) in environmental protection, of which 690 million yuan were for water, 1.64 billion yuan were for air, 150 million yuan were for solid waste and 40 million yuan were for noise.[48] By 2004, this figure had risen to 5.89 billion yuan (about $840 million), with 2.99 billion yuan spent on air pollution abatement.[49] Based on these figures, in both 2000 and 2004 total capital expenditures per ton of steel produced held consistent between approximately $3.05 per ton in 2000 and $3.00 per ton in 2004, as China's steel production levels rose dramatically between 2000 and 2004. This compares to capital expenditures by the U.S. steel industry in 2005 of $2.54 per ton.

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Thus, in recent years the rate of capital expenditure in both the U.S. and China has been roughly similar on a per ton basis. However, it would be expected that the rate of investment in China would be significantly greater because most of China's industry still does not have advanced pollution control technology, and because China's steel industry is in the process of catching up with its more-established U.S. counterparts, which for many years have been spending substantial sums on pollution control equipment. Equally important, the heavy reliance on integrated mills in China would indicate the need for greater capital investment in pollution control equipment in recent years, compared to the far greater reliance on EAFs in the U.S.

Chinese steel executives in four different provinces interviewed for this report helped provide a fuller picture of expenditures by Chinese steel companies. Among the information provided was:

- A company in Shanxi Province, with an annual steel output of 9.3 million tons, reported spending 300 million yuan (about $43 million) as capital expenditures on pollution control in 2007, which amounts to $4.61 per ton of steel.

- A company in Shandong Province, with an annual steel output of 7.1 million tons, reported spending 152.7 million yuan (about $21.8 million) as capital expenditures on pollution control in 2007, which amounts to $3.07 per ton of steel.

- A company in Yunnan Province, with an annual steel output of 6 million tons, reported spending 120 million yuan (about $17 million) as capital expenditures on pollution control in 2007, which amounts to $2.86 per ton of steel.

- A company in Hebei Province, with an annual steel output of 2.3 million tons, reported spending 12 million yuan (about $1.7 million) as capital expenditures on pollution control in 2007, which amounts to 75 cents per ton of steel.

With respect to the two Chinese steel companies with production levels in the middle, capital expenditures appear to be comparable to the overall industry average noted above. The company with the smallest production, from Hebei Province, invested about 25 percent of the industry average, and about one-sixth of the amount invested by the company interviewed with the largest production. The steel company from Hebei Province, with production of 2.3 million tons, is not one of the smallest companies in the country, and its record suggests that many companies, including the majority of all the companies in China that produce less than two million tons per year, are likely to have even lower investment rates than the relatively limited expenditures of around $3 per ton that is the industry average.

c. Pollution Control Costs as Percentage of Total Capital Expenditures.

Because capital expenditures on pollution equipment will benefit a company for a number of years, calculations such as expenditures per ton of steel may exaggerate the amount of the expenditure in the year it is made, and underestimate expenditures in other years. Another way to measure level of effort is to calculate the capital expenditure on pollution control technology as a percentage of total capital expenditures.

The two largest steel companies in China devoted between three percent and five percent of their total capital expenditures on environmental controls:

- Baosteel, the largest steel company in China in 2007, invested 4.34 billion yuan (about $620 million) in environmental protection during its three-phase construction spanning from 1975 to 2000.[50] This accounted for five percent of its total 86.3 billion yuan investment budget.[51]

- Anshan Steel, part of China's second largest steel company in 2007, Anben Steel, set aside between 3 and 3.4 percent of its total investment budget for environmental protection, according to one expert estimate.[52]

The total capital expenditures made by all steel companies in 2004 was 192 billion yuan ($27.4 billion), while the amount spent on capital expenditures in the environmental area equaled 5.89 billion yuan ($841.4 million). Thus, capital expenditures on environmental equipment throughout the industry equaled only three percent of total capital expenditures.

As percentage of total investment, these numbers are much less than in past years in the U.S. In the six years from 1976 through 1981, environmental expenditures, according to a 1995 EPA study, averaged about 17.6 percent of the U.S. industry's total capital expenditures. This was a period in which the steel companies implemented programs to comply with the newly passed Clean Air Act (CAA) and Clean Water Act (FWPCA). The rate of capital expenditures fell in subsequent years, but from 1982 through 1992 environmental expenditures by the U.S. steel industry still averaged 8.4 percent of total capital expenditures.[53]

d. Assistance to Industry from Provincial Governments.

