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Contents

Abbreviations and Acronyms

ADB	Asian Development Bank
BOT	build-operate-transfer
CDB	China Development Bank
CESTT	Center for Environmentally Sound Technology Transfer
CFB	circulating fluidized bed
CIDA	Canadian International Development Agency
COD	chemical oxygen demand
CRAES	Chinese Research Academy of Environmental Sciences
CSRC	China Securities Regulatory Commission
EIA	environmental impact assessment
EPB	environmental protection bureau (provincial and local levels)
EPU	Environmental Projects Limit
ETI	Environmental Technologies Industries
Ex-Im	Export-Import Bank of the United States
FAS	free alongside ship
FGD	flue gas desulfurization
GDP	gross domestic product
GEF	Global Environment Facility
GTZ	Deutsche Gesellschaft für Technische Busammenarbeit (German Technical Corporation)
HSE	health, safety, and environment
HTS	Harmonized Tariff Schedule
IFC	International Finance Corporation
IPR	intellectual property rights
JEXIM	Export-Import Bank of Japan
JV	joint venture (enterprise)
JBIC	Japan Bank for International Cooperation
MIGA	Multilateral Investment Guarantee Agency
MOFTEC	Ministry of Foreign Trade and Economic Cooperation
NGO	non-governmental organization
NPC	National People's Congress
OECD	Organization for Economic Cooperation and Development
OECF	Overseas Economic Cooperation Fund of Japan
PDF	project development funds
PM	particulate matter
PPP	public private partnership
PRC	People's Republic of China
RMB	yuan renminbi (Chinese currency)
SDPC	State Development and Planning Commission
SEPA	State Environmental Protection Administration
SETC	State Economic and Trade Commission
SOE	state-owned enterprise
TDA	Trade and Development Agency
TEC	total emissions control
TIPC	total investment in pollution control
tpd	tons per day
TSP	total suspended particulate
TVIE	town and village industrial enterprise
UNCHE	United Nations Conference on the Human Environment
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNIDO	United Nations Industrial Development Organization
USAEP	United States–Asia Environmental Partnership
USAID	U.S. Agency for International Development
WFOE	wholly foreign-owned enterprise
WHO	World Health Organization
WTO	World Trade Organization

Note: Unless otherwise noted, dollar figures given are U.S. dollars. The exchange rate for the Chinese yuan, or RMB, has been calculated at 8.3 to the U.S. dollar.

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Executive Summary

Environmental protection is currently receiving more attention in Chinese domestic policy than ever before, and all indications are that this attention is going to continue to increase. Spending on environmental protection topped 1 percent of China's gross domestic product (GDP) for the first time in 1999, and investment rates are expected to continue rising. Similarly, citizen awareness and the demand for environmental well-being are increasing. The central government, increasingly cognizant of the financial and social costs of a deteriorating environment, has clearly made its protection a priority.

In November 2000, the Chinese Research Academy of Environmental Sciences (CRAES) estimated that RMB 700 billion ($85 billion) would be needed to meet the environmental goals of the Tenth Five Year Plan (2001–2005). Other estimates indicate that as much as hundreds of billions of U.S. dollars will be necessary to address all the issues thoroughly. The World Bank has estimated that 2 percent of GDP will be needed just to bring air quality standards within range of those seen in the United States in the 1980s. Regardless of the estimations observed, the central government is expected to contribute only 11.4 percent of the CRAES estimate ($9.7 billion) over the next five years, while 34 percent of that estimate (nearly $29 billion) is expected to be sourced from provincial and local governments and 55 percent (over $46 billion) from business enterprises themselves.

The financial demands indicate a strong need for non-public investment, whether it be directly from Chinese state-owned enterprises (SOEs), from the small but growing domestic private sector, or from a variety of foreign investment channels. Under ideal market-oriented circumstances, such investment might materialize with relative ease, but as the system currently functions, it remains challenging to operate profitably in China's environmental sector. This is due in part to the facts that pricing strata for environmental services such as waste and water management do not reflect the actual costs of providing those services, guarantees and security mechanisms are not well established to mitigate the risks of private investment, and legal transparency and equitable enforcement of the law remain lacking in many instances. The government appears to be aware of these conflicts and the fact that they must be addressed if the private sector is to play a considerable role in the environmental protection plan. The rate and efficacy with which these issues can and will be addressed is uncertain.

There is already a trend toward the liberalization of environmental service tariffs. Water prices are rising, and some investors report cooperation from local governments in setting water prices at rates that offer potential for returns on long-term facility investments. Similar tariff liberalization may carry over to wastewater treatment and, in due time, to solid waste management as well. Nonetheless, the common consensus is that, in order to enter the market and eventually turn a profit, investors must have both ample finances and patience.

Because most of the government bodies and enterprises (both SOEs and private enterprises) seeking to invest in environmental protection work under financial constraints, it is critical that the technologies they invest in are efficient and affordable. A fundamental underlying indication of this market analysis is the Chinese demand for innovative technologies that can provide significant results at relatively low marginal costs, management and clean production schemes that can assist in the attainment of efficiencies, and innovative recycling techniques that can turn waste products into money-generating commodities.

Yet, before attempting to enter the Chinese market, it is important to keep in mind the eccentricities of doing any sort of business in China. Numerous complications and barriers, many of which are addressed in detail throughout this document, are encountered by nearly all exporters and foreign investors that enter the Chinese marketplace. Perhaps paramount among those is personal relations, referred to in Chinese and colloquially among non-Chinese as "guanxi." Personal relationships are often at the core of business dealings in China. For those who lack the time, money, ability, or interest to establish such relations and presence in China, an increasing number of service providers with extensive connections and know-how can, for a fee, provide the necessary connections,

networking, and guidance. Regardless of the facilitation and assistance sought, entry into the Chinese market can be a slow and sometimes exasperating process; those willing to spend the time and effort may find the payoff worthwhile in the end.

For the purposes of this report, the environmental sector is divided into the water sector, the solid waste sector, the air sector, the services sector, and resource management. All of these sectors present unique opportunities and complications, which are discussed in turn in the corresponding chapters. Additionally, efforts to enter markets in any of the sectors are subject to a relatively standard set of conditions that apply across the environmental sector and in some cases to foreign investment in China in general; these conditions are addressed in the remaining chapters.

This market study aims to clarify three things for U.S. companies looking to invest in China's environmental protection industry:

1. The real demands for environmental protection in China,
2. The current investment climate in the environmental protection industry and developing trends that may affect it in the near and medium-term future,
3. Methods to access the market and potential results that can be reasonably expected from investment efforts.

This report does not provide comprehensive lists of industries looking to buy or manufacture equipment, local governments looking to implement initiatives, or massive infrastructure development programs that may offer opportunities to technology providers, as all these types of information are time dependent and would be obsolete soon after printing. It does, however, indicate channels by which investors can find this information while offering insights into what the market may have to offer as China pursues its goal of rapid modernization.

Chapter 1
The Market for Environmental Technologies

China's domestic environmental technology industry, according to local government and business leaders, does not lack the ability to produce standard environmental protection equipment. However, the quality and innovative character of this equipment is widely known to be poor, and the country's demand for reliable, affordable, and effective environmental protection equipment is not satisfied. Many of the potential consumers of such equipment lack access to necessary finances. The management skills and know-how needed to use the available technology effectively remain substandard, severely cutting into the efficient allocation of what little funding is available.

Chinese-produced equipment that is of lesser quality than similar foreign-produced equipment is often favored by Chinese end users, as it makes up for its shortfalls in quality by being less expensive and domestically produced. In some instances, purchasers are beginning to favor more expensive, higher-quality exports as maintaining mediocre domestically-produced equipment proves to be inefficient. Nonetheless, it is difficult for foreign technology producers exporting to China to enter the market competitively with products that are similar in design or function to anything already produced in the country. The exceptions to this rule are exporters that are able to provide equipment at significantly reduced prices and those that offer attractive support packages. Such exporters remain few, given such factors as high import tariffs, reduced production costs in China, and various other market barriers. Changes associated with the accession of China to the World Trade Organization (WTO) are having a beneficial impact.

Vendors looking to export equipment to China need either to provide exceptional products brokered through a reliable local representative or to enter the market indirectly through multilateral projects, through other foreign-funded investment schemes, or by targeting the demands of foreign-invested companies operating in China. Another option is to forgo the notion of exporting and establish a local presence in-country via a joint venture (JV) or wholly foreign-owned enterprise (WFOE). Such in-country operations can reasonably expect a share of the market demand if they offer competitively priced goods and services. Trends indicate that Chinese end users prefer to buy equipment and parts produced by Western-invested JVs and WFOEs due to inherent quality differences. JVs and WFOEs can also maintain competitiveness by avoiding customs tariffs and taking advantage of reduced production and labor costs that exporters cannot. Changes associated with WTO accession are influencing these realities and should be considered when developing a market strategy. (See further discussion of the WTO later in this chapter.)

Despite the broad range of environmental legislation that has been promulgated over the past decade and will likely be promulgated in the decades to come, regulation remains weak or non-existent. Chinese environmental protection is not regulation driven but rather economically driven; the economy and its forces, meanwhile, can be described as somewhat market oriented although controlled by seemingly monopolistic behavior. Once this is understood and a marketing strategy is developed that provides an economic and profit-driven explanation for the use of a product, then market entry may be possible. Such a market strategy would require indications not only that a proven technology is technically appropriate for a task but, more important, that savings can be realized, that the payback period for an investment would be favorable, and ultimately that profitability could be enhanced. More sophisticated and costly technologies might require creative financing, in which the vendor would initially carry some of the cost, thus shouldering some risk in proving that the technology is viable, and would later be paid back from the accrued savings or profits according to a pre-arranged formula.

China's Real Demands

The domestic production of basic environmental technology is not impossible for China. The following is an assessment of the country's more complex and advanced needs, which can be roughly divided into four categories: inexpensive solutions, innovations and efficiency, management skills and best practice, and maintenance and equipment servicing.

According to State Environmental Protection Administration (SEPA) statistics, over 70 percent of China's pollution problems stem from industrial pollution, which is primarily generated by seven industrial subsectors: non-metal mineral production; chemical production; pulp and paper production; textiles; ferrous smelting and processing; mining; and electricity production. Nonetheless, other sources such as municipal waste and agricultural pollution factor heavily into the equation, and the needs discussed below are generally applicable across the board.

Inexpensive Solutions

Available finances for environmental protection fall far short of what is needed to address China's serious environmental degradation. One consistent response from local government leaders and enterprises during the research for this market plan was that needs are tremendous but money is scarce.

Foreign enterprises looking to provide marketable solutions to China's environmental problems need to find innovative solutions and to develop affordable and cost-effective methodologies backed by creative financing. Technology providers who can offer means to make significant environmental improvements at affordable prices find themselves warmly welcomed in China.

The potential market size, economies of scale, and the reduced costs of producing in China—through either a JV or WFOE—are keys to commercial viability for inexpensive solutions. A solid market analysis, effective and widespread marketing, and adept use of the advantages of in-country production are all required. Enterprises composed, at least in part, by foreign technology providers are regarded as superior by many consumers in China.

Innovations and Efficiency

SEPA Minister Xie Zhenhua has indicated that RMB 700 billion ($85 billion) will be needed to meet the environmental goals of the Tenth Five Year Plan and, according to CRAES, about 55 percent of that is expected to be covered by enterprises themselves. However, many business enterprises already view environmental protection as a costly burden, and new goals are met with increased disfavor. Therefore, a market demand is developing for innovations and effi-

Box 1. Industries Find Efficiency Through Green Business

Sinopec Corporation and the Shanghai Baosteel Group (Baosteel), although not the only Chinese industries to do so, are finding that smart business simultaneously generates revenues and protects the environment. Both companies have strong internal health, safety, and environment (HSE) departments that establish and enforce standards that often exceed those of the state. Ultimately, their efforts pay off in revenues and offer positive public relations as they enter the international market.

- Since 1983, Sinopec has tripled its revenues while simultaneously reducing pollution. Between 1998 and 1999 industrial output increased 12 percent while major contaminants continued to decrease.
- In 1997, Sinopec spent RMB 90 million ($10.8 million) transforming 22 production units into "clean production units." The investment was recouped through reduced waste management and pollution treatment costs within one year of operation. Phase two, comprising another 20 units, is currently under evaluation, and phase three is already in progress.
- Investment in proactive safety measures by Sinopec and its subsidiary enterprises reached RMB 1.3 billion ($157 million) over the past three years. In 1998 and 1999, they collectively suffered RMB 4 million ($483,000) and RMB 8 million ($967,000), respectively, in asset damages due to accidents. Between 1984 and 1997, before HSE was initiated, that number averaged 20 to 30 million RMB ($2.4 to 3.6 million) per year.
- Baosteel has been experimenting with recycling methodologies that use steel production waste products as a raw material in the construction of concrete roads. In 1998, the steel producer manufactured 10.16 million tons of steel and generated 5.5 million tons of waste. Some 4.7 million tons of that waste was re-used for road construction, generating RMB 187 million ($22.5 million), and eliminating the need to manage that waste through other means.
- By standards in developed countries, Baosteel's achievement may be considered commonplace. But in the developing world, where waste management industries are far less developed, this type of waste is often simply dumped directly into the environment.
- Both Sinopec and Baosteel have indicated that their HSE programs were originally instigated by high-level government and enterprise leadership decrees. In time, the decrees have led to a sincere commitment on the part of both companies.

cient management techniques that allow an enterprise to simultaneously protect the environment and save or generate money, either through increasing efficiency or reusing and recycling by-products.

Some of China's major industries are already putting such innovations to use and are finding that waste products previously seen as useless and troublesome to dispose of can be reused or recycled, and can generate further income. Other industries are developing more efficient and cleaner production methods and are reducing pollution levies and cleanup costs so much that expenditures formerly used to cover those costs can cover upgrade investment costs over a surprisingly short period of time (see Box 1). As enterprises are increasingly burdened with the responsibility of funding China's environmental protection—and internalizing their own environmental liabilities—they increasingly seek out means to make that responsibility affordable and profitable.

Management Skills and Best Practices

Although China is capable of manufacturing a great deal of the basic equipment for environmental protection, there remains a considerable gap in terms of management and know-how when putting that technology to use. There is a demand for consulting and management training that improves equipment performance and overall environmental performance. Many industrialists and officials contacted during the research for this document expressed a need for training on sound management practices and operations.

Additionally, there is a widespread lack of understanding regarding best practices. In some cases, this is due simply to the fact that enterprises are not aware of or do not seek out information regarding such practices. In other cases, a perception perists that environmental protection is necessarily costly and that therefore enterprises must become financially sound before they can become environmentally sound. In either case, it is apparent that information on best practice needs to be widely disseminated, with simultaneous consideration of the innovations and efficiencies discussed above.

Based on these findings, it appears that any initiatives in this area require coordination between individual vendors, industry associations, and the U.S. government.

Maintenance and Equipment Servicing

Another breakdown in the industry—one that heavily influences the efficiency of environmental protection expenditures and equipment—is poor operation and maintenance. This may be due to perceptions that equipment maintenance and servicing is merely another burdensome cost, or it may be due simply to a lack of awareness. Regardless, potentially strong market demand awaits investors who can successfully illustrate to enterprises that relatively small expenditures on maintenance can result in long-term efficiencies and revenues. Furthermore, technologies that require little maintenance or are self-maintaining (which are heavily marketed by Israeli industries in China) undoubtedly have additional competitive advantages.

The Issues

The three primary environmental priorities in China are water quality, air quality, and waste management. They will be the primary focus of environmental protection during the Tenth Five Year Plan and will therefore be the primary focus of this market survey. However, issues such as land degradation, ecological and biodiversity preservation, and other standard environmental concerns are getting attention and offer market potential.

Each of these issues is introduced below. For market analysis and discussion of market potential by sector, see the appropriate corresponding chapters.

Water

Statistics from 1991 to 1998 indicate improvements in river water quality in some limited areas but illustrate an overall trend suggesting significant deterioration as a whole. Forty percent of the country's river water is ranked as poor by domestic standards. Additionally, an estimated 25 percent of all Chinese lakes are affected by eutrophication, almost all of the coastal seas are moderately to highly polluted, and it is now being said that little or no groundwater in the country remains unpolluted.

Water sources in 50 percent of the major cities and towns cannot meet drinking water standards. Ten percent of urban and 80 percent of industrial wastewater receives some treatment, but most of that treatment is inadequate. Most Chinese cities and towns lack municipal wastewater treatment facilities, and many towns do not even have proper drainage systems.

Additionally, parts of the country are dramatically short of water. In some areas, water availability is as low as 355 cubic meters per head (the international definition of water scarcity is 1,000 cubic meters per head).

In 2000, Beijing endured what many called its worst drought in decades.

The vast majority of water in China is biologically and chemically unsound, primarily as a result of

- industrial wastewater discharge,
- municipal wastewater discharge, and
- non-point pollution (generated by agricultural practices, livestock production, and so forth).

Air

Of the three ambient air quality parameters consistently monitored in China—sulfur dioxide (SO_2), nitrogen oxides, and total suspended particulates—only nitrogen oxides have increased concentration in medium and large Chinese cities in the past few years. However, all three pollutants remain formidable concerns for China's environment, and numerous other pollutants remain unmonitored.

Ambient air quality in many large urban areas has shown optimistic trends, but air quality in more than 500 major Chinese cities remains below World Health Organization (WHO) standards. Small cities have seen little or no improvement. Every Chinese city, large or small, faces serious total suspended particulate problems that pose significant threats to public health. The impact of acid rain has stabilized since the mid-1990s, but its influence is still widespread and destructive, affecting approximately 40 percent of China's landmass. Indoor air pollution resulting from fuel combustion is on the decline as briquettes and gaseous fuels replace raw coal for cooking and space heating. Nonetheless, it still poses a severe health risk, particularly for poorer, rural populations.

In keeping with the Montréal Protocol, China was able to freeze increases in the production and consumption of ozone-depleting substances in 1999. However, the country still faces the task of completely phasing out such substances by 2010, a goal that may be difficult to achieve.

- Coal consumption is far and away the most dominant source of air pollution in China, spanning the gamut from large- and small-scale industrial and commercial sources to residential space- and water-heating operations.
- Motor vehicle emissions, in line with the increase of automobiles in most larger cities, are expected to continue rising over at least the next 10 years.
- Non-combustion-related airborne particles resulting from construction and land degradation (e.g., desertification) are on the rise.

Waste

Over 200 of more than 650 cities surveyed in China are surrounded by hills of waste. As of August 1999, more than 6 billion tons of municipal refuse had accumulated and claimed 5.4 billion square feet of land in China. Between 600 million and 750 million tons of industrial solid waste was generated in 1999, and statistics on the generation of hazardous waste vary from 5 to 30 million tons annually. Hazardous wastes are often incinerated and disposed of improperly and are frequently mixed with non-hazardous waste in landfills and dumps.

There is much discussion now of sustainable development through an integrated approach to waste management, including minimization of the production of waste materials and maximization of waste recycling and reuse. Composting, incineration, and landfilling all have roles in the management apparatus, each with its own host of pros and cons. Nonetheless, waste management remains a subpriority for Chinese planners, as air and water concerns take center stage.

- Only 5 percent of household waste and 17 percent of industrial waste receive any treatment.
- An adequate hazardous waste management system does not yet exist.
- Market-based tools that would allow profitability and thereby generate private investment have not been successfully established.

Resource Management

About 20 percent of China's agricultural land has been lost to soil erosion and economic development over the last decade. Desertification in northern China is estimated at 70,000 square kilometers and is increasing by about 2,100 square kilometers per year. Salinization, reduction of pastureland, and loss of arable land are considerable, and the effects of widespread deforestation are having a strong impact. Land degradation is arguably the most critical rural environmental problem in China today.

Financing and Expenditures

China spent just under $10 billion on environmental protection in 1999, reaching 1 percent of GDP for the first time and accounting for an increase of 15 percent over expenditures in 1998. Certain localities, such as Beijing, Shanghai, Xiamen, and Dalian, are claiming expenditures in the range of 3 percent of local GDP. There has been considerable discussion about raising

national expenditures over the next few years to the neighborhood of 1.3 percent to 1.5 percent of GDP; however, it is uncertain how soon that goal can be reached, what it will include, and to what extent it would be reflected in opportunities for various types of vendors.

In a year 2000 report, CRAES indicated that 11.4 percent of the $84 billion that will be spent during the Tenth Five Year Plan is expected to come from the central government, 34 percent is expected to come from provincial and local governments, and 55 percent from business enterprises themselves. A smaller amount ($4 billion) will be sought from foreign governments and international finance institutions. Whether or not business enterprises will be able to cover their 55 percent of the bill remains to be seen and is dependent upon location. In fact, the goals of the Ninth Five Year Plan placed a similar burden on enterprises, which was not fulfilled in most parts of the country.

Nonetheless, enterprises in and around cities like Beijing, Shanghai, Shenzhen, and other relatively affluent coastal areas are quite up to the task. Last year in Beijing, over 55 percent of the spending on pollution control came from enterprises. However, increasing numbers of enterprises in much of China's antiquated rust bowl are in dire straits simply to pay out wages and keep operations running, making the possibility of upgrading pollution control a long-term goal for many of them.

Chapter 9 of this document provides further in-depth discussion of environmental protection financing in China.

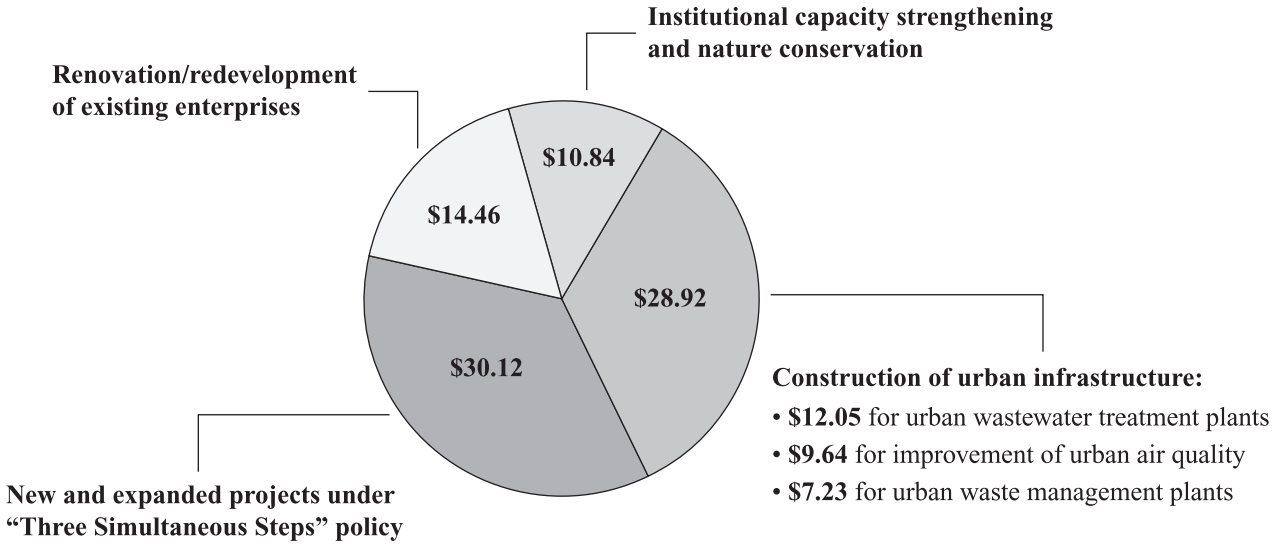
Visualizing the Market

The Role of Policy and Enforcement

Although demand in China's environmental industry remains predominantly driven by financing through official assistance programs or through enterprise interests in efficiency, policy pressures are becoming increasingly influential. As China's environmental policies become more comprehensive and detailed, market niches will become more defined. Investors looking for key market-entry points need to keep a close watch on the development of policy and, of equal importance, on policy enforcement trends.

However, unlike some countries in which policy is consistently and efficiently upheld through transparent and equitable enforcement, Chinese environmental policy can vary in its influence on market demand due to lapses in enforcement. Enforcement of policies is being stepped up, particularly in some of the more developed regions, and environmental policies are beginning to carry more weight.

Figure 1.1 Anticipated Investment in Environmental Protection in China, 2001 – 2005 (billions of U.S. dollars)



Source: Cao Dong and Sun Rongqing, *Environmental Financing in China: A Review* (CRAES/SEPA working paper presented at a conference sponsored by the OECD Center for Cooperation with Non-Members, Environmental Policy Committee, November 2000).

There are currently several barriers to enforcement, which include conflicts of interest between environmental and development goals, a breakdown in the rule of law, lack of capacity on the part of local enforcement agencies, and weaknesses in monitoring systems. The prevalence of these and other barriers varies tremendously from region to region and should be considered in determining where to locate an operation or where to market products.

At the same time, however, it is not unheard of for local governments or other entities to respond to mandates and deadlines by paying cash to import required equipment such as compressed natural gas bus engines or air monitoring equipment. Such circumstances provide lucrative, albeit inconsistent, market opportunities, and, much like the market demand created by multilateral and untied bilateral assistance programs, these circumstances create a market environment quite unlike that in the U.S.

It is also advisable to monitor government policies pertaining to priority projects and goals and to consider incentives and preferential policies to encourage investment in that regard. However, before taking advantage of such policies, investors should critically review the circumstances. In some instances, whether the incentives and preferential treatment will make up for the difficulties and costs that could be faced is questionable (see Box 2).

In sum, it is not so much the regulatory pressures as the economic efficiencies and the availability of assistance funding that currently create market opportunities for foreign vendors. For now, most exporters will likely find market demand by offering efficiency solutions that either save money or generate revenues, or by exploiting the opportunities generated by multilateral and untied bilateral assistance programs. (See Chapter 10 for further discussion of positioning U.S. exporters in the market.)

Market-Based Incentives

Market-based incentives, or the setting of resource and service tariffs (such as those for water and waste management) at a level that legitimately represents the cost or value of those resources and services, is an idea that is only just beginning to gain a foothold in China. The Chinese government is reluctant to institute drastic tariff changes for fear that rapidly increasing the costs of resources and services, which have thus far been covered by the state, could stir social unrest. Yet the government appears well aware of the need to begin a process of instituting these tools, and potential investors would do well to watch closely, as changes could be instituted rather quickly.

Water is the first natural resource to have been affected by market-based incentives, with tariffs rising several times in 2000 alone. In December 2000, the Yellow River Water Commission raised irrigation water prices by 100 percent, hoping to encourage water conservation. Household water tariffs, although still quite low, are on the rise in some parts of the country, thereby introducing the idea that consumers will have to begin paying for the resources and services they use. As tariffs increase, consumers (particularly industries with high water consumption rates) will likely start looking for ways to reduce their costs.

Tariff liberalization trends are not altogether clear, but wastewater management is already being brought into the fold, and solid waste management will probably be affected in the near future. Additionally, there has been some experimentation with emissions trading as a market tool to influence air pollution management, an idea that the government is examining, and that may instigate increasing demand for monitoring devices and air pollution control technology. However, progress here is currently limited by the small number of participating enterprises and the lack of a free market for services such as electricity, in which individual enterprises are directly concerned with their own financial bottom lines.

The WTO and the Environmental Industry

The U.S.-China bilateral trade agreement that led up to China's accession to the World Trade Organization directly addressed the environmental sector only briefly and vaguely. In particular, it addressed China's commitments to environmental services, which include sewage services, solid waste disposal services, cleaning services for exhaust gases, noise abatement services, nature and landscape protection services, and other environmental protection services. However, environmental monitoring and pollution source inspection were not included. Additionally, foreign service suppliers could provide environmental consultation services via cross-border delivery, without establishing a presence in China; other service suppliers could operate in China through joint venture operations. Because the exact effects of the WTO's General Agreement on Trade in Services (GATS) on the sector are in fact quite vague, service providers are advised to consult a WTO specialist when considering the possibilities.

In addition to its effects on trade in services, WTO accession is resulting in significant tariff reductions on machinery and other imports. Overall, average tariffs

Box 2. Investing in the West: Hype Versus Reality

The 10 western provinces of Shaanxi, Sichuan, Guizhou, Yunnan, Gansu, Ningxia, Inner Mongolia, Qinghai, Xinjiang, and Tibet are the focus of China's western development plan. The region covers 57 percent of the country's landmass, is home to 23 percent of the population, and claims over half of all the country's verified natural resources. Yet 90 percent of the country's poorest people live in the region, registering a per capita GDP of only 60 percent of the national average. Much of the region is mountainous, and agricultural land is of poor quality. Infrastructure and transportation capacities are lacking, as are education and a supply of qualified industrial managers and administrators. Direct investment is scant, the region is disconnected from international and even domestic markets, the environment is deteriorating, and the poverty-stricken population, without the proper resources and know-how, continues to stress the local ecosystem. Additionally, the potential for social unrest resulting from inequitable development across the country is something the government can no longer ignore.

The development plan's intended focuses are infrastructure development; the fostering of industries that maximize local comparative advantage; capacity building for science, technology, and education; a vastly improved investment climate; and environmental protection. Official support for the initiative has been overwhelming, with many emphasizing that development in the region is long overdue. Promises of increased direct investment, preferential tax rates, eased restrictions on foreign investment, simple solutions to complicated foreign exchange issues, and other incentives to draw both foreign and domestic investment to the region have been made.

However, beneath the rhetoric run concerns that foreign investors must consider:

- The plan is extremely long-term, with an anticipated timeline of 20 to 30 years or more.
- The majority of proposed projects are large-scale, long-term infrastructure development projects, which are notorious in China. A Ministry of Finance survey of recently completed large-scale infrastructure projects found that, on average, such projects went 85 percent over budget and were 23 months behind schedule.
- The region lacks a secure legal climate and high-quality human resources. Local officials blindly gather and promote projects with little regard for long-term, efficient planning. Such circumstances traditionally breed corruption and shortcuts in China, resulting in misallocated funds and final products of poor quality.
- Official media reports indicate that total investment in the region increased 17.9 percent in 2000, constituting billions of renminbi. However, only a percentage of this money has actually been transferred or invested; the remainder is accounted for as signed proposals or contracts. Whether these funds will materialize as actual investment remains to be seen.
- Many projects are billed as environmental or ecological projects, in keeping with the plan's environmental focus. However, prospects for environmental protection are not guaranteed. Although a proclaimed propensity toward environmental protection may offer opportunities for related industries, the phrase environmental protection is not well understood. Barriers and resistance to true environmental protection measures still exist.
- In some estimations, the development plan is more a political campaign for social stability than an economically viable campaign for growth, as central planners continue to realize the need to narrow China's development gap.

Many foreign investors have investigated business prospects in China's western regions, but as a result of some or all of the above factors, most have left empty handed. The prognosis is not that China's west will never yield quality opportunities, but investors should consider how much progressive change is required before venturing in.

will be reduced to 10 percent within five to seven years of accession. For specific details on the agreement and tariff schedules or to inquire about tariff rates for a particular item, contact the U.S. Department of Commerce for a copy of the agreement, or obtain a copy of the *Regulations on Import and Export Tariffs of the People's Republic of China*, available for RMB 240 from the Publishing House of the General Customs Administration, No. 6 Jianguomennei Avenue, Beijing 100730, China, +86 (10) 6519-5616, 6519-5615.

Although the agreement contains very little that is directly associated with the environmental sector, WTO accession is generating significant, indirect impacts on the industry. Many of the changes that benefit industries across the board, such as the dismantling of non-tariff barriers, the discouraging of import substitution policies, and (ideally) increased transparency, benefit the environmental industry.

Agreements on distribution services are also benefiting environmental industry players, and agreements on commission agent services, wholesaling, retailing, and franchising may all be central to the plans of exporters developing a presence in the country. Foreign service suppliers are now allowed to provide all "subordinate services," including after-sales services. Once again,

details in regard to these agreements are complex, and a WTO specialist should be consulted by service providers that are considering the possibilities.

In consideration of the role state-owned enterprises play in China's economy, governmental influence on the decisions of SOEs regarding the purchase and sale of goods and services has been addressed by the bilateral agreement as well. Under the agreement, decisions by state-owned and state-invested enterprises are based on commercial considerations, and the enterprises of other WTO members have equal opportunity to compete for contracts with such enterprises. Although China has chosen not to sign the Government Procurement Agreement, all procurements for commercial and non-governmental purposes by state-owned and state-invested enterprises are considered non-governmental procurement. Additionally, the receipt of benefits, investment approvals, and so forth, are no longer contingent upon technology transfers encouraged or imposed by the government. Under the bilateral agreement, technology transfers and similar issues are decided upon solely by the involved parties, without interference by the state.

Yet another significant and influential aspect of WTO entry is the effect it is having on other Chinese industries, which in turn affects market opportunities for environmental technology providers. According to the World Bank, as WTO accession slowly opens Chinese markets, China is shifting its industrial base to industries in which it benefits from comparative advantages (labor-intensive sectors as opposed to land-intensive sectors). Following are some of the industries that the World Bank expects to be affected by WTO accession, and the opportunities they may offer to environmental exporters:

- **Textiles.** China's production of processed cotton products, including the dyeing of such products, is rising, resulting in increased industrial water consumption and wastewater generation. Water conservation, recycling and reuse methodologies, and wastewater treatment are important.
- **Livestock Production.** As China's agricultural product markets (particularly non-rice grain product markets) open to less expensive international competitors, many farmers are switching production focus. Livestock production is increasing, which is causing, among other things, an increase in livestock wastes. If improperly handled, such wastes will pose serious water pollution threats. Water pollution control and efficient waste management techniques with potential for reusing such wastes are important.
- **Increased Production of Leather and Fur Products.** Increased livestock production is benefiting livestock producers by increasing income, but it is also causing increased water consumption and water pollution.

  Foreign technology providers have reported difficulties in managing the wastes of some leather treatment facilities in China, as leather treatment processes have a great deal of impact and some Chinese facilities are primitive. Foreign technology providers have indicated that they lack the technology or know-how to manage pollution in such facili-

Box 3. Town and Village Industrial Enterprise: The Little Big Polluters

Town and village industrial enterprises (TVIEs), which are economically significant small private and collectively owned enterprises, are slipping through the enforcement web of China's environmental protection. Very few, if any, of these facilities are up to state standards.

Unlike SOEs, TVIEs are weakly linked to the government, and pressures upon them to meet environmental standards are quite low. This may be a result of practical and logistical problems associated with enforcement of protection policies, or it may reflect the significant economic performance of the sector, which some are reluctant to restrain.

Pollution statistics relevant to TVIEs are far from complete. Nevertheless, there are strong indications that TVIE pollution is a significant contributor to total pollution discharges and that emissions target rates for the sector are in fact increasing. Year 2000 chemical oxygen demand targets for TVIEs increased 36 percent over 1995, while those targets remained generally unchanged for SOEs. The Ninth Five Year Plan target levels for TVIE SO_2 emissions were nearly 50 percent higher than the actual 1995 levels, while the target levels for SOEs were reduced.

The United Nations Industrial Development Organization (UNIDO), with funding from the Global Environmental Facility, has initiated a program to bring energy-efficient technologies to TVIEs by strengthening capacity to govern the clean development of TVIEs and by stimulating demand for clean technologies through regulatory and market reforms, as well as the development of financing mechanisms. Exporters that offer goods potentially of benefit to TVIEs, but that have avoided the market due to TVIE financial constraints or market instability resulting from sporadic government cleanup campaigns, may find the UNIDO program instrumental in facilitating market entry.

ties because these types of facilities were transferred out of their countries before control technology was developed.

Water conservation methodologies and water pollution control are important, as are cleaner leather production techniques.