Steel companies in China, along with companies in other industries, may receive government funds to defray some of the cost of purchasing pollution control equipment. The Law of the People's Republic of China on the Promotion of Cleaner Production of 2002 provided that Chinese industries that operate in a clean manner may receive government support from "relevant funds."[54] In 2003 the new Ordinance on the Levying of Discharge Fees directed that discharge fees collected by the EPBs of provincial or local governments should be transferred to that government's treasury department. The treasury departments then include the discharge fees in an Environmental Protection Special Fund and disperse the funds for environmental projects. This represents a reform of the earlier practice which allowed each EPB—instead of the treasury department—to both negotiate the size of discharge fees to be paid by industry, and to dispense the funds collected back to the companies for pollution control projects. This change may avoid the distorted results that can occur when the same regulators that negotiate discharge fee levels with the steel company also decide how much of the collected fees to return to the same company. According to one Chinese expert, as much as 80 percent of the amount a company pays in discharge fees is eventually returned to it in this manner.[55]

There may also be related foundations in various provinces that distribute some funds to industry for pollution control technology and other clean technology. For example, in Jiangsu Province, the Environmental Pollution Prevention Foundation has helped finance the acquisition of clean technology by small and medium size companies since at least 1998. The foundation is managed by the provincial treasury together with the EPB. The source of the foundation's funding includes: 20 million yuan ($2.86 million) each year from the treasury; plus five percent of the discharge fee on SO_2; plus donations.[56]

A total of 2.9 billion yuan ($414 million) were dispersed to all industries in 2006 from these different funds to support capital expenditures in the environmental area.[57] This $414 million represents about six percent of the total amount of 48.4 billion yuan ($6.9 billion) of 2006 capital expenditures in the environmental area by all industries.

The actual amount of support that the steel industry obtains from these government funds is unclear. One academic expert indicated in an interview for this report that at least two large steel companies, Baosteel and Shougang (Capital Steel), may have received substantial amounts of money under this program. In the view of this expert, some of the officials running the funds have a preference for supporting large companies due to the fact that investments in such companies can produce the largest improvements in emissions; these companies, furthermore, are likely to be the most stable and the most likely to continue in business for a substantial number of years. However, there is no public record of the total amount the various funds have provided to steel companies.

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Chapter VI: Enforcement and Compliance

The local government in Tangshan helped protect small steel mills by approving their applications to upgrade slightly above the shutdown threshold.

Local regulators had placed Tangshan's 23 small steel companies on a "shutdown" list, but steel company owners mocked them. One explained to local reporters that his attitude was, "You make your list; I'll make my steel."

By mid-2007, some mills no longer existed on paper. But they continued their steel production at night. Other companies operated on a round-the-clock basis. Fearing that with continued publicity a government-ordered shutdown might still occur, they wanted to pump out as much steel as possible.

A considerable rise in steel prices on the world market in 2007 triggered a new boom in Tangshan, stimulating its steel mills to increase their production even further.

As Pan's regulatory "hurricane" stretched through its fourth year, SEPA released documents showing 82 cases of serious environmental law violations by different industries, including thirty steel companies. Tangshan was cited as one of the nation's most problematic regions.

Pan again held press conferences. This time he accused Tangshan's government of "blindly developing an energy-consuming, high-pollution industry despite the already extremely limited carrying capacity of the environment."[1]

According to Pan, Tangshan still had seventy steel companies, with an average annual output of only 0.65 million tons, and 80 percent of them had never undergone any environmental assessment. He documented that many new steel companies in Tangshan had started production without approval; other companies, he said, were exceeding PM emissions standards and violating other environmental policies.[2]

Today, when people in Tangshan hang up their freshly-washed clothes outside to dry, the clothes still turn black.

1. Small Steel Mills and China's Enforcement Problems.

The difficulties that the central government faces in attempting to enforce environmental decisions on the Chinese steel industry are illustrated by its recent experience in trying to reduce the number of small mills. Its experience in Tangshan, chronicled at the beginning of this and each of the previous chapters, is just one example of these problems.

In the early years of this decade, as the demand for steel rose, private investors constructed many small mills, sometimes without the necessary approval of the authorities and without investing in up-to-date technology.[3] Many experts and company officials interviewed for this report confirmed that these small mills tend to be among the heaviest polluters and they have posed particular enforcement problems for the government officials. A high percentage of the small mills may go out of business in a short period of time, so there is less incentive for the owners to invest in expensive pollution control equipment. One adviser to one of the large steel companies said of these smaller mills, "We have too many crazy new guys polluting the air, dirtying the water and paying low salaries to their workers."[4]

China's central government is concerned about many of these small mills because they are inefficient consumers of energy, iron ore and other raw materials, and because their pollution levels are excessive. As discussed below, the central government has adopted an aggressive strategy of doing what it attempted in Tangshan, shutting down small and inefficient furnaces.

a. Initiative of NDRC.