- **Increased Fruit and Vegetable Production and Processing.** As a result of decreased grain production, there is an increase in the production of fruits and vegetables, causing an aggregate increase in the use of water and pesticides. Water conservation methodologies and irrigation techniques particular to fruit and vegetable production, improved pesticides, and the dissemination of sustainable agriculture and non-point pollution control methodologies are important.
- **Restructuring of Forestry and of Pulp and Paper Production.** Massive restructuring in the forestry sector is phasing out small-scale pulp and paper production facilities. The development of new and more efficient production facilities offers opportunities for investment in cleaner production, water conservation, and water pollution control. Furthermore, researchers at the World Bank have indicated that the paper industry, with its relatively high chemical-oxygen-demand (COD) discharges and low abatement costs, may be the most cost-effective target for reducing organic water pollution.

Generally speaking, WTO accession is increasing competition, spurring local industries to improve technology, management, and general know-how. Efficiencies that both affect and are affected by environmental performance are increasingly important, particularly as awareness of eco-efficiency principles becomes more widespread. Additionally, increased scrutiny by international communities with an eye on environmental protection is strengthening Chinese industries' commitment to environmental protection and increasing their demand for environmental technologies as they seek to become competitive players in international markets.

A number of WTO-associated Web sites are listed among the resources for further reading at the end of this chapter.

Structural Trends of Pollution Control Investment

The structure of total investment in pollution control (TIPC) has changed over time in regard to the three main categories receiving that investment: urban infrastructure construction, renovation and redevelopment of existing enterprises, and new projects (see Figure 1.2).

Investment in urban infrastructure has seen both the most overall growth and the largest increase in percentage of total investment. Investment in this sector was $1.8 billion during the Seventh Five Year Plan and reached $15.6 billion in the first four years of the Ninth Five Year Plan. In 1999, investment in this sector accounted for 58 percent of TIPC, while it accounted for only about one-third of TIPC during the seventh Five Year Plan.

Investment in renovation and redevelopment of existing enterprises has remained relatively constant since the seventh Five Year Plan but has declined as an overall percentage of TIPC. Investment in this sector as a proportion of TIPC fell from 41.2 percent during the seventh Five Year Plan to 16.9 percent and 18.5 percent, respectively, in 1998 and 1999.

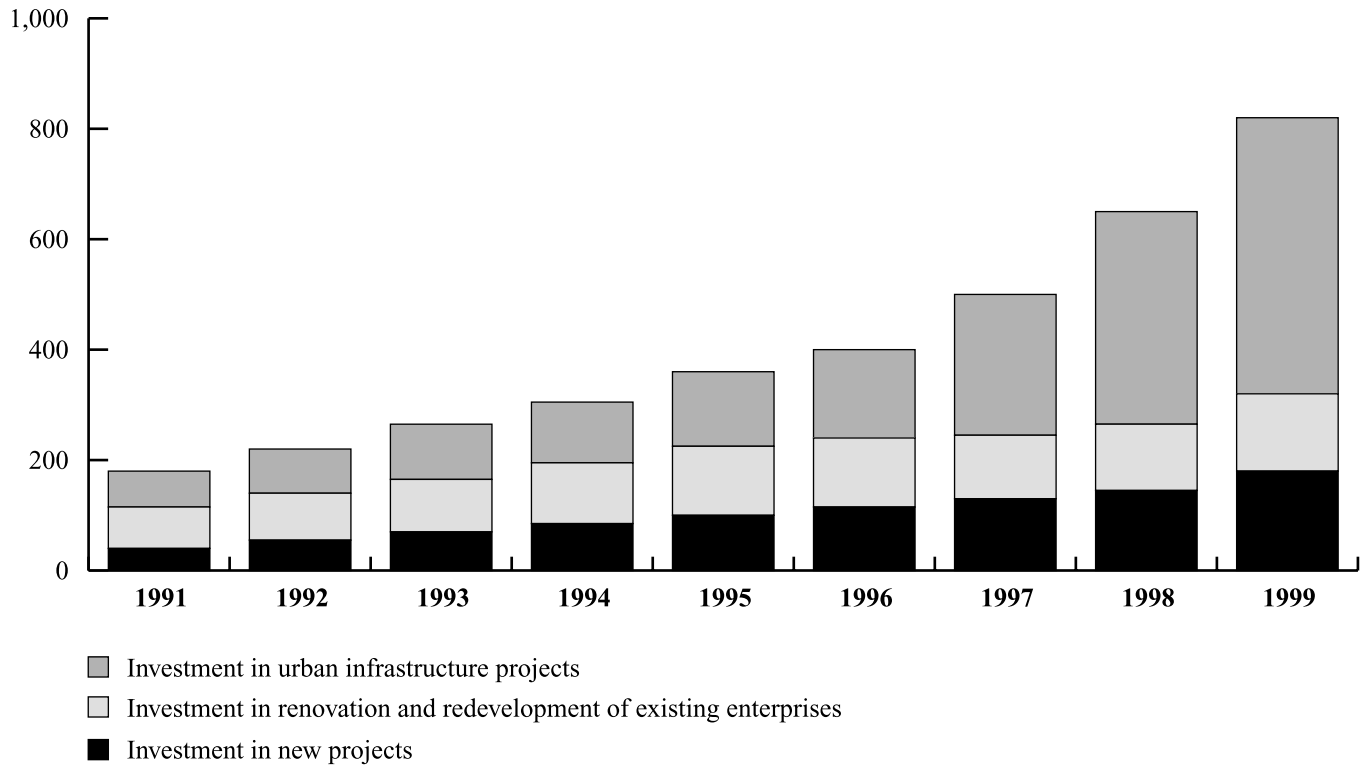
Investment in new projects has increased consistently from year to year but has fluctuated in terms of TIPC percentage. It accounted for 26.6 percent of TIPC during the seventh Five Year Plan, rose by less than 1.5 percent in the eighth Five Year Plan, dipped to 19.7 percent in 1998, and rose to 23.3 percent in 1999. Overall, the share of investment in new projects has declined slightly since the seventh Five Year Plan.

Understanding China

Definitions of environmental protection vary from place to place, and China is no exception. In fact, because it lists initiatives such as urban beautification (i.e., fixing sidewalks and painting buildings) as environmental protection, China's definition may be one of the broader examples known in the world. Therefore, it is important for investors to keep definition variances in mind, as they may positively or negatively affect things such as tax brackets, incentives, and market demand.

On a similar note, it is necessary for investors to understand the Chinese market and adapt themselves and their products to it rather than try to impose a change to create a more favorable investment climate for themselves. The Chinese environmental protection market is increasingly open to the technology, skills, and know-how of the foreign sector, but tolerance is limited for investors who insist on doing things their way, without considering the situation, needs, and desires of the Chinese. Thus, techniques and technologies that have proven successful elsewhere may not be appropriate in China. Investors should keep this in mind when establishing market-entry strategies and should

Figure 1.2 Structural Trends of Total Investment in Pollution Control in China, 1991 – 1999 (billions of yuan renminbi)



Source: Cao and Sun, *Environmental Financing in China.*

work hard to adapt themselves to the particular demands of the country.

It must also be noted that the Chinese do not take kindly to being used as a testing ground for unproven environmental schemes, particularly when they are expected to provide the funding. If newly innovated, untested, but relatively promising technology or management schemes are presented to China, complete with funding, there is some possibility that the Chinese will allow a pilot project to be developed in the country. However, schemes that are considered suspect or require financing from the Chinese government will not be looked upon favorably.

Finally, many Chinese industries still view environmental protection as a significant financial burden. With policy changes and stepped-up enforcement poised to increase that burden, many industries may see environmental protection as more of a threat than a boon. For that reason it is critical to offer, whenever possible, technologies and innovations that can turn environmental protection into a profitable endeavor. In marketing technologies or consulting on management methodologies, it is vitally important to clearly and convincingly stress efficiency, recycling, and the fact that environmental protection need not incur long-term costs but can in fact be profitable if instituted properly.

Many upgrades that could initiate efficiency and profitability require heavy doses of capital investment. Much of China's industrial sector lacks that capital, and many of the businesses propped up by the SOE supporting apparatus have barely enough to get by, never mind invest. Thus, it is necessary to consider these factors at all points of strategy development and to keep in mind that some enterprises, in some regions, are far more likely to accept and benefit from eco-efficiency strategies than others.

Box 4. Environment and Social Stability Face Off Across the Country

As 2000 drew to a close, goals set by the Ninth Five Year Plan to bring all polluting industries in the country into compliance with state pollution standards by year's end had companies scrambling to clean up and governments closing down operations.

The SEPA and other related departments intensified inspection processes during the period; proud claims of high compliance rates were heard, as were troubling stories of closing enterprises and distraught laborers. The tricky balancing act of shutting down heavy industrial polluters and preventing unemployment from skyrocketing further out of control was underway.

Enterprise closure is a stiff threat used to pressure polluters into compliance, and under new air and water laws, it will likely continue to play a strong role. But some enterprises, particularly the antiquated industrial behemoths of China's fabled "rust belt," simply cannot cover the costs of upgrading and protecting. Closures, on the other hand, bring the burden of unemployment and potential social unrest. As an insurance policy, most closures have taken place in dispersed smaller enterprises rather than in large operations.

Meanwhile, despite initial successes in pollution reduction among those industries still in operation, inconsistent monitoring and enforcement strategies may, in the long term, undermine what has been accomplished. Intermittent and poorly executed inspections in many parts of the country may not be sufficient to prevent enterprises from lapsing back into old habits after the pressures of the campaign subside.

The economically more dynamic eastern and southern regions of the country have been most successful in bringing about compliance that is likely to hold, particularly through improved production processes and the development of cleaner technologies. Those regions heavily burdened with decrepit industrial facilities, however, are left balancing concerns of environment and social stability.

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BuyUSA:
www.buyusa.com

Central Intelligence Agency:
www.cia.gov/cia/di/products/china_economy

ChinaOnline:
www.chinaonline.com

Far Eastern Economic Review:
www.feer.com

National Bureau of Asian Research.
NBR Publications:
www.nbr.org/publications

South China Morning Post:
www.scmp.com

U.S.-China Business Council:
www.uschina.org

U.S.-China Business Council: China and the WTO:
www.uschina.org/public/wto

U.S. Department of Commerce:
www.doc.com, www.usatrade.gov

U.S. Department of Commerce,
International Trade Administration,
Office of Environmental Technologies Industries:
www.environment.ita.doc.gov

U.S. Embassy, Beijing:
www.usembassy-china.org.cn

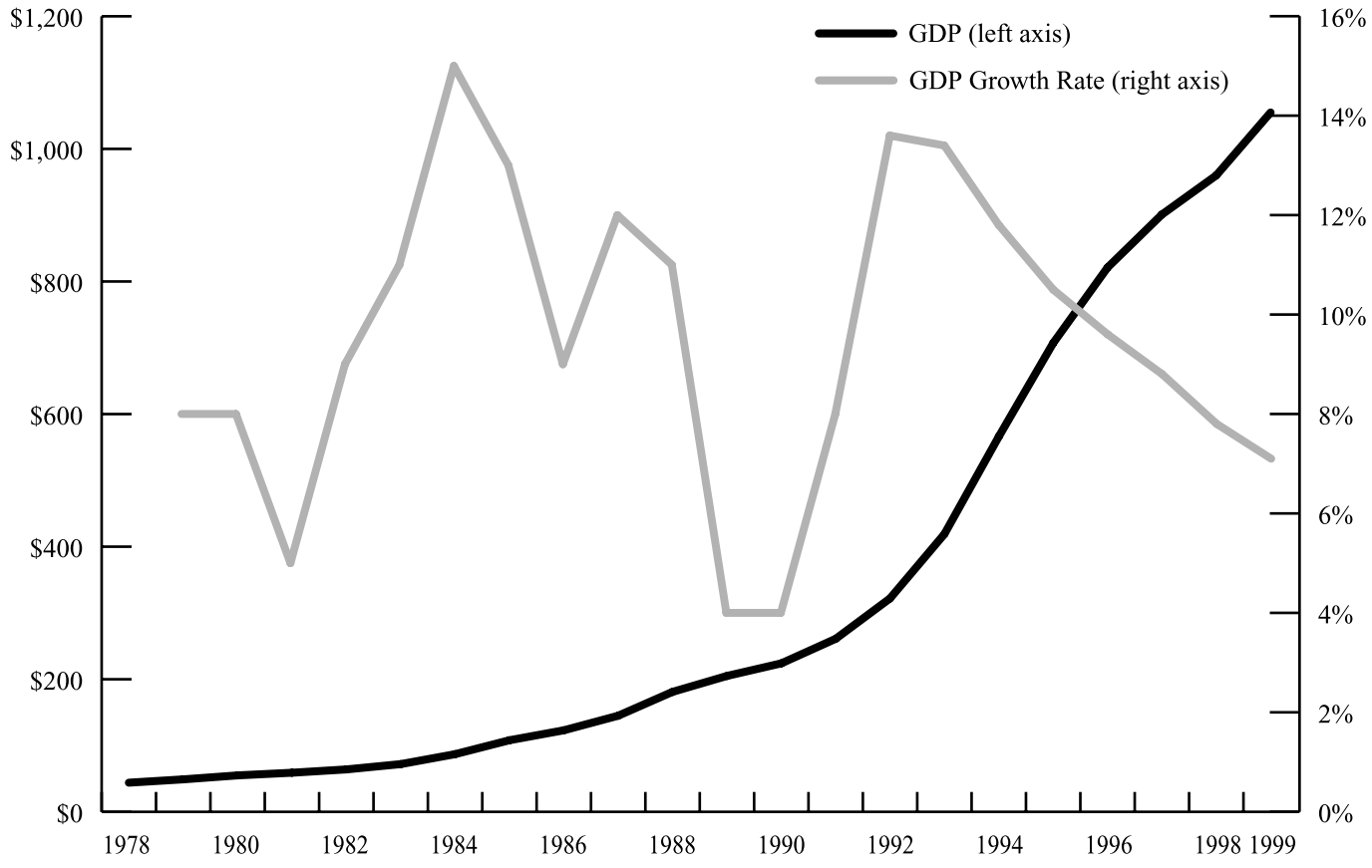
U.S. Embassy, Beijing,
Country Commercial Guide: China:
www.usatrade.gov

The World Bank Group in China Web site:
www.worldbank.org.cn/English/home.asp

Chapter 2
Economic Overview

China's economy has seen consistent growth since Deng Xiaoping's policy of economic reform and opening began in 1978. For much of the 1980s and early 1990s, the nation enjoyed double-digit rates of GDP growth. That growth began to slow, however, in 1992, and remained in decline as a result of inflation, fallout from the Asian financial crises, sluggish domestic demand, rising unemployment, and eventually deflation (see Figure 2.1). In early 2001, the economy began to show preliminary signs of picking up, with GDP growth nearing 8 percent (the official target for 2000 was 7 percent), consumer prices slowly rising, and exports gaining strength as the rest of Asia began shedding the influence of the Asian financial crises.

Figure 2.1 Chinese GDP and GDP Growth, 1978 – 2000 (billions of U.S. dollars and percent)



Source: Sinosphere Corp.

Economic predictions for the coming years range from moderate to cautiously optimistic. Most predictions call for annual GDP growth of 7-plus percent over the next two to three years. Recent increases in domestic demand are viewed as potentially sustainable and may be a sign that the country's deflationary spiral has come to an end. Consumer spending on such substantial items as residential property rose an estimated 40 percent in 2000 and will likely continue to increase. Nonetheless, domestic demand remains sluggish and continues to present a macroeconomic concern.

The most promising indicator that GDP growth will be sustained at over 7 percent is the current fiscal policy. Much of China's growth over the past several years has been heavily influenced by large amounts of government spending, and it is clear that this spending will continue. Since 1998, the country has issued RMB 360 billion ($43.5 billion) in government bonds to fund fiscal-stimulus spending on infrastructure development. A probability model developed by the State Information Center indicates that GDP growth for the year 1999 would have been 4.3 percent instead of 7.0 percent if the bonds had not been issued and the funds allocated as they were.

Bonds funded 46 percent of government spending in 1998, whereas in 1993 they accounted for 3.8 percent of expenditure. Approximately 15 percent of 2001 government expenditure was earmarked for interest payments. The country's debt burden is currently considered sustainable; however, it is unclear how long this deficit spending will continue.

The Financial Burden

The assessment of China's finance and debt structure is somewhat different, however, if financial sector reforms, SOE reforms, pension reforms, and agricultural reforms are taken into account. The World Bank singles out these four sector reforms as the major financial burdens on China's economy, each of which requires creative macroeconomic management on the part of policy-makers. According to the World Bank, the one temporary reprieve is China's exceptionally large stockpile of personal savings, which equals around 40 percent of GDP. WTO entry is gradually opening the domestic banking sector up to foreign banks, which may draw some assets away from the state.

China's banks are burdened with tremendous amounts of non-performing loans paid out to SOEs that are based more on political interests than on commercial viability. According to the People's Bank of China, approximately 20 percent of outstanding loans in the biggest state-owned banks are non-performing, 75 percent of which can likely be recovered. Outsider estimates of non-performing loans vary (25–40 percent non-performing, with only about 15 percent recoverable, is not unreasonable), but the widespread consensus is that the People's Bank of China's estimate is significantly understated. In sum, non-performing loans are estimated at $180–360 billion, or 18–36 percent of 1999's GDP.

Recently, the central government instituted a debt-to-equity swap system by which banks were relieved of a percentage of their bad loans. Asset management companies have been established to acquire percentages of selected SOEs' debts and turn them into equity. These companies, which become part owners of any SOEs for whom they have acquired debt, are expected to restructure the enterprises, and make them profitable. Thus far, the scheme has done little more than relieve the banks and some SOEs of a degree of the strain resulting from the debt burden. Significant changes in management policy are necessary if reduced burdens are to improve financial management (on the part of the banks) as well as enterprise management, production efficiency, and profitability (on the part of the SOEs). So far there has been little sign of such changes.

Significant downsizing is also underway in the state-owned sector. Under a strategy of "grasping the large and letting go of the small," the government is working to turn some of the larger SOEs around, hoping they will develop into self-sufficient, profit-oriented, giant international corporations. At the same time, many of the smaller SOEs have been left to the devices of local governments, resulting in significant closures and layoffs.