In April 2007, the National Development and Reform Commission (NDRC) made a high-profile announcement: by the end of 2007, China would phase out small steelmaking furnaces with a total capacity to make 30 million tons of iron and 35 million tons of steel. By the end of 2010, the NDRC said, it would phase-out small furnaces with the total capacity to produce each year 100 million tons of iron and 55 million tons of steel. By achieving this goal, NDRC experts explained, the Chinese steel industry would save 50 million tons of coal, 100 million tons of water and reduce 400,000 tons of sulfur dioxide (SO_2) emissions by 2010.[5]

The NDRC quickly signed "target responsibility agreements" with 10 steel-producing provinces to eliminate small furnaces with 39.86 million tons of ironmaking capacity and 41.67 million tons of steelmaking capacity before 2010. According to the agreements, 22.55 million tons of ironmaking capacity and 24.23 million tons of steelmaking capacity would be gone before the end of 2007.[6] In December 2007, NDRC signed more agreements with eighteen other provinces to eliminate small furnaces with another 49.31 million tons of ironmaking capacity and 36.1 millions of steelmaking capacity before 2010.[7]

In total, the agreements covered various companies owning some 948 steel facilities in the 28 provinces, with their names published to encourage public scrutiny. In an apparent attempt to facilitate the closings, Guangdong province in the past year gave $3.6 million to cities that shut down certain steel facilities.[8]

b. Effectiveness of Chinese Government Policy.

This shutdown strategy is only partially working. A document the NDRC released in October 2007 listed several problems that have been impeding the shutdown process, many of which are very familiar to anyone who had studied the Chinese steel industry. Some companies had simply enlarged their furnaces slightly over the size threshold for phase-out, so that they could avoid the shutdown; some companies had temporarily left their furnaces idle, without dismantling them, so that they could quickly resume production whenever public attention faded; some companies had sold their non-complying facilities to companies in other regions; some companies had changed their usage of their small furnaces to produce products other than iron, such as ferrous alloy.[9] As noted in the description of the mills in Tangshan, some mills, though no longer existing on paper, still continued their steel production at night. Many of them operated in a round-the-clock manner to produce as much as they could before the serious crackdown.[10] NDRC was also forced to recognize that the shutdowns had adversely affected local tax revenues and employment, which put pressure on local governments to avoid the shutdowns.

One Chinese scholar who closely observes the government's compliance efforts indicated in an interview for this report that the periodic efforts of well-publicized crackdowns (fengbao) on violators of the environmental laws such as occurred in Tangshan are not very effective in the long run. They may result in factories closing temporarily, but the facility might reopen after a few months in the same place, or the owner might reopen his business in another polluting factory somewhere else.

By November 2007, NDRC had achieved only 40 percent of its 2007 phase-out target.[11] As discussed in Chapters I and II, the 2008 global economic troubles on the one hand may further slow government efforts to close down small, polluting mills and these conditions may limit other enforcement efforts, but on the other hand some of the smaller and more polluting mills may be forced simply by reduced demand to close.

2. Inadequate Resources Available to MEP.

As noted previously, the MEP has about 300 official employees, as compared to the roughly 18,000 employees of the Environmental Protection Agency (EPA), its counterpart in the U.S.[12] The MEP's Bureau of Environmental Supervision, which was created in 2003 to serve as the entity in the central government specifically responsible for the enforcement of environmental regulations, is also seriously understaffed. A 2006 OECD report determined that in 2004 it had an annual budget of 4.4 million yuan (about $600,000), and that the Bureau could employ only 45 enforcement officers This made up just 0.62 percent of the total budget of the State Environmental Protection Administration (SEPA) in 2004.[13]

To make the situation even worse, the Bureau has also been given numerous other responsibilities, including coordination of national discharge fee collection efforts, which, according to researchers, further strains its already limited manpower.[14] As discussed in Chapter II, there are additional employees from research institutes that the MEP can utilize in carrying out its functions, but even counting these unofficial employees the MEP's resources devoted to enforcement do not begin to equal those of the EPA.

In addition to the limited resources, the Bureau also has inadequate legal tools at its disposal. In a 2005 media interview, a Bureau official openly expressed concerns with SEPA's inability to use coercive power over polluting enterprises, including the power to shut down facilities and to collect fines directly from the enterprises' bank accounts. The absence of criminal sanctions in most cases and the absence of authority to impose significant civilian penalties also restrict the Bureau's ability to hold polluters accountable.[15]

In contrast to China, the federal government in the U.S. plays a more extensive role in enforcing environmental laws. EPA has extensive legal authority and resources to enforce the environmental laws. Its enforcement arm has more than 3,000 employees and an annual budget of more than $700 million, compared to MEP's 45 enforcement officers and a $600,000 budget noted above. The EPA has 17 program offices and 10 regional offices around the country that report to and coordinate with EPA headquarters. In addition to its enforcement resources, the EPA has its own technical and engineering staff to make scientific judgments about complex regulatory compliance issues. It also utilizes numerous private contractors who provide technical advice to EPA enforcers. When there is a serious environmental violation, the Environment and Natural Resources Division of the U.S. Department of Justice often takes the lead in enforcing environmental laws through the U.S. federal courts. EPA's numerous regional offices play a key role in coordinating local environmental enforcement through cooperation with regional offices of other agencies (particularly the Department of Justice in the area of enforcement), state enforcement offices, and non-governmental institutions.[16]