SOE reform and low profitability in the sector have led to the functional disintegration of the SOE-based social security system, resulting in a growing implicit pension debt. Loss-making SOEs are no longer able to fund workers' housing, health care, education, and pensions, all of which are responsibilities that traditionally rested with SOEs and work units. Some of these funds, which are estimated at $240 billion, will need to materialize. The same holds true for money needed to support the country's rapidly aging population.

Finally, the agricultural sector, historically the country's primary economic sector, is now viewed as the economy's weak link. Farmers' incomes have risen slowly in comparison with incomes in other sectors and accession to the WTO may have negative effects that lead to even poorer overall performance.

Structural Changes

It is the assessment of the World Bank that China is undergoing four types of structural change. Any one of these changes could result in a significant reallocation of resources or income distribution, affecting the economy as a whole. However, all four changes are occurring simultaneously:

- A shift from a command economy to a market economy, which began after China's opening up in 1978 and is marked by progressively deregulated prices and resource allocation decisions as well as decreased state activity in the economy. The shares of retail, agricultural, and capital/industrial goods sold at prices fixed by the state fell from 97 percent to 5 percent, 94 percent to 23 percent, and 100 percent to 12 percent, respectively, between 1978 and 1999; the public sector's share of total fixed investment fell from 82 percent in 1980 to 53 percent in 1999; and direct investment funding from the government budget fell from 30 percent to 6 percent over the same period of time.
- A shift from an agricultural-based economy to an economy predominantly based on manufacturing and services. Between 1980 and 1999, agriculture's percentage of total output declined from 30 percent to 18 percent, and the share of the work force in the agricultural sector fell from 69 percent to 47 percent. During the 1990s, jobs in the agricultural sector decreased by about 3.4 million per year, while jobs in the services sector increased by 8 million per year.
- A demographic profile shift from high fertility and low longevity to low fertility and high longevity. The population growth rate has slowed from 1.9 percent per year in 1980 to 0.88 percent in 1999. Life expectancy rose from 67 years of age in 1980 to 69.5 years of age in 1997. The population's share of children (14 years of age and below) has fallen from 35.5 percent in 1980 to an estimated 24.9 percent in 2000, while the aged population (65 years of age and above) rose from 4.7 percent in 1980 to an estimated 6.7 percent in 2000.
- A shift from a relatively closed to a relatively open economy. External trade in China is now conducted through over 200,000 direct import-export enterprises, as opposed to the 10–16 state trading firms that once controlled all import and export activities. Non-tariff trade barriers have fallen to an estimated tariff-equivalent level of 9.3 percent, affecting 33 percent of imports. The average weighted tariff rate for the economy is an estimated 18 percent. Approximately three-quarters of imports receive very low tariffs or none at all.

Other Factors of Influence

Other factors that influence the overall performance of the nation's economy should also be recognized:

- Despite the fact that most of the country's massive SOEs are loss making, they are the beneficiaries of most commercial lending and capital account investment. Large amounts of financial resources are being used to keep SOEs afloat. In some parts of the country, much of those resources are used to provide employees with only the most basic of necessities, such as housing and food, leaving little money for investments in production upgrades and the development of efficient production methods. Many SOEs are likely to remain unviable for the foreseeable future.
- Non-state firms account for over two-thirds of the nation's industrial output and an estimated one-quarter to one-half of GDP, yet access to both bank loans and public equity markets is dominated by SOEs. Even under the best of circumstances over 80 percent of private-firm financing is self-generated. The government is aware of the important role that private enterprises will play in the future development of the country's economy, and institutional changes, although likely to be slow, are anticipated.
- A tremendous development gap exists between the coastal regions and the western part of the country, as well as within isolated pockets of the east.
- Per capita GDP in Guizhou Province, one of the country's poorest, is only 8 percent of that in Shanghai, the country's richest city. With 16 million people, Shanghai accounts for little more than 1 percent of the country's population but accounts for 5 percent of its industrial output.
- Guangdong Province accounts for 10 percent of national GDP and 40 percent of foreign trade, yet it comprises only 5.8 percent of the country's population. The Pearl River Delta area, which accounts for 25 percent of Guangdong's provincial population, receives 80 percent of the province's foreign direct investment and accounts for 90 percent of its exports.
- The western region of China, which is the focus of the newly unveiled "Great Western Development Plan," accounts for 57 percent of the country's landmass, 23 percent of the population, and more than half of all verified natural resources, yet it contains 90 percent of the country's poorest people, with per

capita GDP in the region registering at only 60 percent of the national average.

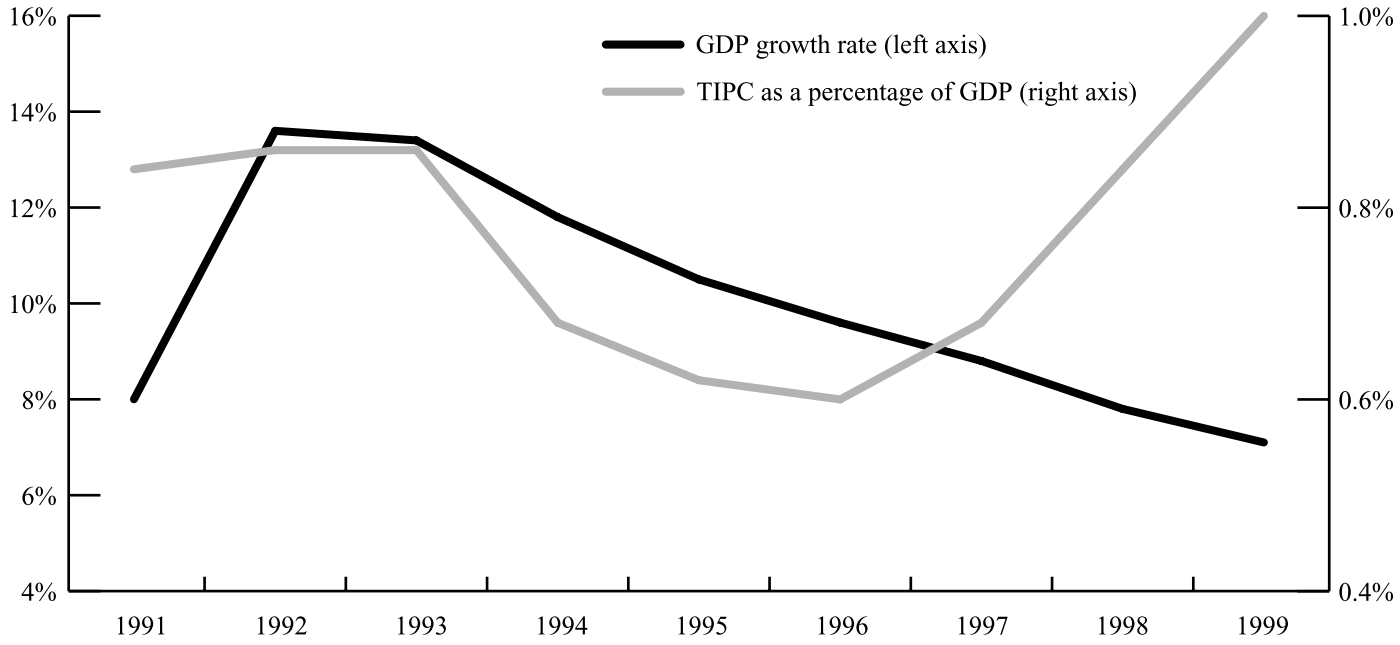
- The country remains rife with corruption and unscrupulous enterprise management. News coverage of disciplinary action taken against corrupt officials is seen almost daily in the local media. Such corruption affects the national economy and local economies and creates tremendous sticking points for both foreign and domestic investors. Random audits of 159 companies by the Ministry of Finance in 1999 revealed that 157 companies had falsely reported their profit figures, 147 had falsified their asset accounts, and 155 had falsified their equity accounts. Each category was both over- and understated to cumulative amounts of $177 million to $299 million. Some enterprises kept duplicate records and provided different accounting statements to different authorities.

Economic Development and Environmental Investment

Pollution Control Investment

According to CRAES, the leading SEPA think tank, national economic development and environmental investment in China have been closely related over the past 15 years. As GDP grew, so did rates of total investment in pollution control. In fact, TIPC's percentage of total GDP increased even as the GDP growth rate slowed (see Figure 2.2). Investment during the eighth Five Year Plan was 2.7 times that in the seventh Five Year Plan, and Ninth Five Year Plan expenditure exceeded that of the eighth. Environmental investment's average percentage of GDP rose from 0.6 percent in the seventh Five Year Plan to 0.77 percent in the eighth. By the end of the Ninth Five Year Plan, investment reached 1 percent of GDP.

Figure 2.2 GDP Growth Rate and Total Investment in Pollution Control (TIPC) as a Percentage of GDP in China, 1991 – 1999



Source: Cao and Sun, *Environmental Financing in China.*

TIPC as a percentage of total national investment in fixed assets also showed overall growth. TIPC averaged 2.41 percent of total national investment in fixed assets during the seventh Five Year Plan, peaked in 1991 at 3.09 percent, dipped in the mid-1990s, and trended upward after 1995 to reach 2.76 percent in 1999 (see Figure 2.3).

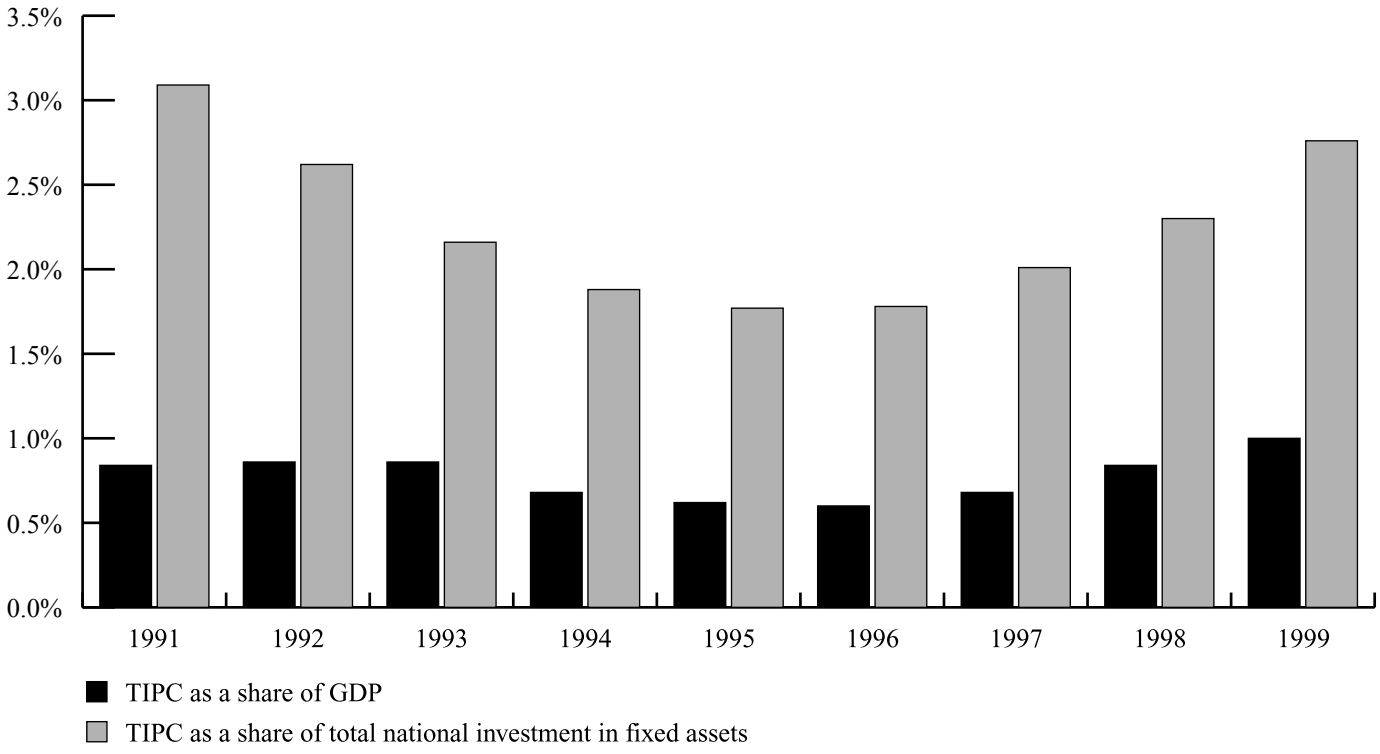
Remarks attributed to Xie Zhenhua, the minister of SEPA, indicate that environmental investment reached 1 percent of GDP in 2000, and is expected to reach 1.3–1.5 percent over the next five years. Official forecasts are calling for RMB 700 billion ($84.6 billion) in environmental investment over the course of the Tenth Five Year Plan. In some major coastal cities such as Beijing, Shanghai, Dalian, Qingdao, and Xiamen, environmental spending has reached as high as 3 percent of GDP. However, it should be noted that the definition of environmental protection is quite broad and inconsistent in China. It may include urban beautification and other activities not normally categorized as environmental protection elsewhere. Thus, figures for annual environmental spending cited in various Chinese publications may vary as much as 15 percent depending on the sources of data and methods of calculation.

Macroeconomic Perceptions and Finance Tools

The steady development of China's economy has increased investor confidence in macroeconomic stability, opening up potential for the use of financial tools such as stocks and bonds. Although both stock and bond markets in China have a considerable way to go before they can be considered comprehensively developed, they are facilitating some degree of environmental investment.

State Development and Planning Commission (SDPC) reports indicate that a significant portion of the $43.5 billion in government bonds used for fiscal-stimulus spending on infrastructure development since 1998 has been directed toward environmental protection and the management of natural resources. The investments have reportedly increased daily wastewater treatment capacity by more than 8 million tons and solid waste treatment capacity by 31,000 tons. Centralized heating, flood control, forest management, and capacities to extract and use natural gas also reportedly benefited.

Figure 2.3 Total Investment in Pollution Control (TIPC) as a Share of Chinese GDP and of Total National Investment in Fixed Assets, 1991 – 1999 (percent)



Source: Sinosphere Corp., from data reported in Cao and Sung, *Environmental Financing in China.*

Over 30 environmentally related companies are currently listed on China's stock exchange, with reportedly high degrees of success. Stock markets in China have become a tool for gaining quick infusions of financing from small-scale Chinese investors, particularly personal investors. However, the relatively underdeveloped and somewhat dubious nature of the country's stock markets prevents them from being more readily exploited for the purposes of environmental financing. (China's stock markets are discussed further later in this chapter.)

There is discussion within government think tanks regarding the development of bond markets, publicly traded investment funds, and other financial tools to be focused on environmental sector investment. The effective use of these tools would greatly reduce the financial burden currently shouldered by government budgets. However, a more developed and better regulated financial sector is required before such tools can reasonably be expected to perform in this capacity. Experts have suggested that the necessary climate for such tools will not develop during the Tenth Five Year Plan, and perhaps not even during the 11th. (See Chapter 9 for a discussion of finance programs and resources.)

Institutional Changes, Decision-Making, and Efficiency

China's gradual shift from a command and control economy to a market economy has caused a slow decentralization of decision-making power. The responsibilities of different stakeholders within the financial decision-making process (such as banks, local governments, and enterprise managers) are being increasingly clarified. Liability for performance outcome, and therefore financial and enterprise efficiency, is on the rise.

Particularly among such high-profile and economically important SOEs as Sinopec and Baosteel (see Box 1), as well as among SOEs in some of the more economically and environmentally developed regions of the country, industrial efficiency and financial bottom lines are becoming more and more important. Reportedly, industries with progressively oriented management and the commercial potential for successful reform are being given increased flexibility to make investment and management decisions with decreased interference by the central government. Efforts to increase operational efficiency through cleaner production, improved management, and improved equipment maintenance are already being seen and are expected to increase.

Privately-owned enterprises, which by their very nature are more entrepreneurial and competitive than their state-owned counterparts, have a stronger vested interest in efficiency than even the most successful and personally responsible SOEs. The non-state sector is on the rise and is expected to grow significantly in the near term. Financial and investment tools remain out of reach for most private enterprises, making efficiency that much more important. (For a detailed analysis of China's private sector, see the International Finance Corporation's "China's Emerging Private Enterprises," available online at *www.ifc.org/publications.*)

Environmental Prospects for the State-Owned Sector

Unlike those SOEs with potential for commercial success, discussed in the previous section, many of the country's SOEs are caught in a downward spiral of poor viability and tremendous burden. Efforts to downsize and close large numbers of those SOEs that show little or no hope of reform and future profitability have been underway for some time; however, mass layoffs and severance of numerous benefits such as health care and housing carry significant social impact. Thus, smaller SOEs are being dissolved while many of the larger ones are being kept afloat not so much in hopes of turning them around but simply to prevent mass numbers of people from becoming disenfranchised.

Many SOEs, particularly those in China's northeastern "rust belt," rank as some of China's worst polluters. Some facilities in the area date as far back as the Japanese occupation of the 1930s and 1940s, and have efficiency capacities to match. Appropriate upgrades could benefit both the efficiency and the environmental performance of these enterprises significantly, and some degree of return would likely be seen relatively quickly. However, the required initial capital is extremely difficult to secure, and many such enterprises would face considerable difficulties in paying back loans from both public funds and commercial lenders even if they were to begin seeing improved financial outcomes as a result of increased efficiency.

Institutional Changes and Financial Liberalizations

Changes in China's economic and financial institutions are occurring rapidly and may have a tremendous impact upon the future development of the economy. No matter how committed the government is to environmental protection in China, there is little hope for success without the economic capacity to address the

issues. What follows is a discussion of several influential factors in China's macroeconomy, the continued development of which will affect both environmental protection and the environmental industry.

WTO Accession, Trade, and Investment

China's central planners are acutely aware of the effects WTO accession is having on the domestic economy, the pressures placed on Chinese enterprises, and thus the need to reform certain regulatory and institutional systems to increase efficiency in economic development. Already a number of changes are being seen, and they will increase and intensify in the coming years, partially as a result of regulations imposed upon the country by the WTO itself and partially as a result of the pressures imposed upon domestic enterprises by the presence of highly competitive foreign enterprises operating in China with fewer restrictions than ever before.

Some of these changes may benefit foreign enterprises by leveling the playing field and breaking down barriers established to protect less-competitive domestic enterprises. Others, however, benefit domestic enterprises as much as foreign ones. Ultimately, the government expects WTO membership to rationalize the country's international trading apparatus and foster highly competitive Chinese enterprises.

The most significant changes anticipated within a decade of accession will be

- increased regulatory transparency,
- further development and rationalization of the financial sector,
- intensified SOE reform, and
- growth and development of the private sector.

Regulatory Transparency

The Ministry of Foreign Trade and Economic Cooperation (MOFTEC) has established a new agency specifically intended to clarify all rules and regulations associated with WTO entry and foreign trade laws and regulations. All foreign trade activities are governed by formally published laws and regulations. Any internal laws and regulations that have not been formally published will be void. The MOFTEC has made clear its intentions to overhaul regulations to bring them more in line with international standards and has mandated that any measures formulated and implemented by local authorities must be consistent with national laws and reported to MOFTEC. All foreign business laws and regulations are available to the public, and drafts of certain laws are available for review and consultation in the formulation phase. Generally, this is in keeping with the commitments China made leading up to WTO accession. WTO entry is catalyzing transparency of laws and regulations as well as the development of a rules-based system, thus ensuring some level of predictability and gradually improving the climate for foreign trade and investment.

Other issues of regulatory transparency could remain troublesome in China for some time to come, though. As a rule, the country keeps information on what it classifies as state secrets and matters of national security under tight wraps. The law defines these in a vague and broad manner. Foreign investors in environmental industries have reported serious problems with such issues in the past. Initiatives have been stalled and in some cases terminated for infractions of laws that have not been made available to the public. It is also not unheard of for such laws to be used as an excuse to stall an initiative even though the true issue of contention is entirely unrelated.

Development and Rationalization of the Financial Sector

The Tenth Five Year Plan calls for a dramatic overhaul of the entire Chinese financial sector. Again, as a result of WTO accession, Chinese administrations are attempting to bring domestic financial institutions up to international standards. The central bank—People's Bank of China—and the China Securities Regulatory Commission (CSRC) are raising standards in both the banking system and the securities markets, to ensure the viability of the financial sector and increase international investor confidence. Several key components, such as an efficient and reliable credit rating system, are still lacking entirely. Other components are in need of further development and strengthening.

Banks. In November 2000, the National Bureau of Statistics reported that risks borne by the four state commercial banks had increased by 65 percent over the past eight years, resulting in a drop in their capital adequacy ratios to an average of 5.51 percent in 1999 (the internationally accepted critical rate of adequacy is 8 percent). Based on an unpublished internal rating index, risk assessments in the financial sector as a whole have risen by nearly 12 percent since 1991.

Administratively, political interference in commercial banking operations remains a stumbling block, and the independent and efficient promulgation of regula-

tions is lacking. Meanwhile, competition within the banking sector is on the rise, placing increased performance pressures on the commercial banks. Two years after WTO accession, foreign banks will be allowed to make local currency loans to Chinese companies. Five years after accession, they will have unlimited access to the consumer market.

There is adequate awareness within the pertinent administrations regarding the concerns and threats the banking system faces. Administrative changes are underway, but some analysts question how efficiently reforms can be carried out. The People's Bank of China is developing an index system to detect and evaluate financial risks. It will monitor operations within the banks, security markets, and other fundamental macroeconomic indicators.

Stock Markets. China's stock markets are somewhat chaotic, thriving more on rumor and manipulation than on market-oriented standards. Regulations and qualifications for listing in the markets are strict, keeping many companies off the boards. Meanwhile, the stock exchange is partially used to fund ailing SOEs through public offerings, and investors often buy in believing that the government will not allow a listed SOE to go bankrupt. The Zhengzhou Baiwen Company nearly proved them wrong in late 2000 when speculation arose that the massive retailer would be allowed to go under, but instead the SOE was bailed out once again, only enforcing the belief. Regulators reportedly feared that allowing Baiwen to go bankrupt would decimate investor confidence and possibly drain financial support from the 1,000-plus listed companies. In April 2001, China's first delisting finally occurred, marking the demise of the Shanghai Narcissus Electric Appliance Company. The event was accompanied by warnings of possible future delistings of similarly troubled enterprises, as well as widespread accolades for a sound step toward the modernization of the Chinese economy.

Prior to the Narcissus event, government-supported investor confidence led China's A-shares market to rank as the world's second best performing market in terms of growth in 2000. There is much indication that changes will arise, making future stock market growth more quality based in coming years. If faithfully implemented, the initiatives listed below should increase competition, creating stronger links between stock prices and profits and thereby shifting capital to the stronger companies:

- The CSRC has pledged to reduce interference in the setting of stock prices, slowly allowing market forces to determine rates of growth in order to reduce market price distortions and strengthen the market as a whole.
- Disclosure rules for listed companies are tightening, increasing transparency. Increased transparency limits the likelihood of accruing massive amounts of bad debt in the market, as has occurred in the banks.
- Various market tools such as mutual funds are currently under development. Foreign experts are involved in the development of these tools; however, their capacity to invest directly in the market will remain extremely limited for some time.
- A slow opening of the A-shares market to foreign companies looking to list in China is expected to begin soon. The A-shares market is reserved for domestic investors and firms, and the B-shares market, previously reserved for foreign investors, has recently been made available to domestic buyers.
- Listing policies are easing, and more enterprises (SOEs) are listing.
- Discussion regarding the development of a new technology-based market similar to the NASDAQ is ongoing. The bursting of the new economy bubble late in 2000 stirred speculation that such a new board may offer opportunities for smaller firms loosely related to the technology sector to list, as the resulting dearth of new-economy firms would fail to saturate the market. At the time of publication, the future of the new board was still uncertain.

Bond Markets. Currently, SDPC examines the issuance of all corporate bonds and sets limits on their volume. Each year less than $1.2 billion worth of corporate bonds are floated, as compared with $48 billion in treasury bonds. The CSRC controls the interest rates of both types of bonds. Corporate bond interest rates are routinely set below those for treasury bonds.

SOE Reform

In 1998, Premier Zhu Rongji set a goal to turn around loss-making SOEs within three years. While the time schedule has been relaxed somewhat, SOE reform policies since then have focused on enterprise restructuring, downsizing, and adjusting product output mixes. The government has also been focusing on a small number of what it calls "key" enterprises and major industries while deconstructing small and medium-sized SOEs and encouraging non-state capital to enter more sectors. During the Tenth Five Year Plan, reform will continue. The State Economic and Trade Commission (SETC) is expected to consolidate the state-owned sector into 50 to 100 giant SOEs.

By the end of 2000, proclamations of attaining Zhu Rongji's goal were numerous, even though the government was calling them questionable. The SETC proclaimed that 520 of the country's best-performing SOEs registered profits upward of $25 billion in the first 11 months of the year. However, a closer analysis indicates that 9 of the 14 major industries accounted for 93.6 percent of the total earnings and that petroleum and telecom alone accounted for 50 percent. One hundred fifty-eight of the 520 key SOEs registered 95.6 percent of the profits, and the top ten performing SOEs accounted for 74.2 percent of the total profits.

A number of factors such as high international oil prices, reduced debt burden as a result of debt-to-equity swaps, increased exports, and a number of IPOs on foreign exchanges are partially responsible for the profits. Varying degrees of sustainability among these and other factors indicate that a lot of work has yet to be done if the SOEs are to gain true overall profitability.

The Private Sector

Income tax payments from private enterprises in Beijing increased 110 times over the past six years, with their contribution to overall business income tax revenue in the municipality increasing from 0.3 percent in 1994 to 15.7 percent in 2000.

There remains little doubt that regulatory authorities recognize the importance of the private sector and are quietly condoning its support. The SETC is taking on the role of promoting the private sector's development, and drafting guidelines. The government has also expressed a desire for the private sector to participate in the western development plan, and the Ministry of Construction has indicated that the tightly controlled urban utility sector is gradually opening to private enterprise investment as well.

Nonetheless, a host of barriers continue to hinder the sector. It is extremely difficult for private enterprises to access funding from either banks or securities markets. Private enterprises, like foreign-invested enterprises, are restricted to certain sectors. State owned and private enterprises are not treated equally in regard to registration, taxation, government services, international trade, and access to financing. (For a detailed analysis of China's private sector, see the International Finance Corporation's "China's Emerging Private Enterprises," available online at *www.ifc.org/publications*.)

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Chapter 3
Legal and Policy Review

Prior to the 1970s, few administrative measures were promulgated to facilitate the administration of water and soil conservation, forestation, health and safety in the workplace, or urban beautification, and no clear environmental protection goals, laws, or policies existed in China. This remained the case until after the Chinese government attended the 1972 United Nations Conference on the Human Environment (UNCHE) in Stockholm, which is regarded not only as a milestone in the development of international environmental protection but also as a turning point in the development of environmental protection in China. In 1973, the first National Environmental Protection Meeting was held in Beijing. Following the meeting the State Council promulgated its Guidelines on Environmental Protection and its Rules on Environmental Protection and Improvement, which are regarded as China's first environmental policies. At that time, these policies filled the role of the environmental protection law promulgated on a trial basis six years later. Since then, environmental protection has gained increasing prominence on the government agenda.

Following the first National Environmental Protection Meeting of 1973, the Environmental Protection Committee of the State Council was established in 1974, culminating in the development of a national-level environmental protection administration. Under this organization, several environmental protection regulations, as well as standards on pollution discharge and quality of municipal drinking water and food, were enacted between 1974 and 1978.

In 1978, the Constitution of the People's Republic of China was amended to include Article 11, marking for the first time an inclusion of environmental protection therein and providing a constitutional basis toward those means. The "trial" Environmental Protection Law of China was then promulgated in 1979, stipulating many of the basic components of environmental protection in China today. In 1989, the Environmental Protection Law of the PRC was promulgated, replacing the trial law of 1979. By the end of 2000, six laws, around 100 administrative regulations, and over 1,000 local regulations had been promulgated by the National People's Congress (NPC), the State Council, various ministries, and provincial and municipal governments.

Legal Framework of Environmental Protection Laws and Regulations

China's legal system for environmental protection is based on a broad framework (at the constitutional level) that is filled in by laws and regulations stipulated by incrementally lower levels of law-making bodies.

The Constitution

Article 11 of the Constitution, promulgated in 1978, initially gave a constitutional basis to the protection of the environment. Since the article's promulgation, the Constitution has undergone further reform, strengthening commitment to environmental protection. Nonetheless, the constitutional commitment to the environment is general, serving only as a base of legitimacy for the further development of environmental laws and regulations.

Basic Law

The basic, or general, laws are those laws formulated by the NPC and its Standing Committee, and they rank second to the Constitution in terms of authority. These laws are more pointed than the components of the Constitution that support environmental protection, but they remain general in comparison with the regulations devised to carry out their directives. Currently, six such laws have been promulgated with regard to environmental protection. They are

1. the Environmental Protection Law of the PRC,
2. the Marine Environmental Protection Law of the PRC,
3. the Water Pollution Prevention and Control Law of the PRC,
4. the Air Pollution Prevention and Control Law of the PRC,
5. the Solid Waste Management Law of the PRC, and
6. the Environmental Noise Pollution Prevention and Control Law of the PRC.

Regulations

Administrative regulations of the State Council serve to implement the basic laws promulgated by the NPC and its Standing Committee. Basic laws rank higher in authority than regulations; however, regulations are more numerous, specific, and instrumental than basic laws. There are many regulations for environmental protection, including, for example, the Administrative Regulations for Environmental Protection of Construc-tion Projects, the Implementation Details of the Water Pollution Prevention and Control Law of the PRC, and the Implementation Details of the Air Pollution Prevention and Control Law of the PRC.

Ministerial administrative regulations rank next in the authoritative hierarchy, and again they exceed their superiors in number. SEPA is the major source of ministerial regulations with regard to environmental protection. Several other ministries and commissions, such as SDPC and SETC, issue them as well.

The People's Congresses at the provincial and municipal levels, as well as other local government bodies, issue local regulations limited in authority to their respective localities. It is at this point that China's legal structure becomes most specific. Local regulations, and thereby local implementation of national laws, can vary from locality to locality.

International Treaties

International treaties are a final component of China's environmental legal system. China is signatory to 73 international treaties particular to environmental protection, 50 of which are multilateral and 23 bilateral.

Leading Principles of Environmental Protection Laws and Regulations

Four legal principles define China's environmental protection goals and serve as the broad guidelines of environmental protection legislation:

1. **Harmonious Development** stipulates that environmental protection must parallel economic and social development, so as to achieve economic, social, and environmental benefits in unison. Its ultimate goal is the realization of sustainable development, and it is interpreted by the law in that environmental protection must be incorporated into all social and economic development planning.
2. **Stressing Prevention While Strengthening Control** places the emphasis of environmental protection on pollution prevention but recognizes that in most cases gradual improvements in pollution abatement efforts are all that can be expected.
3. **The Polluter Pays** principle seeks to impose the costs of environmental degradation on those who are responsible for that degradation. In practice, these costs are imposed directly upon Chinese enterprises, in the form of pollution levies, and only indirectly upon consumers, in the form of higher prices.
4. **Public Participation** is, theoretically, sought out in China's environmental protection legal apparatus. In many cases, the capacity for the public to influence environmental protection remains limited by the same factors that affect its impact on other public spheres, and public participation is largely excluded from the policy development process. However, many environmental protection bureaus (EPBs) at the municipal level accept and process public input and complaints in regard to environmental degradation. Administrators are realizing that encouraging public voicing of dissatisfaction (within "the bounds of the law") may help to justify increased spending on environmental protection, and citizens are increasingly encouraged to support environmental protection.

National Measures Toward Environmental Planning and Protection

The following is a broad-based description of the processes and measures through which national-level environmental protection is constituted and carried out. Although the environmental legal system in China is increasingly comprehensive and rationalized, it remains complex and in certain cases contradictory. Additionally, laws and regulations are sometimes revised and promulgated quite rapidly.

Environmental protection planning establishes environmental protection targets and the measures needed to meet those targets. Local EPBs conduct preliminary surveys and establish plans that are then submitted to SEPA for national-level review and incorporation into the national Five Year Plans. The process takes years and requires repeated confirmation, evaluation, consulting, and coordination.

The plan targets set for the year 2000 included the following:

Box 5. Public Participation

A number of recent public opinion polls carried out by private market research companies, research centers, and other interest groups have found that environmental issues are registering as top concerns of Chinese citizens. In a 2000 survey in 10 cities around the country, about half of the respondents selected environmental protection as their top concern, ahead of issues such as unemployment, corruption, and economic growth. A 2001 survey found a similar number of people ranking environmental issues over population growth and an underdeveloped education system.

In accordance with Article 11 of the Environmental Protection Law, SEPA and provincial EPBs have been issuing national or provincial environmental reports on a regular basis since 1989. The reports, which cover water, marine, air, noise, industrial solid waste, radiation, land and cultivated land, forest and grassland, biodiversity, climate change, and other related issues, also provide statistical data and information on major environmental protection activities. The purpose of the reports is to arouse public concern, instigate a degree of pressure on polluters and local governments, and drum up citizen support, interest, and even supervision over environmental issues. The regularity of these reports varies from locale to locale, with some cities reporting on some subjects daily. Prior to these allowances, such information was not made public.

To further facilitate public participation in environmental protection, SEPA issued a notice on establishing separate offices at both SEPA and local EPBs to review and respond to citizen complaints in December 1990. According to this and further regulations, such complaints must be responded to within 30 or 90 days, depending upon the intricacies of the issue at hand. If citizens are dissatisfied with the solution proposed by an EPB, they are entitled to refer the issue to higher-level EPBs or to the courts for reexamination. Citizens dissatisfied with a solution proposed by SEPA may refer the issue to the courts.

- The development of a relatively well organized environmental management and legal system appropriate to the socialist market economy
- The placing of environmental pollution and ecological damage "largely under control"
- The facilitation of environmental improvement for some cities and regions
- The establishment of a number of demonstration cities and regions whose economies are in rapid development and whose environments and ecology are in sound condition

The plan for 2010 includes the following targets:

- A "fairly well implemented" sustainable development strategy
- The further establishment of an environmental legal system
- A "largely changed" situation of environmental pollution and ecological deterioration
- Sharply improved environmental quality
- The achievement, within a "large number of cities and regions," of rapidly developing economies with sound ecological and environmental conditions

Although the plan targets appear to be vague, general, and in some cases overly idealistic, they serve a fundamental purpose in setting goals to be achieved through the administrative capacities of lower-level governments.

Environmental Planning During the Ninth Five Year Plan

Goals for the Ninth Five Year Plan sought to keep the year 2000 discharge rates of many pollutants near or below 1995 levels while increasing overall economic and productivity growth. Table 3.1 lists the official 1995 statistics for 21 major pollution categories and the corresponding goals for the year 2000.

A number of programs, such as the One Control and Two Targets (Yi Kong Shuang Da Biao in Chinese), the 3321 Campaign, and the China Trans-century Green Engineering Program, have been established to facilitate the implementation of the plan.

One Control and Two Targets. One Control and Two Targets is intended to control pollution in terms of total emissions, thereby controlling discharge concentration at point sources of pollution and improving air and water quality. "One control" refers to the total emissions of a particular polluting discharge allowed nationwide. Under the plan, the total allotment for each pollutant is to be divided among the provinces, and then further divided within the provinces, all the way down to local EPBs and ultimately to each enterprise. Older facilities, which are usually state-owned, are generally given higher allocations for discharge, while newer facilities are seen as more capable of reducing overall discharge levels.