3. Poorly Crafted Laws and Weak Mandates.

Chinese environmental laws, though extensive in scope, have major conceptual and structural problems. According to one Chinese professor specializing in the environment, part of the cause of these problems is an attempt to follow international trends in environmental regulation while "ignoring necessary procedural and implementation mechanisms."[17] This has led to China adopting some laws that even developed countries do not impose, although these regulations do not have a great deal of actual influence.[18]

The professor uses China's Solid Waste Law as an example. Because of the legislators' lack of information about the mechanics of solid waste and available pollution-abatement technologies, this law is very difficult to enforce in practice. The various articles of the Solid Waste Law express broad principles but few substantive standards or detailed procedures to implement the law, even though the law has been on the books for more than 12 years.

The vagueness of Chinese environmental laws and its impact on enforceability is also demonstrated in the Air Pollution Prevention Law. It contains platitudinous statements such as "enterprises should prioritize the use of high-energy-efficiency and low-pollution technologies."[19] Or, "the State encourages the use of low-sulfur content coal."[20]

According to one Chinese expert who had experience earlier in his career trying to implement the laws, this absence of detailed standards and other necessary guidance in the law and regulations makes it very difficult for industries and officials at the local level to know precisely what requirements they should implement and enforce.[21]

Compared to the Chinese laws, U.S. environmental statutes and regulations contain more specific criteria, more prescriptive language, and more detailed procedures, while avoiding non-binding or hortatory language. Both the Clean Air Act (CAA) and the Clean Water Act (FWPCA) have been amended and strengthened on several occasions, so that both statutes are now detailed and prescriptive. This reflects the tendency of Congress to reduce the amount of discretion granted to the EPA to administer the law, and the desire to provide clear directions to industry on the steps it needs to take to comply with the law. As a result, there is less opportunity for a company to use an ambiguous provision to avoid complying with the law, and to avoid implementing and enforcing a provision.

Chinese programs may also lack adequate legal basis to permit effective enforcement. The total emission control targets discussed in Chapter III that China may adopt in order to control total emissions of SO_2 suffer from a lack of specific rules governing allocation of the targets and penalties. China's Air Pollution Prevention Law does not list any civil or criminal penalties for companies breaking the total emissions control targets, rather than the concentration standards. This leads to difficulties in implementation.[22] Without the support of national laws, environmental regulators are not able to impose any punishment over polluters whose emissions exceed emissions targets.

4. Inadequate Resources Available to Provincial and Local Governments.

Most of the officials available in China for inspecting facilities are not at either the central government or the provincial level, but at the municipal and county level. In 2004, there were over 3,000 environmental inspection agencies in China with a total of about 47,000 inspectors—633 inspectors at the provincial level (with the highest number of 53 inspectors in Tianjin and the lowest of 8 in Hubei province), 8,164 inspectors at the municipal level, and 38,356 inspectors at the county level.[23] However, a recent report by the Organisation for Economic Co-operation and Development notes that this level of staffing is not sufficient for local EPBs to do their job.[24] For example, even in Shanghai, which has received national recognition for its leadership on environmental matters, there are only 50 employees available to inspect over 20,000 factories.[25]

There is also a shortage of high-quality, well-educated employees among those involved in the enforcement effort. A recent survey by the MEP's Bureau of Environmental Monitoring and Inspection and by the Environmental Defense Fund involving 85 local environmental agencies showed that on the county level only 63.1 percent of the environmental bureau staff had the equivalent of a college education and not a single county-level employee in the surveyed agencies had a graduate-level degree.[26]

Researchers from the Bureau of Environmental Monitoring and Inspection and the Environmental Defense Fund have concluded that 47 percent of the provincial environmental budget should be used for daily monitoring, inspection, fee collection and other enforcement work.[27] Instead, they found that only 18.4 percent of the provincial environmental budget is actually used for enforcement. Money from the enforcement budget, the researchers found, is often transferred for other uses irrelevant to monitoring and inspection. The survey also found that on the provincial and municipal levels, five inspectors usually share one vehicle, while at the county-level 12.5 inspectors share one vehicle.[28]

The size of an EPB's budget for enforcement has been shown to be the most fundamental factor in determining the effectiveness of environmental enforcement in China. In a 2003 study on environmental enforcement among several Chinese cities specifically chosen to be representative of the various regional differences, researchers found that greater resources encouraged more aggressive enforcement.[29] In fact, when compared with other factors that can affect environmental enforcement, such as public support or clarity in rules and regulations, this study found government financial support of EPBs to be the chief determinant of agency actions.[30]

Regional and interagency coordination is another problem hindering enforcement in China. Because environmental agencies have traditionally had a low stature in the government hierarchy, it is difficult for them to coordinate enforcement efforts among different provinces or government agencies. Although in recent years high-profile multi-agency "joint enforcement campaigns" (*lianhe zhifa xingdong*) have achieved some results, the long- term coordination problem persists.

The absence of adequate funding and the lack of coordination between authorities at the local level have especially affected the success of China's efforts to reduce water pollution. Local authorities tend to give priority to enforcing air pollution controls since the condition of the air directly affects local residents. In comparison, polluted water can be diverted downstream to other cities, thereby enabling the local authorities to avoid the need to treat the water itself. In the absence of effective coordination between local jurisdictions and the absence of grants to treat water, mayors are likely to spend more of their limited financial and enforcement resources on controlling air pollution, and controls on water pollution suffer as a result.[31]

Poor, remote regions have particular problems in enforcing the laws. They are not able to attract technically trained staff. Appointed officials in these bureaus often have no background in environmental protection or related fields and receive little administrative support: they are paid meager salaries and are denied even basic resources such as vehicles to assist in conducting their work.[32]

Finally, law enforcement also suffers from the involvement by middlemen mediating on behalf of polluters, reflecting the emphasis on personal relationships (*guanxi*) in Chinese culture.[33] The influence of *guanxi* on local environmental law enforcement may be significant. In order to maintain "harmonious relations" with enterprises, EPB staff will often not recommend revoking permits in spite of serious violations, nor fine enterprises for noncompliance.[34] Even more problematically, this emphasis on social connections and indebtedness can lead to EPBs showing greater leniency towards facilities that generate fiscal revenues or create employment opportunities for the community.[35]

In an effort to improve compliance rates, China's central government has attempted to increase its involvement in local enforcement in recent years, as well as to make funding of provincial budgets more of a priority. The year 2006 marked the first year that funding for environmental protection was formally itemized in the central government's budget, as expenditures before then were so low that it was not necessary to do so.[36] Yet it remains to be seen what effect, if any, this will have on improving the function of the EPBs. Similar efforts by the central government in the past have resulted in more inspections, but not necessarily more enforcement of laws or penalties. For example, during several SEPA campaigns to improve enforcement from 2001 to 2004, the number of actual sanctions imposed decreased substantially as a percentage of the number of inspections, dropping from 13 percent of inspections to only 4 percent.[37]

By contrast, in the U.S. the number of state and local environmental enforcement officials has been growing steadily over the past 20 years, especially in the area of air and water pollution control. Also, the numbers of environmental enforcement attorneys in each state's Attorney General Office has increased markedly. While in 1982 the total budget of the states for clean air, clean water, and hazardous programs was $510 million, in 2008 the total state spending on all environmental programs is expected to be over $12.5 billion.[38]

The effectiveness of state and local enforcement agencies is not due solely to the amount or resources states devote to it. As discussed previously in this chapter, the state and local enforcement effort benefits from the detailed nature of the federal law containing clear requirements that leave less room for discretion at the local level. The fully developed nature of U.S. environmental law also provides the EPA with clear authority to influence the activity of state and local officials, and ultimate authority to intercede if enforcement efforts at the local level are ineffective. Finally, as discussed in Chapter II, the effectiveness of the environmental laws in the U.S. is furthered by all the ways that the public at the local level can participate in the preparation and implementation of standards, including the ability of citizens to use the court system to contest the adequacy of a company's compliance record. No similar opportunity exists in China.

5. Effectiveness of Government Inspection Programs.

As a result of the limited resources and other problems discussed above, studies have indicated that the inspection program in China is less than fully effective. In many cases, "approved and installed air and water pollution control equipment is put in operation only at times when inspectors' visits are expected."[39] Moreover, a large number of Small and Medium Enterprises (SMEs) are not regularly inspected because local inspectors, constrained in manpower, often choose to focus on big industrial polluters.[40] One expert on the environmental laws in China also pointed out in an interview for this report that the leadership of the local governments to whom the EPBs report may ask the EPB not to inspect a particular factory favored by the local government, or it may alert the factory in advance to the impending inspection by the EPB. Without recent, reliable monitoring data, Chinese regulators may have to rely on sporadic, visual observations of steel plant operations such as emissions from stacks, but as this approach does not ensure accurate observations over time, it is inherently unreliable.

In the U.S., announced and unannounced inspections, requests for information, and post-enforcement monitoring and reporting are conducted on a regular basis by both federal and state employees. The steel industry as a matter of routine was subject to 3,144 federal inspections conducted over the past five years at 450 different steelmaking facilities under six different environmental programs.[41] These numbers are just illustrative, as there is nothing unique about steel facilities that would cause a larger number of inspections than those for other types of facilities. This averages more than seven inspections a year by federal inspectors alone at each facility.