The "two targets" are to bring Chinese industries within local and national standards regarding all industrial pollutants and to improve air and water quality in

Table 3.1 1995 Pollution Figures and Year 2000 Targets

Category of Pollutant	*1995 Levels*	*Target Levels for 2000*
Total soot emission (10,000 tons)	1,744	1,750
Industrial dust discharge (10,000 tons)	1,731	1,700
Sulfur dioxide emissions (10,000 tons)	2,370	2,460
Chemical oxygen demand (10,000 tons)	2,233	2,200
Oil pollutant discharge (tons)	84,370	83,100
Cyanide discharge (tons)	3,495	3,273
Arsenic discharge (tons)	1,446	1,376
Mercury discharge (tons)	27	26
Lead discharge (tons)	1,700	1,670
Cadmium discharge (tons)	285	270
Hexivalent chromium discharge (tons)	670	618
Industrial solid waste (10,000 tons)	6,170	5,995
Wastewater discharge (100 million tons)	356	480
Industrial wastewater discharge (100 million tons)	222.5	300
Treatment rate of industrial wastewater (percent)	76.8	74
Treatment rate of urban sewage (percent)	19	25
Treatment rate of industrial waste gases	74	80
Comprehensive utilization rate of industrial solid wastes	40	45
Decontamination rate of urban refuse (percent)	43	50
Forest coverage (percent)	13.92	15.5
Nature reserve area (10,000 hectares)	7,185	10,000

Note: The amounts of wastewater and industrial wastewater discharged and the treatment rates in 1995 do not cover township enterprises.

Source: Ninth Five Year Plan for Environmental Protection and Year 2010 Long-Term Goals (Beijing: SEPA, 1996); available online at *www8.silversand.net/com/lser/GH/gh_1/2010.htm.*

municipalities, provincial capital cities, special economic zones, coastal development cities, and major tourist cities. In 1997, SEPA issued the Ninth Five Year Plan "total emissions control" (TEC) standards for 12 major pollutants (see Table 3.2). Enterprises unable to meet the requirements of One Control and Two Targets face closure.

Official figures indicate that among 238,000 enterprises affected by the One Control and Two Targets program nationwide, 90 percent reached the targets by the end of 2000. Among those that did not reach the targets, 520 "key enterprises" identified by SETC were granted a grace period extending to Dec. 31, 2002. Those enterprises not identified by SETC as "key" will face strict measures formulated by their local governments, including requisite ceasing of production or closings. There is reason to believe that the figure of 90 percent is not entirely accurate, and issues of reversion raise questions regarding whether all enterprises that met the standards by the deadline are still operating within them.

The 3-3-2-1 Campaign. The 3-3-2-1 Campaign refers to the following targets, which have been selected as key pollution prevention and control zones: three rivers

Table 3.2 Pollutants Selected for Total Emissions Control

Category of Pollutant	*1995 Levels*	*Target Levels for 2000*	*2000 vs.1995 (percent)*
Total soot emission (10,000 tons)	1,744	1,750	0.37
Industrial dust discharge (10,000 tons)	1,731	1,700	−1.80
Sulfur dioxide emissions (10,000 tons)	2,370	2,460	3.82
Chemical oxygen demand (10,000 tons)	2,233	2,200	−1.49
Oil pollutant discharge (tons)	84,370	83,100	−1.5
Cyanide discharge (tons)	3,495	3,273	−6.4
Arsenic discharge (tons)	1,446	1,376	−4.8
Mercury discharge (tons)	27	26	−3.7
Lead discharge (tons)	1,700	1,670	−1.9
Cadmium discharge (tons)	285	270	−5.4
Hexivalent chromium discharge (tons)	670	618	−7.7
Industrial solid waste (10,000 tons)	6,170	5,995	−2.9

Source: *National Total Pollution Control Scheme for the Ninth Five Year Plan* (Beijing: SEPA, 1997); available online at *www.zhb.gov.cn/sepa/layout/files/95.htm.*

(the Huaihe, the Liaohe, and the Haihe); three lakes (Taihu, Chaohu, and Dianchi); two zones (an acid rain control zone and an SO_2 control zone); and one municipality (Beijing). Most of these targets exist in or are affected by several provinces, thus making strong cooperation among provincial governments necessary. Each was selected because of serious pollution issues.

The acid rain control zone and SO_2 control zone total 1.09 million square kilometers in area, which amounts to 11.4 percent of China's total territory. Within this, the acid rain control zone covers about 133 cities and counties in Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Chongqing, Sichuan, Guizhou, and Yunnan. The total area reaches 0.8 million square kilometers, amounting to 8.4 percent of the total Chinese territory. The SO_2 control zone covers about 125 cities and counties in Beijing, Tianjin, Hebei, Shaanxi, Inner Mongolia, Liaoning, Jilin, Jiangsu, Shandong, Henan, Shanxi, Gansu, Ningxia, and Xinjiang. The total area reaches 0.29 million square kilometers, amounting to 3 percent of the total territory. These regions constitute the most troublesome sources of SO_2 and acid rain; therefore more stringent measures are being taken in them to address the problems.

The Trans-century Green Engineering Program. Initiated as part of the Ninth Five Year Plan for Environmental Protection, and under the auspices of Agenda 21, the Trans-century Green Engineering Program is composed of a series of environmental protection projects implemented in key locations and provided for through enhanced financial resources. The program's aim is to focus limited financial resources and manpower on serious pollution issues to bring environmental and ecological deterioration under control. The project has three phases, corresponding with the Ninth, Tenth, and Eleventh Five-Year Plans.

Agenda 21. China's Agenda 21 is a direct result of the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, and it was in fact the first national-level Agenda 21 formulated in the world. The program is now regarded as the country's blueprint for sustainable development and environmental protection. Agenda 21's primary focuses include capping industrial pollution at 1995 levels while maintaining rapid industrial growth; increasing pollution levies so as to equal or exceed waste-treatment costs; increasing and improving the use of market-based and financial tools for environmental protection; promoting clean production; and developing a large-scale plan for environmental protection known as the Trans-century Green Engineering Program.

The Center for Environmentally Sound Technology Transfer. The Center for Environmentally Sound

Table 3.3 Trans-century Green Engineering Program Project Distribution

Contents of Control	*Number of Projects*	*Remarks*
1. Control of water pollution in seven major river basins	**650**	A total of 801 projects for prevention and control of water pollution
Huaihe basin	282	
Liaohe basin	30	
Haihe basin	56	
Songhua River basin	44	
Yellow River basin	69	
Pearl River basin	36	
Yangtze River basin	133	
2. Control of water pollution in three major lakes	**35**	
Dianchi	13	
Chaohu	7	
Taihu	15	
3. Control of water pollution in major coastal cities	**99**	
4. Control of water pollution in other cities	**17**	
5. Major acid rain pollution control regions	**109**	
East China	9	
Central China	36	
South China	28	
Southwest China	36	
6. Control of air pollution in major cities	**219**	
7. Control of solid waste pollution	**272**	A total of 328 projects for prevention and control of air pollution
Industrial solid wastes	118	
Hazardous waste and radioactive waste	85	
Disposal of municipal waste	69	
8. Ecological environmental protection	**118**	
Ecological environmental protection and restoration	54	
Rural ecological protection	37	
Preservation of nature reserves	27	
9. Actions related to global environmental issues	**69**	
Greenhouse gas control	28	
Ozone layer protection	14	
Biodiversity conservation	27	
10. Capacity building of national environmental supervision and administration	**3**	
Total	**1,591**	

Source: *The China Trans-century Green Engineering Program* (Beijing: SEPA, 1996); available online at *www.zhb.gov.cn/sepa/layout/files/greenhtm.*

Technology Transfer (CESTT) was established in 1997 with the intention of further developing China's Agenda 21. With support from the Ministry of Science and Technology, technical assistance via the Asian Development Bank, and under the direction of the administrative center for Agenda 21, CESTT assists small and medium-sized enterprises with accessing, developing, and applying environmentally sound technologies.

The Tenth Five Year Plan for Environmental Protection

SEPA completed its draft of the Tenth National Five Year Plan for Environmental Protection (2001–2005), which was incorporated into the Tenth National Five Year Plan for Economic and Social Development (the Tenth Five Year Plan) in March 2001. The plan stipulates environmental targets for the end of 2005, which are characteristically general in nature. They include the further establishment of environmental protection policy, law, and administrative systems appropriate to a socialist market economic system; a reduction in the tendency toward environmental pollution and ecological deterioration; the improvement of environmental quality in key cities and regions; and an increase in the number of cities and regions in which economic development is rapid while environmental and ecological conditions remain sound.

Tasks for the Tenth Five Year Plan include the following:

- To continue total emission control and maintain a continuous decline in total pollution discharge
- To direct economic restructuring toward the promotion of clean production
- To promote municipal sustainable development focusing on the improvement of environmental quality
- To emphasize ecological protection and pollution prevention and control equally
- To launch a "three zone" ecological protection strategy to include special ecological function zones, key resource development zones, and ecologically sound zones
- To strengthen environmental protection enforcement in rural areas and to control rural environmental pollution effectively
- To develop the domestic environmental industry and to maintain an effective supply of environmental technologies and products
- To strengthen the management of nuclear environmental safety and prevent and control radiation-associated issues actively
- To accelerate the modernization of environmental management in the energy industry
- To protect national environmental safety and participate actively in international environmental initiatives

In augmentation of the 3321 Campaign of the Ninth Five Year Plan, key regions identified in the tenth plan will include the Yangtze River, the Yellow River, and the Bohai sea; the number of key cities for pollution control is to be expanded from 47 to 100.

Environmental Protection Standards

By the end of 1999, 426 environmental standards had been established throughout China, classified as national environmental standards, SEPA environmental standards, and local environmental standards. SEPA is in charge of the establishment of national environmental standards and SEPA environmental standards, both of which are in use nationwide. SEPA environmental standards function for categories for which national standards are not available. Once equivalent national environmental standards are formulated, SEPA environmental standards automatically become invalid.

National environmental standards include the following:

- National environmental quality standards, which regulate the concentration of toxic substances in a given environment and serve as the basis for other environmental standards
- National emissions standards, which regulate the concentration of pollutants discharged into a given environment
- National environmental monitoring methods standards, which regulate techniques and methods used in sampling, testing, analyzing, and processing data collected for monitoring environmental quality and emissions
- National environmental sampling standards, which are used for preparing solutions, adjusting and collating analysis and testing equipment, and regulating other aspects of sampling and analysis
- National environmental basic standards, which standardize items such as technical terms, symbols, abbreviations, graphics, and data indexes used in the environmental protection field

When no national environmental quality standards or national emissions standards are available for a particular category, provincial governments may formulate

local standards; provincial governments may also set more stringent standards than the equivalent national emissions standards. Local standards must be submitted to SEPA for record keeping.

Three Simultaneous Steps

The Three Simultaneous Steps policy stipulates that all environmental protection facilities must be designed, constructed, and operated simultaneously with the main construction project, as opposed to designing, building, and operating a facility with the intention of retrofitting the project with an environmental protection plan and facility at some stage after its completion. The Three Simultaneous Steps policy applies to all new, expansion, and renovation projects. For treatment facilities, the measure is generally applied to those components that are being expanded or renovated; however, it may apply to an entire facility once any portion is added, modified, or upgraded.

The three steps for treatment facilities can be summarized as follows:

1. **Design:** The engineering design institution must ensure that the pollution measures recommended in the environmental impact assessment (EIA) and required under the Three Simultaneous Steps measure are included in the facility design. Technically, this process involves receiving approval from the same environmental regulatory entity that approved the project's initial EIA report (SEPA, the provincial EPB, or the local EPB, contingent on the scale of the project). In reality it is often synonymous with registering the project.
2. **Construction:** The construction of environmental facilities must meet the requirements as specified in the EIA and should be undertaken simultaneously with the main construction component.
3. **Operation:** Upon completion of construction, a trial operation period commences. Following the trial operation period, a thorough inspection of the technical, financial, health, safety, and environmental aspects of the completed project is implemented. If a facility fails the inspection, the EPB requires upgrading and a further inspection within a specified time period.

Environmental Impact Assessment

The EIA concept was first introduced to China in the Environmental Protection Law of 1979. Beginning in the mid-1980s, the government began requiring EIAs for large-scale projects. The program has since developed steadily, incorporating the experiences of other countries with local practices and constraints and resulting in a system that in many ways is beginning to resemble EIA programs elsewhere. The Administrative Regulations for Environmental Protection of Construction Projects (1990) and the Technical Guidelines for Environmental Impact Assessment (1993) are key pieces of legislation strengthening the country's EIA program. Other laws, such as the Marine Environmental Protection Law, the Water Pollution Prevention and Control Law, and the Air Pollution Prevention and Control Law, include EIA requirements.

The scope of EIAs is presently restricted to construction projects, including expansion and renovation projects, and does not include major long-term planning, policy, or regional development considerations. A revised EIA law is currently undergoing review and, when promulgated, will reportedly require performance of the EIA at an earlier stage of the project approval process, increasingly comprehensive methods and protocols, cost-benefit analysis, fines for non-compliances, and legal liabilities.

Regulatory guidelines such as the Administrative Regulations for Environmental Protection of Construction Projects, the National Technical Guidelines for Environmental Impact Assessment, and the Administrative Provisions for the Inspection and Approval of Completed Environmental Protection Facilities of Construction Projects (1993) regulate the EIA process. The most recent EIA regulation is the 1998 Management Protocol. Significantly, the State Council itself issued this document, while the other regulations listed above were issued by SEPA. The 1998 Management Protocol is a detailed implementation document backed by the authority of the premier's office and is relatively well enforced. It includes existing overall policy goals such as mass loading targets and use of clean technology and provides greater detail on the regulation of EIAs and environmental facility construction, including specification of non-compliance fines.

Clean Production

The state encourages the adoption of clean production to reduce air and water pollution and the accumulation of solid waste. The SETC is authorized, in conjunction with other ministries, to list for elimination certain "backward" production techniques and technologies known to cause heavy air and water pollution or to result in the creation of significant amounts of solid waste. The production, sale, and use of the listed techniques and technologies are illegal. Similarly,

SETC publishes listings of clean production technologies and techniques, the use of which is encouraged.

Emissions Registration and Emissions License

Emissions registration requires enterprises constituting a pollution source to register with local EPBs in regard to those pollutants being legally discharged. The purpose of the registration is to facilitate comprehensive accounting by local EPBs regarding emissions under their jurisdiction. Registration also enables further administrative action toward pollution prevention and control, monitoring, supervision, and compilation of statistics. Local EPBs have the right to inspect facilities to verify the information provided by registered enterprises.

Emissions registration must be filed with local EPBs following the inspection and approval of pollution prevention and control facilities and prior to official commencement of operation. The scope of registration includes type, quantity, and concentration of emissions, receptacle of emission discharge, process of emissions discharge, type of noise pollution sources, strength of noise pollution, general conditions of pollution prevention and control facilities, and general conditions of storage, utilization, and disposal facilities for solid and other types of waste.

If there are any significant changes to the registered items during the operation of a facility, including the removal or disuse of the facility, the enterprise must file an amending registration with the original EPB 15 days prior to the change. Enterprises ceasing operations must inform the original EPB. If emissions do not meet relevant national or local standards, enterprises must specify why and adopt measures to meet the standards.

In addition to registering, the enterprise must submit an emissions license application to the local EPB. Upon successful application, an emissions license will be issued to the enterprise to serve as legal permission for the discharge of specified pollutants. This regulation does not apply to radioactive waste, which is subject to separate and more rigorous requirements.

Emissions Fees

Emissions fees are levied on enterprises discharging pollutants in excess of state standards. Under new air and water laws, all emissions, even those not exceeding state standards, receive levies, with heavier levies, legal liabilities, and potential closure looming for those enterprises exceeding state standards. Local EPBs or their authorized monitoring institutions survey factors such as the type, quantity, and concentration of pollutants to determine the exact amount of the emissions fee, in accordance with pertinent regulations.

Revenues collected via the emissions fee system are generally recycled into the environmental protection apparatus by servicing loans and grants for upgrading enterprises (as much as 80 percent of the fees paid by an enterprise can be returned to the enterprise to finance environmental upgrades), augmenting EPB budgets, and financing pollution treatment and the restoration of polluted environments. The fees do not, however, exempt enterprises from legal liabilities, compensation for personal injury or property losses, or other financial burdens associated with further pollution prevention and control measures.

The major weakness of the Chinese emissions fee system is that levies remain too low to provide an incentive for pollution control. Some enterprises find it more cost-effective to submit emissions fees than to develop or operate costly pollution control facilities or take other measures to prevent and control emissions. Additionally, local EPBs often prefer to maintain emissions fees at the current lower level rather than increase them and provide a stronger incentive to improve pollution control, because 20 percent of all collected emissions fees are used to augment EPB budgets; there has been recent discussion, however, regarding the elimination of this practice. There is also discussion of transforming the current emissions fee system into a more efficient and better-regulated taxation system, but such a change is not expected during the Tenth Five Year Plan.

Coal consumption, which remains the principal energy source in China, reached 1.28 billion tons in 1995, and SO_2 emissions resulting from coal burning reached 23.7 million tons, ranking as the world's highest. In early 1992, to tackle the problem, SEPA together with a number of other ministries and supported by the State Council initiated a trial SO_2 emissions fee for coal burning in industrial sectors. Guizhou Province, Guangdong Province, and nine cities in other provinces were selected for the trial. Based on the experiences in these locales, the practice was expanded, eventually covering the entire acid rain control zone and SO_2 control zone by Jan. 1, 1998. Unlike most other emissions fees, the SO_2 emissions fee is collected regardless of whether the emissions exceeded standards; any emission of SO_2 requires a fee, whereas the exceeding of standards constitutes a basis for heavier enforcement measures.

Environmental Monitoring

Under the Environmental Protection Law, monitoring systems must be established to conduct environ-

mental monitoring in China. National and local monitoring stations are classified into four levels (national, provincial, municipal, and county) and are encompassed in a three-level monitoring network (national, provincial, and municipal). National monitoring stations are operated under SEPA, and local-level monitoring stations are operated under the relevant EPBs. Additionally, specialized environmental monitoring networks have been established for major river systems, marine areas, and agricultural environments. Every monitoring station must write monthly and yearly reports, as well as any other report requested by upper-level stations or superiors, and submit them to the directly superior monitoring station for inclusion in a more comprehensive report. Some large cities now provide daily environmental reports, made public via local media.