As discussed in Chapter III, Chinese industry monitoring of its own emissions is limited and the monitoring data it collects is of limited usefulness to officials seeking to enforce environmental standards. In the U.S. a steel plant's monitoring technology must be operated in compliance with its Title V permit, and the data from that technology must be reported on a periodic basis.[42] The plant manager of a U.S. steel facility must certify that the monitoring has been operating properly and that the data from the monitoring are complete and accurate.[43] False certifications or falsified data can be a criminal act and punished accordingly.

In addition, monitoring technology that is in wide use by governments in the U.S. is sufficiently advanced that state air pollution regulators can often pinpoint within hours the exact source and location of a spike in any particular pollutant. In the steel industry, such a spike could result from a failure of pollution control equipment (a torn bag or broken dust vacuum), extended operations of pollution-generating equipment, or a change in the hazardous air pollutant content of the fuels or raw materials used by the facility. The prevalence and reliability of monitoring data in the U.S. helps to ensure that U.S. steel plant emissions stay within federal and state expectations.

6. Inadequacy of Penalties for Violation of China's Environmental Laws.

A penalty in the form of a monetary fine is the most commonly used enforcement tool for local environmental officials in China (60 percent of the non-compliance responses are fines).[44] The most powerful tool—shutting down the polluting facilities—is generally not used because it is beyond the discretion of local EPBs. Instead, such decisions rest with local political leaders, who are often growth-oriented and reluctant to close productive factories important to the local economy.

a. Level of Penalties.

A recent article written by senior Chinese officials states that fines designed to deter violations of environmental laws have two major problems: the fines are often too low, and they are one-time punishments that contain no additional penalties for continued violations.[45]

Below is a list of violations and fines in China's Air Pollution Prevention Law that are most relevant to the steel industry:

Violation	Penalty
Refusing to allow inspection; Falsifying records; Failing to operate pollution control facilities properly or leaving them idle without permission	< 50,000 yuan No criminal prosecution
Operating without installing air pollution control facilities or with control facilities not meeting requirements	10,000 – 100,000 yuan No criminal prosecution
Emitting air pollutants above emissions standards	10,000 – 100,000 yuan No criminal prosecution
Emitting dust, toxic, or fetid gases without proper control facilities	< 50,000 yuan No criminal prosecution
Causing a major air pollution accident	< 500, 000 yuan Possible criminal prosecution

Except for "major air pollution accidents" that are severe incidents of harmful emissions, the general upper limit set under the Air Pollution Prevention Law for fines is 100,000 yuan (about $14,000). EPBs have discretion to reduce the final size of the penalty below the upper limit, and often do so in negotiations with the factory that is out of compliance.

Environmental regulators are also impeded by the fact that fines are generally just a one-time event. Continuation of violations after imposition of the initial fine may evoke no negative consequences for a steel plant because China's Law on Administrative Penalties mandates that fines should not be imposed more than once for the "same violation." It does not clearly define what constitutes "the same violation," and the enterprise that is not in compliance often argues that its continuing pollution is the same, single violation and cannot be punished with multiple fines.[46]

In the instance of violations of the Environmental Impact Assessment Law (EIA) by developers of new industrial facilities, violations for failure to prepare an assessment are capped at the equivalent of $25,000, an amount that may not be sufficient to deter violations in connection with the construction of a new multimillion dollar industrial facility. Even then the penalty only applies after the developer who may have already built a project without first preparing the required assessment fails to prepare an assessment at a later date when requested to do so.[47]

Statistics on the actual number and size of fines imposed are difficult to obtain. MEP only publishes the total amount of fines collected from all industries.[48] It does not release industry-specific figures, so the information does not disclose the ones paid by the steel industry. But China's environmental fines are set at very low levels, so the actual financial burden that they may impose on the steel industry is also likely to be low. The low level of fines has the unintended consequence of encouraging companies to discharge pollutants above permitted levels, to turn off pollution control equipment, and to forego the purchase of pollution control equipment.

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Criminal sanctions are rarely used. A statute adopted in 1997 applicable to incidents involving air, water, or solid wastes imposes criminal liability on individuals responsible for a "major environmental pollution accident which leads to the serious consequences of heavy losses of public or private property or human casualties." In such instances the law provides for prison terms of up to three years, or up to seven years if the "consequences are especially serious."[49] However, one expert's review of the records suggests that at least in its first five years, 1997-2002, cases were criminally prosecuted in less than 5 percent of serious environmental pollution cases.[50]

b. Effect of Fines on Conduct.

Research by Professor Wang Canfa indicates that in China the cost of pollution activities that infringe the law only amounts to 10 percent of the pollution abatement cost and two percent of the actual externality imposed on the society.[51] Under such circumstances, any "rational" enterprise is likely to opt to break the law instead of complying with it. One instructive example of the actual effect of the fines on industry is the course of action of a Beijing utility company. It designates 1,200,000 yuan ($171,430) at the beginning of each year (100,000 yuan x 12 months) as a "budget for fines," and then continues its emissions as usual.[52]

The study by Professor Wang Canfa also used a copper smelting facility to demonstrate why companies will choose not to purchase pollution control equipment. Usually, the investment for a set of air pollution control equipment costs millions, even tens of millions of yuan. The daily profit of such a copper smelting facility is hundreds of thousands of yuan. Yet the upper limit for fines is set at only 100,000 yuan. Rather than spend the millions of yuan required to purchase the necessary equipment, the copper company chose to pay an occasional penalty of 100,000 yuan that represents less than one day's profits.

Because the fines are so relatively low, other companies that have actually purchased the pollution control equipment may also choose not to use the equipment. The Chinese media have exposed several cases involving steel companies that intentionally leave their pollution control equipment idle to save operational costs. In one reported story, most of the steel companies investigated had left their pollution control equipment idle. Included in this group was Tangshan Steel, ranked fourth in total steel production in 2007. As chronicled at the beginning of Chapter V, a steel company director explained that the annual savings for not operating pollution control facilities amounts to 25 million yuan.[53] In such cases, a 100,000 yuan penalty would constitute only 4/10 of one percent of these cost savings.

A researcher at one of China's leading universities interviewed for this report noted that it was difficult to increase the fines to a level that would be effective because fines at that level might lead to closing the steel mill, which many local economies could not afford because of the adverse effect on workers and their families. Furthermore, the researcher noted, higher fines could encourage polluters to misrepresent actual amounts of pollution they were generating. A few years ago a local government official told the researcher that at least 50 percent of the time companies decide that it is more economical to pay the occasional fines, along with any discharge fees, instead of purchasing the necessary pollution control equipment.[54] While this local official was only speaking for conditions in a particular province, the researcher believes that this is a widespread phenomenon in China.

c. U.S. Fines.

U.S. law provides for significantly higher fines. As previously noted, violators of the CAA are subject to fines up to $32,500 per day per violation. From 1995 to 1999, environmental penalties imposed by the states alone averaged more than $96 million a year.[55]

Knowing violations, false statements and tampering with monitoring equipment can also subject the violator to criminal penalties; e.g. imprisonment of not more than 15 years. Similarly, section 309 of the FWPCA provides for a daily penalty of up to $32,500 for any negligent release of hazardous substances into a sewer system or publicly owned treatment work (POTW). Knowing violations may be punished with fines of up to $50,000 a day. The FWPCA also provides for imprisonment of up to 15 years.[56]

Courts are not reluctant to impose criminal sanctions on U.S. companies and their individual officers for violation of the environmental laws. For example, from 1999 through 2007, two companies and their subsidiaries engaged in the making of cast iron or machine parts were charged a total of seven different times with criminal violations of the environmental laws.[57] If convicted of environmental crimes, companies, in addition to fines or jail terms for their employees, can be barred from selling their products to any U.S. government agency for up to three years.[58]

Civil enforcement actions in the U.S. may impose on the polluter the obligation to acquire additional pollution control equipment to ensure that the company comes into compliance with the environmental laws. Actions against steel companies have been relatively few, but the following illustrates the authority the U.S. governments and state agencies have to enforce the law against steel companies as well as any other industry. During 1999 and 2000, the U.S. Justice Department and EPA announced consent decrees with three steel companies that required them to expend more than $100 million on new air pollution control equipment and other projects to benefit the environment.[59] The order specified what type of pollution control equipment was to be purchased, set deadlines for the purchase, installation and operation of the equipment, and required reports to federal enforcement officials, including data from emissions monitoring equipment.[60]

In another example, federal officials required three U.S. steel companies to pay more than $19 million for water pollution control equipment and compliance penalties.[61] In the solid waste area, between 2005 and 2008, four steel companies were required to pay more than $4 million in penalties for violations of federal waste disposal regulations.[62]

Since the fines under the FWPCA and CAA are imposed for each day a violation continues, they can add up to very substantial amounts. In an ongoing case between EPA and DuPont, for example, EPA is seeking to charge DuPont about $300 million in fines for violations that took place between 1981 and 2001.[63]

Further enhancing the deterrent effect of fines, U.S. tax laws forbid companies from deducting monetary penalties as an expense when calculating the company's taxes.

Compliance with environmental laws and regulations, moreover, is now an integral part of federal securities and corporate governance laws. Under the 2002 Sarbanes-Oxley Act, public companies must investigate and disclose instances of noncompliance to the federal government, as well as the company's resulting exposure to federal civil and criminal penalties.[64] The financial risks for U.S. companies mount exponentially for continuing environmental regulation noncompliance.