On-the-Spot Inspection

Both SEPA and local EPBs conduct on-the-spot inspections of pollution sources to supervise the implementation and enforcement of all requirements stipulated by the relevant laws and regulations. Supervision departments are established within both SEPA and local EPBs to conduct such inspections, levy fines for violations of laws and regulations, and collect emissions fees. Enterprises under inspection have expressed concern regarding the confidentiality of trade and enterprise secrets that may be discovered during the inspection process. Under the Tentative Procedures on Environmental Protection Supervision, inspectors are required to maintain confidentiality in regard to such secrets.

Abatement Deadlines

Enterprises discharging pollutants in excess of relevant emissions standards over an extended period of time, as well as pollution sources located in or near natural reserves, historic sites, scenic spots, or other locations under special protection, may be required to carry out pollution control measures within a prescribed period. The directive to impose an "abatement deadline" can be handed down only by local governments, not by EPBs. However, EPBs are responsible for impact assessments, action plan evaluations, and implementation supervision.

When considering the imposition of an abatement deadline, authorities take into account the seriousness of the pollution. If discharges in excess of standards do not cause serious pollution, enterprises may simply be required to pay heavier emissions fees. There are no detailed stipulations specifying what constitutes serious pollution; however, in practice, the following factors are generally considered when deciding upon the issue:

- Whether the total volume of the pollutants discharged continuously exceeds relevant emission standards
- Whether multiple types of pollutants are discharged, many of which do not easily degrade in nature
- Whether discharged pollutants and discharge rates constitute a threat to public health
- Whether discharged pollutants have become a public nuisance and have instigated dispute

Facilities located in or near natural reserves, historic sites, scenic spots, or other locations under special protection are less subject to flexibility based upon the seriousness of the pollution and are more likely to receive an abatement deadline as opposed to increased levies. In cases where adequate financial resources and technical capacity are unavailable, enterprises are generally shut down instead of receiving an abatement deadline. The time limits for abatement deadlines generally range from one to five years.

Accident Reporting

Environmental pollution accidents must be followed by measures to control the pollution, inform nearby communities that may be affected, and report to local EPBs. After an accident is reported, local EPBs must report to local governments regarding further pollution control and emergency response measures. Local EPBs must also conduct on-the-spot investigations and collect pertinent information to be applied to further prevention and control measures. Accidents are graded into four levels based on their seriousness; level three accidents must be reported to provincial EPBs, and level four accidents must be reported to SEPA.

Incentives

Incentives such as tax deductions and waivers, special funds, and honorable awards and certifications, as well as certain disincentives, have been established both nationally and locally to encourage improved environmental protection. Several examples of such incentives and disincentives are introduced below.

Import Tax and Value-Added Import Tax Waiver. In an effort to accelerate foreign investment and promote the import of advanced technologies and equipment, import tax and value-added import tax on some pollution prevention and control products may be waived.

Income Tax Waiver. Enterprises using certain industrial waste products as major raw materials for new products may have their income tax on the sales of such products waived for five years.

Adjustment Tax on Investment in Fixed Assets Waiver. Enterprises investing in fixed assets for the reuse of the "three wastes" (air, water, and solid wastes) may have their adjustment tax on investment in fixed assets waived.

Value-Added Tax Waiver. Enterprises using coal gangue, stone coal, coal ash, and certain other items as raw materials to produce building materials may have their value-added tax waived provided that the recycled products constitute no less than 30 percent of the raw materials in the production process. Enterprises using wastewater and solid waste to process gold and silver may have their value-added tax waived.

Ban on Bank Loans for Outdated Products and Technologies. The SETC provides listings of outdated products and technologies that are heavily polluting or not energy efficient. Commercial banks bear legal liabilities for providing loans to facilities for the production or utilization of these listed items.

"Excellence in Environmental Protection Technology." Environmental protection technologies meeting a number of criteria may be considered for SEPA's "Excellence in Environmental Protection Technology" title. SEPA awards the title on a yearly basis, and local EPBs are charged with the popularization of the technologies. Enterprises must give priority to the utilization of these technologies if feasible; otherwise, their EIA or application for financial assistance will not be approved.

Environmental Protection Certification. SEPA and provincial EPBs confer environmental protection certification on environmental protection equipment and facilities that are deemed suitable. SEPA issues, on an irregular basis, lists of equipment and facilities that are considered important in environmental protection and must acquire such certification. When conducting new, expansion, and renovation projects, enterprises must use certified equipment and facilities. The conferment is valid for three years and is renewable.

Environmental Labeling. In order to qualify for environmental labeling, a product must uphold environmental protection requirements throughout its life cycle, from production to consumption to disposal. Environmental labeling not only increases a product's competitiveness but also provides consumers with an opportunity to support environmental protection by purchasing such products. Environmental labels are valid for three years and may be renewed upon reevaluation.

Main Regulators of Environmental Protection

The National People's Congress

The National People's Congress is the country's highest legislative body and holds exclusive authority in enacting, amending, and interpreting the Constitution of China, as well as all laws and policies pertinent to major aspects of national social and economic development. Additionally, the NPC supervises the implementation of laws and policies and determines appointments to positions of central government leadership and the Supreme People's Court and Supreme People's Procuratorate. About 3,000 representatives from the provinces, municipalities, and autonomous regions are elected to the Congress every five years and convene in Beijing once a year. The Standing Committee of the National People's Congress is the working organization of the Congress and maintains its authority and responsibility while the Congress is not in session.

Local people's congresses, which are maintained at the provincial, municipal, county, and township levels, constitute the local regulatory bodies, are in charge of local legislative issues, and determine the appointment of local government leaders. No standing congress committees are maintained at the township level.

The Environmental and Resources Protection Commission, a subsidiary organization of the Standing Committee of the National People's Congress, is the highest authority in charge of drafting laws and regulations pertinent to environmental and natural resources protection and supports the National People's Congress in overseeing the implementation of relevant legislation. The commission has three divisions: the general affairs department, the legislation department, and the research department. Mr. Qu Geping, chairman of the commission, is currently a central player in regard to Chinese environmental law and policy.

The State Council

The State Council is the central government body charged with the implementation of all laws and policies and has authority over all sectors of national social and economic development. It is comprised of a premier, vice premiers, state councilors, ministers, a general secretary, and vice general secretaries. Leadership positions are filled by appointment and are approved by the National People's Congress every five years. The State Council formulates administrative regulations and policies based upon the Constitution and laws of China and maintains the leadership role over all levels of local government.

In 1998, a large-scale restructuring of the State Council and its subsidiary ministries and commissions was carried out, followed one year later by the restructuring of all local governments. The restructuring was aimed at increasing government regulatory and administrative roles and decreasing government roles in specific business issues. Additionally, it was intended to reduce the bureaucracy and financial burdens that have long been a serious barrier to the development of the country. As a result of the restructuring, the number of subsidiary organizations under the State Council has decreased from 40 to 29.

Under the leadership of the State Council, provincial and lower-level local governments function very much like the State Council in regard to local social and economic affairs. They must report to both the local people's congress and the government body operating at the next-highest level of administration.

Ministries and Commissions Influencing Environmental Protection

The following ministries and commissions influence the environmental protection sector and administer environmental protection measures within their official jurisdictions on a daily basis. Like most other ministries in China, they are structured vertically, from the national level to the county and even the township level. Local bodies report to both the local government and their upper-level counterparts.

The State Environmental Protection Administration (SEPA). The State Environmental Protection Administration is the highest strictly environmental administrative authority in China. Its responsibilities include the drafting of laws, the issuing of regulations and standards, the analysis and reporting of environmental indicators, the supervision of nationwide environmental legislation enforcement, and the development of pollution prevention policy and planning. In setting environmental protection targets and developing plans to meet those targets, SEPA works in collaboration with the Ministry of Construction, SDPC, and SETC, among others, and is responsible for overseeing the implementation and coordination of those targets in cooperation with the relevant institution and agencies.

As part of the 1998 government restructuring plan, SEPA was elevated to the ministry level, representing a theoretical strengthening of its authority. SEPA did relinquish much of its control over planning and policy for the environmental industry to SETC but is expected to increase its role in determining national policy and objectives. Nonetheless, a perceived conflict of interest between environmental protection and economic development remains among the ministries, and SEPA's lesser authority and financial capacity in comparison with the likes of SETC and SDPC remains something of a sticking point.

SEPA's vertical authoritative structure is also troublesome in that local governments exercise control over most administrative details within local EPBs. EPB financing, personnel, daily administration, and so forth are managed by local governments, while SEPA establishes broad operative goals and administrative directives. As a result, local governments have more leverage to see that EPBs act in accordance with local government interests as opposed to state-level SEPA directives. The administrative details of SEPA's operations are a constant topic of policy-making discussion, and further changes in administration, and possibly even structure, are to be expected.

The State Development and Planning Commission (SDPC). The State Development and Planning Commission develops medium- and long-term social and economic development plans (thereby defining the fundamental development goals for the country) and supervises the implementation of those plans. Thus, SDPC exerts influence upon all social and economic sectors, including the environmental field.

SDPC responsibilities include researching and advising on the formulation of state economic and social development strategies with an aim toward maintaining a development balance and structural optimization; planning for resource development, energy distribution, and ecological and environmental protection infrastructure development; gathering and analyzing development and economic indicators for the financial and banking sectors; and proposing allocations of public investment funds and foreign capital funds.

The SDPC maintains significant influence over specific projects in order to coordinate overall investment in various sectors of the economy. However, following government restructuring, the commission, like all ministries, is intended to assume a more regulatory and administrative role, becoming less involved in the determination and approval of specific projects and, from a macroeconomic planning position, assuming an increased role in encouraging investment and development by domestic and foreign institutions and companies. At the same time, the State Council appears to be increasing the relative authority of the State Economic and Trade Commission while slowly diminishing the authority of SDPC, which is viewed as a legacy of China's former planned economy.

The State Economic and Trade Commission (SETC). The State Economic and Trade Commission is the most powerful regulator of daily national economic operations, particularly in regard to industrial aspects. The SETC influences most economic sectors directly or indirectly through implementing and supervising economic and social development plans. It is also responsible for supervising and analyzing national economic trends, adjusting daily economic operations, establishing short-term economic operational goals, policies, and measures, and carrying out international cooperation efforts.

Additionally, SETC oversees the drafting and implementation of state industrial policies, plans investment layout for competitive industries, drafts policy for reforming state-owned enterprises, promotes enterprise development, oversees project investment and financing, oversees resource use and application, and coordinates environmental protection and the development of environmental industry.

The Ministry of Finance. The Ministry of Finance is the primary organization under the State Council charged with issues pertinent to state revenues and expenditures, financial policies, and taxation policies (in conjunction with the State Taxation Administration). The Ministry of Finance, independently or in cooperation with other government organizations, formulates, implements, and supervises laws, regulations, strategies, policies, and planning pertinent to financial and taxation issues; conducts administration over the state's annual budget and expenditures, including the formulation and implementation of plans for the expenditure of state revenue, arrangements for state project investment, government purchase planning and policies, special financial accounts, and government foundations; conducts administration over state debts, including the planning and issuance of state debts, as well as relevant policies; conducts administration over the accounting and auditing sectors; conducts administration over international loans via foreign governments, the World Bank, the Asian Development Bank, and other such institutions; conducts administration over the taxation of foreign-related operations, such as the taxation of imports and exports; and carries out planning pertinent to financial research, education, and training.

The Ministry of Foreign Trade and Economic Cooperation (MOFTEC). The Ministry of Foreign Trade and Economic Cooperation's primary function is the formulation and implementation of policies, laws, and regulations concerning foreign trade and economic cooperation, which includes analysis of international trade and economic climates and their impact on China, approval and issuance of international trade and business licenses, and regulation of the import-export markets. MOFTEC is also the main government channel for bilateral finance cooperation and plays a key role in the approval process for foreign investment.

The Ministry of Construction. The Ministry of Construction formulates regulations, policies, and planning with regard to municipal and township design and construction, the building industry, the residential housing industry, architectural designing and consultancy, and the municipal public works industry. Additionally, the ministry's responsibilities include, in cooperation with other ministries, the formulation of construction standards, construction budgets, and feasibility studies. Many aspects of infrastructure development, including transportation, energy, communications, water treatment and supply, and waste management, are directly or partially under the auspices of the Ministry of Construction.

The Ministry of Science and Technology. The Ministry of Science and Technology formulates policies, strategies, regulations, and planning with regard to the development of science and technology. Planning for and promotion of scientific and high-tech research, as well as the facilitation of financing for scientific and technological research, are included in its responsibilities. The ministry also plays a role in facilitating international cooperation in scientific advancement.

The Ministry of Science and Technology maintains an innovation fund for small technology-based firms, which is the only ministry-furnished support fund at least partially directed toward environmental protection. Aimed at facilitating the transformation of scientific research achievements into technological innovations to benefit economic growth, the fund is gaining in repute and capacity.

The Ministry of Land Resources. The Ministry of Land Resources regulates natural resource administration and is responsible for the protection and rational utilization of land, mineral, marine (except fishery), and other natural resources, as well as the supervision and pollution prevention of groundwater resources. The ministry also develops technology standards, procedures, and solutions for land, mineral, and marine resource use; drafts and implements general and specific land application plans; and participates in preliminary city planning.

The protection of landowners' and land users' legal rights and the investigation and resolution of land ownership and land use disputes fall under the jurisdiction of the Ministry of Land Resources, as does the devel-

opment of international cooperation on land, mineral, and sea resources.

The Ministry of Communications. The Ministry of Communications formulates and implements strategies, policies, and regulations with regard to land and water transportation and shipping. The ministry is charged with the maintenance of the public roads, highways, and related facilities and fee collections. Similarly, the development and maintenance of the water transportation and shipping infrastructure and the collection of related fees fall within the ministry's jurisdiction.

The Ministry of Communications also supervises water transport and shipping safety, the inspection of ships and marine facilities, the prevention and control of pollution caused by ships, and ocean emergency response.

The Ministry of Water Resources. The Ministry of Water Resources' responsibilities entail the formulation and implementation of regulations, policies, and plans with regard to water resources and efficient water use. Water quality inspections, investment and management plans, pricing, taxation, and administration of national water and soil conservation, as well as flood and drought prevention, are included.

The State Forestry Administration. The State Forestry Administration formulates and implements regulations, policies, and development plans regarding forestry and ecological conservation. Its responsibilities include administration of the state forestation fund, forestation operations, soil erosion and desertification alleviation, surveying and monitoring of national forest resources, and the approval and supervision of forest resource utilization. Additionally, its jurisdiction enters the realm of biodiversity and endangered species. Administration over the protection and management of wild plant and animal species, including endangered plants and animals, is included. International trade in both endangered and non-endangered plant and animal species, international treaties in regard to such species, and other international treaties relevant to the State Forestry Administration are included among its responsibilities.

The Ministry of Agriculture. The Ministry of Agriculture formulates and implements development strategies, policies, and regulations with regard to agricultural development. Additionally, it coordinates with relevant ministries to promote sustainable agriculture, sustainable utilization and protection of fisheries, and protection for aquatic life, grasslands, and wetlands. Supervision of fertilizer quality, animal husbandry, and medicinal treatment of livestock is also carried out, in collaboration with other affiliated ministries.

Township and village enterprises fall under the jurisdiction of the Ministry of Agriculture. Industrial enterprises within this category are significant contributors to environmental pollution but generally remain outside of the environmental protection apparatus. The few environmental statistics available on township and village industrial enterprises are compiled by the Ministry of Agriculture.

The State Taxation Administration. Taxation policies and procedures, including the development of favorable taxation policies to promote environmental protection, and import-export taxation with and without regard to environmental technologies and related incentive policies, all fall within the jurisdiction of the State Taxation Administration. There has been some discussion, as noted above, regarding the possibility of transforming pollution levies into environmental protection taxes and shifting the jurisdiction over such funds to the relatively authoritative and administratively better organized State Taxation Administration.

Major Environmental Protection Laws

The Environmental Protection Law of the PRC

The Chinese government did not include environmental protection in the Constitution of the PRC until 1978, when it stipulated that the state protect and improve the ecological environment, remedy pollution and other public hazards, guarantee reasonable use of natural resources, and protect rare animals and plants. The 1978 alteration of the Constitution became the foundation of detailed environmental legislation. The NPC established the Environmental Protection Law on a trial basis in September 1979. The State Council further announced in 1983 that environmental protection was to become a strategic task in the process of modernizing China. Environmental protection was raised to the rank of national policy, second in importance only to family planning. However, environmental protection was not integrated systematically into politics, causing some policies to have contradictory impacts on the state of the environment. An example was the household responsibility contract system, which stated that the right to use land belonged to farmers, while the state was owner of the land and rural collectives were in charge of public interests. The Environmental Protection Law of the PRC, effective on Dec. 26, 1989,

helped to consolidate environmental directives in a more systematic way.

The Marine Environmental Protection Law of the PRC

The Marine Environmental Protection law defines the respective roles of SEPA, the State Oceanic Administration, the State Maritime Affairs Administration (under the Ministry of Communications), the State Fishery Bureau (under the Ministry of Agriculture), and military environmental protection organizations with regard to marine environmental protection. SEPA is the central coordinator and supervisor of marine environmental protection, and oversees prevention and control of oceanic pollution caused by onshore sources.

The law stipulates that measures to protect, restore, and preserve marine ecological systems and historic natural sites and landscapes must be taken. Natural marine reserves at the local and national level must be set up. Emergency response plans for marine pollution accidents, offshore oil leakages, and enterprise-related pollution issues are to be formulated, and implementation is carried out in accordance with such plans in case of accidents. Pollution discharges from onshore sources to ocean areas must be evaluated and approved by local EPBs, in consultation with local oceanic bureaus, maritime affairs bureaus, fishery bureaus, and military environmental protection organizations. Such facilities are not to be located within or in proximity to marine natural reserves, major fishery zones, coastal scenic spots, and other localities under special protection. Provisions and guidelines for EIAs related to both onshore and offshore marine-impacting construction, production, discharging, and so forth are outlined in the law.