Furthermore, in the U.S. most enforcement actions receive widespread coverage in the media, and subject the company to adverse publicity that may harm its business. The EPA and the Department of Justice issue press releases that detail the precise amount of the mandated pollution control purchases and financial penalties obtained in judicially-approved settlements for noncompliance.[65] Details about the allegations of environmental noncompliance are disclosed in EPA administrative documents and in the federal court proceeding on the enforcement. There is also an opportunity for the public to comment on any environmental enforcement settlement the federal government might propose to make with a company.[66]

7. Chinese Government Statistics on Rates of Compliance.

Despite all the evident weaknesses in the Chinese regime for enforcing its environmental laws, official statistics published by the Chinese government state that overall compliance rates with the country's environmental requirements in all industries combined is high. In big cities like Beijing, the reported compliance rate is higher than 95 percent.[67] However, other experts interviewed for this report, while pointing out that there are no studies that gauge the actual level of enforcement, expressed doubt that the level of compliance with the environmental laws is as high as indicated by official statistics. One expert estimated that the level of compliance was at best no higher than 50 percent. Another expert to whom we spoke called the official numbers "an obviously doubtful figure." And one of China's top environmental lawyers has been publicly quoted as expressing the view that "barely ten percent of China's environmental laws and regulations are actually enforced."[68] As discussed in Chapter III, the central government has itself indicated that its collection of discharge fees owed by companies is only about 30 percent of the total fees owed.

There are a number of reasons for skepticism about the "official" compliance numbers. First, the numbers are developed at the local level and are then passed through intermediate levels of government to Beijing. Members of the Chinese bureaucracy who are responsible for collecting the statistics are aware that their compensation depends on these statistics showing widespread compliance.

Second, because of the absence of a robust system of monitoring equipment and reports, the numbers are no better than the reports of the inspectors who visit the plants. These inspections may be inadequate, facilities may turn on their pollution control equipment only when they know that inspections are about to occur, and illegal discharges may be hidden from the inspector. Aggravating this problem is that much of the non-compliance with environmental standards is likely to occur in the smaller mills that are the least likely to be inspected or to be subject to effective government regulation.

Third, the statistics are not subject to careful review and testing by other agencies, as occurs for example with numbers that are collected to calculate the gross domestic product (GDP). Different agencies may compile substantially different numbers in the environmental area, and there is no effort to test the numbers against each other or to develop a single set of authoritative numbers representing the consensus of the agencies involved.

Finally, these compliance numbers, however exaggerated, only refer to compliance with existing environmental standards. As discussed in Chapter IV, many of these standards are weak, and the government is now seeking to strengthen them. If the MEP adopts tougher standards, as it is considering, there is no way of knowing the extent to which Chinese steel companies will comply with them in the absence of stronger penalties. The new standards are likely to pose a significant challenge to the government enforcement agencies, given the structural weaknesses and limited resources available to the MEP and local environmental agencies.

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Conclusion

China clearly faces serious challenges in controlling air, water, and solid waste pollution generated from the process of making steel. The Chinese government in Beijing has announced its intent to take steps to address these challenges, and it has in fact begun to move on several fronts to address the serious issues raised by the levels of pollution in the country. However as this report shows, the size and difficulty of the task the central government faces is large, and success can only be achieved with determined effort by all concerned.

It is unquestionably in the interest of China to do so. The health of the Chinese people is threatened by the high levels of pollution emanating from steel plants, particularly from the plants that are older, smaller, and lack modern, state-of-the art pollution control technology. At the same time that it upgrades and improves enforcement of the standards governing air, water and solid waste, the central government must begin to control greenhouse gases produced by the steel industry (and by other industries as well). Taking action to control Chinese steel industry pollution would help conform the practices of the Chinese steel industry more closely to those of steel producers in the West, who are obliged to compete with Chinese companies that currently face lower pollution control costs. Action by China would assist nations around the world in combating global warming.

No report of this length can address all the issues raised by China's pollution control regime. Much about this difficult issue remains to be explored, and more research remains to be done. The Alliance for American Manufacturing hopes, however, that this report will increase the dialogue between China and the U.S so that these issues may be explored further, and steps may be identified to make Chinese pollution standards and enforcement efforts more consistent with programs now in place in the U.S. and other steel producing countries around the globe.

The U.S. Government, U.S. scientists and engineers, and the U.S. steel industry can do much to help the Chinese in these efforts. They should be prepared to do so. Existing technologies are becoming more cost-effective, and new technologies are coming on line all the time. These techniques and approaches to controlling the problem can be readily applied and adapted to the needs in China, as long as the Chinese government is willing to take the necessary steps—and to assume the necessary costs—that such actions would entail.

About AAM

The Alliance for American Manufacturing (AAM) is a unique non-partisan, non-profit partnership forged to strengthen manufacturing in the U.S. AAM brings together a select group of America's leading manufacturers and the United Steelworkers. Our mission is to promote creative policy solutions on priorities such as international trade, energy security, health care, retirement security, currency manipulation, and other issues of mutual concern.

Contact

Alliance for American Manufacturing
727 Fifteenth Street, NW
Suite 700
Washington, DC 20005
phone: 202-393-3430
fax : 202-628-1864
email: info@aamfg.org
www.americanmanufacturing.org

Alliance for American Manufacturing
AAM
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