Dumping standards and relevant evaluation procedures are the jurisdiction of the State Oceanic Administration. The State Maritime Affairs Administration has authority to enact compulsory measures to prevent and control pollution associated with maritime transport and shipping facilities and has authority regarding accidents associated with such facilities within PRC maritime territory.

The Water Pollution Prevention and Control Law of the PRC

SEPA and local EPBs are in charge of the general administration of water pollution prevention and control. Organizations under the Ministry of Communications, charged with the administration of inland water and ocean transportation, have authority over water pollution caused by ships. The Ministry of Water Resources, the Ministry of Public Health, the Ministry of Land Resources, municipal public works bureaus, and water resources bureaus coordinate with SEPA and local EPBs regarding water pollution protection and control.

Regarding river protection, SEPA, in conjunction with other relevant government organizations, is charged with drafting pollution prevention and control plans for the major state-designated rivers. Based on these plans, provincial EPBs and other local government organizations draft pollution prevention and control plans for their respective sections of transprovincial and transcounty rivers. The plans are submitted to the State Council or provincial governments for approval.

Local-level governments must incorporate the protection of municipal water resources, and pollution prevention and control, into municipal development plans. Focus is to be placed on the construction and improvement of water distribution and sewage systems and municipal wastewater facilities.

Groundwater protection zones for drinking water are to be designated by provincial governments. The zones are separated into graded levels, the most strict of which disallows any wastewater discharge, tourism activities, swimming and other such activities, and new construction projects or expansion projects for non-water distribution or non-water protection purposes. Any facility producing emissions within such a zone must be removed or undergo abatement measures.

The Air Pollution Prevention and Control Law of the PRC

The Air Pollution Prevention and Control Law of the PRC outlines the incorporation of air pollution prevention and control into the state economic and social development plan. Total emissions control standards, air quality standards, and air emissions standards are established. Guidelines for the supervision and implementation of laws and regulations, comprehensive utilizations, scientific research on air pollution prevention and control, forestation, and municipal beautification are contained herein.

The most recently amended version of the law provides more stringent guidelines in regard to emissions control, thereby making it illegal to exceed relevant national and local emissions standards. Previously, enterprises exceeding such standards were made to pay levies; under the new law such enterprises will be fined, abatement deadlines may be imposed, and closures are possible.

The law also authorizes the State Council and SEPA to designate the following special regions for the implementation of more stringent measures:

- Acid rain control and SO_2 control zones
- Total emissions control zones for air emissions
- Key air pollution prevention and control cities (the number of which is mandated to rise to 100 during the Tenth Five Year Plan).

Crude lump coal containing high SO_2 and soot concentrations must undergo a washing process before use. The sale of coal-burning devices unable to meet relevant emissions standards is banned. Newly designed urban structures depending on coal for fuel must include central heating facilities. Fireproof and dustproof coal storage facilities are requisite.

The manufacture, sale, and importation of automobiles and ships failing to meet relevant emissions standards are banned. Provincial governments, when issuing new emissions standards for automobiles and ships, must get approval from the State Council. Provincial EPBs can authorize organizations to conduct air emissions checks for automobiles and ships, and local EPBs can conduct random examinations of automobile emissions systems in parking lots.

Industrial enterprises discharging dust must take relevant preventive and control measures. Flammable gases must be reutilized if the relevant facilities are available; otherwise, gases must be processed to reduce pollutants prior to discharge. Measures to reduce sulfur, synthetic ammonia, and coal gas must be taken where applicable. Measures to control dust must be taken at construction sites.

In keeping with China's commitment to the Montréal Protocol, measures to encourage the production and utilization of substitutes for ozone-depleting substances will be taken by central and local governments with the intention of phasing out the use of all ozone-depleting substances.

The Solid Waste Management Law of the PRC

SEPA is charged with the general administration of solid waste management nationwide. Other ministries coordinate with SEPA and conduct administration of solid waste management within their official jurisdictions, and local EPBs and government bodies fill their respective roles on a local basis. The Ministry of Construction and local municipal public works bureaus are in charge of the administration of collecting, sorting, processing, storing, transporting, and disposing of municipal solid waste.

Stipulations aim to minimize the production of solid waste, promote its reutilization, and, wherever possible, mitigate its harmful capacities. To do this, the state encourages and supports clean production, comprehensive resource utilization, scientific and technological research and development, and popularization of technologies suited to solid waste management.

To prevent and appropriately manage industrial solid waste, SETC in concert with other ministries must research, develop, and popularize techniques and equipment aimed at reducing the production of solid waste. Additionally, lists of "backward" techniques and equipment are published, and the production, sale, and use of such items are outlawed.

The Environmental Noise Pollution Prevention and Control Law of the PRC

The Environmental Noise Pollution Prevention and Control Law of the PRC charges government bodies with the establishment and enforcement of environmental noise pollution standards. The law includes provisions for the prevention and control of industrial noise pollution, construction noise pollution, traffic noise pollution, and noise pollution caused by social activities. In the cases of industrial and construction noise pollution, measures must be taken to reduce or dampen noise, and time frames are to be established to further regulate the allowance of varying levels of noise. In the case of traffic-caused noise pollution, all motor vehicles, including water vessels navigating inland bodies of water and railline locomotives, are to employ sound-dampening apparatus and restrict the use of horns and sirens within the limits of the law. It is required that sound-dampening barriers be built in instances where traffic-related or other sources of noise pollution cannot be brought within the limits of the law.

Environmental Protection Policies for Western Development

The Chinese government has defined five key priorities for the development of the poorer western regions. However, the development strategy is dichotomous in the sense that industrial and infrastructure development are being strongly pushed while at the same time environmental protection and sustainable development will be maintained.

The potential for this development drive to cause problems for the already desertified and polluted western areas is significant. Most western provinces suffer severe

water shortages, and Lanzhou, the capital of Gansu Province, is among the world's most polluted cities.

Industry is the foremost contributor to western pollution. In comparison with industries in eastern and southern cities, western industries are outdated, inefficient, and highly polluting. In addition, as coastal regions attempt to clean up polluting factories by shutting them down or charging steep fines, these same industries are pushed to the west, where pollution regulation and enforcement are more difficult. The hope is that greater investment brings more efficiency to the region and that closer government attention eliminates the frontierlike attitudes that have so far contributed to its deterioration.

The government places a high priority on environmental protection, investing large amounts in tree- and grass-planting schemes to stabilize soil and water resources. However, the western population consists mostly of rural farmers, among whom are China's poorest. Many of these people depend on farming as their primary source of income and on forest resources for cooking and heating. Most of their practices of irrigation, agriculture, and forest resource use are highly inefficient and have a heavy impact. Tree felling for fuel contributes to massive desertification, poorly managed irrigation leads to salinization and inefficient water use, and improper use of fertilizer and pesticides causes untold non-point-source environmental complications. It remains to be seen how the agricultural sector will be "restructured" so that the members of the local population may retain their livelihood and in fact better their practices.

The most pressing concern for the time being is the lack of water. Serious droughts afflict the region each year, and water management is practically unheard-of. Unsustainable farming practices have taken root, and multilateral irrigation projects have not been successful outside of project bounds. If western development goes as planned, the demand for water will soar. The government's solution—to divert water from the Yellow River—could have disastrous effects on regions of southeastern China.

Legal Trends in the Environmental Field

As a result of amendments to the Air Pollution Prevention and Control Law, governments at all levels must now include measures for atmospheric protection in all economic and social development plans. Similarly, the awaited environmental impact assessment law will likely require EIAs to be included in the formulation of such plans. Thus, a more comprehensive approach to environmental monitoring and protection is developing within the legislation itself. At the same time, legal bases are being developed to promote and support cleaner production, emissions trading, and market-based incentives, and a growing recognition of the need for legislation regarding the comprehensive utilization of natural resources exists. Finally, a definitive shift from concentration-related regulations and end-of-pipe pollution control to a holistic approach to pollution control (manifested in TEC) is undoubtedly taking place.

Environmental Impact Assessment (EIA) Law

Major issues expected to be addressed by this new law include expanding the activities that require an EIA to include the formulation of laws, the formulation and implementation of national economic and social development planning, and the formulation and implementation of economic and technological policies; conducting EIAs at an earlier stage of the approval process; carrying out post-EIAs to regulate activities with a potentially serious impact on the environment; and providing for public disclosure of EIAs.

Cleaner Production Law

SETC is the leading authority regarding clean production and the Cleaner Production Law, which may have implications for new investment and facility upgrades. The latest draft (issued in July 2000) includes procedures concerning the formulation of clean production standards, requires that evaluations of clean production be incorporated into EIAs, established efforts for the promotion of clean production, and sets legal liabilities for violations of the law. The draft also provides for the identification of enterprises with large production potential but severe pollution problems and allows for special measures to assist such enterprises in the development of cleaner production. In the meantime, pilot activities have been carried out in several industries, among them petrochemicals and chemicals, steel and iron, and light industries in Beijing, Tianjin, Shenyang, Taiyuan, Jinan, Fuyang, Lanzhou, Shanghai, Chongqing, and Kunming.

Water Pollution Law

The amended Water Pollution Law presently being discussed by the State Council will most likely facilitate proper exploitation, effective use, and unified management of water resources with particular emphasis on water shortage, water pollution, and flood prevention

projects. It is also expected that the Water Pollution Law will be revised according to the same principles as the Air Pollution Law; however, details have not yet been published.

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Chapter 4
The Water Sector

Per capita water resources in China are equivalent to only 26 percent of the world average. The northern part of the country is plagued by severe water shortages and the widespread contamination of most surface water and groundwater. The southern part of the country, meanwhile, is subject to annual floods, in addition to its own widespread pollution. The Yangtze River clearly delineates water resource disparities between North and South China; south of the Yangtze, 81 percent of the country's total water resources face serious pollution from upstream contamination, while to the north heavy industrialization and urbanization contribute to the degradation and misuse of the remaining 19 percent.

Water supply and quality constraints have prompted the government to begin discussion of an immense South to North water diversion scheme, intended to pump water from the Yangtze to drought-afflicted cities such as Beijing and Tianjin in the North. The project may offer opportunities to foreign technology exporters. That such a major project is underway indicates the severity of water issues in the North.

Over half of the Chinese population does not have access to potable water, and recently the government conceded that there are no exploitable clean water resources left anywhere in the country. Overexploitation and misuse of groundwater in the North have caused widespread declines in the water table, and pollution often renders hazardous what is available. Although data are limited, it is thought that overflowing septic tanks and leaking sewers contribute to much of the deterioration. Similarly influential is the intrusion of pesticides and heavy metals from agriculture and industry. Aquifers in coastal areas are experiencing seawater intrusion and are becoming brackish as a result.

The state intends to focus considerable public environment and resource protection spending over the next decade on water supply, water treatment, and water pollution problems. Enormous investments and changes in the enforcement of regulations can thus be expected in the next few years. As an example, a November 2000 State Council notice, the *Notice on Strengthening Water Supply, Water Conservation and Water Pollution Prevention in Cities*, stipulates that all cities must build sewage treatment plants during the Tenth Five Year Plan and that all cities should have at least 60 percent of their sewage undergoing treatment by 2010 (70 percent in provincial capitals and major tourist cities). Currently, according to recent statistics, urban sewage discharges equal 137 million tons per day across the country, as much as 90 percent of which goes untreated.

Water-related exports in a number of subsectors have found markets in China, despite barriers. Table 4.1 lists dollar values for these, serving as some indication of current markets and future potential. Considering heightened awareness, the growing need for suitable water resources, and the increasing propensity toward the development of market-based tools and incentives, these numbers are likely to grow and the range of market opportunities will increase.

Policy Framework

Pricing and Market-Based Tools

According to the *Notice on Increasing Wastewater Treatment Fees and Establishing an Urban Wastewater Treatment System*, issued in October 1999 by SDPC, the Ministry of Construction, and SEPA, wastewater treatment fees shall be based on the operation and maintenance costs of wastewater treatment plants. Effective from Nov. 1, 1999, the wastewater treatment fee—based on volume—is combined with the water supply fee and collected centrally; the actual fee is still subject to the influence of local conditions. Urban public utility bureaus are in charge of fee collection, and wastewater treatment plants receive an appropriate allocation of funds each month. Table 4.2 reflects the price changes of November 1999 in three key cities.

As these fees were still too low to establish an incentive-based environmental protection scheme, the year 2001 saw additional price hikes.

Table 4.1 Water Treatment Products: U.S. Exports to China (FAS value in thousands of U.S. dollars)

HTS Number	*HTS Description*	*As of April 2001*	*2000*	*1999*
39269	Biofilm medium, woven fabric sheets	16,490.1	39,314.7	23,609.2
46012	Erosion control matting, ecologically safe ground covers	0.0	53.8	70.3
560314	Manmade-filament fabric for wastewater filtration	275.7	737.3	434.7
591190	Environmental protection cloth	1,104.0	2,551.3	3,197.9
84136	Submersible mixer pumps to circulate wastewater, sewage pumps	456.5	3,272.0	3,148.3
84137	Centrifugal pumps lined to prevent corrosion, centrifugal sewage pumps	1,987.3	11,098.0	5,878.7
841381	Wind turbine pumps	4,481.1	2,628.7	1,772.0
842121	Filtering or purifying machinery	26,544.1	35,350.0	25,596.9
842129	Filtering or purifying machinery, other	1,874.1	7,194.6	7,505.0
842833	Belt-type aboveground conveyors used to transfer solids or slurries between plants	7.7	1,736.8	3,285.5
84368	Hot-water weed-killing systems	250.9	1,047.0	260.2
847982	Agitators for wastewater treatment other than kneading machinery	3,813.0	4,249.7	3,470.6
854389	Ozone production systems	9,756.8	32,243.5	11,619.3

Source: U.S. International Trade Commission, USITC Trade Database, *www.dataweb.usitc.gov.*

Current Concerns and Priorities

Discharge of industrial and municipal wastewater represents the top priority for the Chinese government. Non-point causes of water pollution such as the overuse of fertilizers and pesticides are increasingly pressing issues that need to be addressed.

All government officials contacted for this study stated that China is focusing the bulk of its environmental initiative over the next few years on water projects, specifically in the "three lakes, three rivers" areas (the Huaihe, Haihe, and Liaohe basins and the Taihu, Chaohu, and Dianchi Lakes). Changes in Chinese regulations include stepped-up requirements for water treatment capacity; however, few or no funds are provided to facilitate these, leaving municipalities and industries to search for creative means of financing requisite initiatives.

In 1998, wastewater treatment projects accounted for 58 percent of pollution control spending, representing the largest allocation of the environmental budget to an individual sector. In 1999, overall environmental budget spending on wastewater projects was decreased to 52 percent, with an increase in air pollution treatment. The Tenth Five Year Plan (2001–2006) places more emphasis on water conservation methods and supply infrastructure, but the government continues to emphasize cleanup and antipollution measures.

Although issues of poor enforcement remain, the power and acumen of local authorities are increasing. As an example, over 1,000 businesses in the Huai River area

Table 4.2 Water Treatment Price Changes in Beijing, Guangzhou, and Shanghai

City	*Date of Change*	*Type*	*Price per m^3 before change*	*Price per m^3 after change*
Beijing	November 2000	Residents	RMB1.60 (1.30 water+0.30 pollution levy $ 0.19 (0.16 water+0.04 pollution levy)	RMB 2.00 (1.60 water+0.40 pollution levy) $ 0.24 (0.19 water+0.05 pollution levy)
		Enterprises	RMB 2.10 (1.60water+0.50 pollution levy) $ 0.25 (0.19 water+0.06 pollution levy)	RMB 3.20 (2.40 water+0.80 pollution levy) $ 0.39 (0.29 water+0.10 pollution levy)
Guangzhou	May 2001	Residents	RMB 1.00 (0.70 water+0.30 pollution levy) $ 0.12 (0.08 water+0.04 pollution levy)	RMB 1.20 (0.90 water+0.30 pollution levy) $ 0.14 (0.11 water+0.04 pollution levy)
		Enterprises	RMB 1.23 (1.05 water+0.18 pollution levy) $ 0.15 (0.13 water+0.02 pollution levy)	RMB 1.52 (1.25 water+0.27 pollution levy) $ 0.18 (1.15 water+0.03 pollution levy)
Shanghai	December 2001	Residents	RMB 1.58 (0.88 water+0.70 pollution levy) $ 0.19 (0.11 water+0.08 pollution levy)	RMB 1.73 (1.03 water+0.70 pollution levy) $ 0.21 (0.12 water+0.08 pollution levy)
		Enterprises	RMB 1.80 (1.10 water+0.70 pollution levy) $ 0.22 (0.13 water+0.08 pollution levy)	RMB 2.00 (1.30 water+0.70 pollution levy) $ 0.24 (0.16 water+0.08 pollution levy)

Sources: Beijing Water Supply Company *(http://finance.sina.com.cn)*; Guangzhou Water Supply Company; Shanghai Water Supply Company *(www.hwcc.com.cn)*.

were forced by local governments to close for environmental non-compliance in late 2000. By some estimates, as many as 70 percent of those reopened within three to six months. However, new regulatory initiatives are increasing demand for management systems.

Water Pollution and Market Prospects

Ten years ago, central water pollution control concentrated on discharges by state-owned industrial enterprises. Now, private enterprise overshadows the state-owned sector. Industrial output has swollen, along with the wastewater output that goes largely untreated. Meanwhile, municipal wastewater, in terms of total pollution, has more than doubled. Agricultural pollution is a worrying contributor, affecting not only lakes and reservoirs but also groundwater and coastal areas. Control measures are often sporadic or ineffective. According to various sources, between 80 and 90 percent of wastewater still flows into China's rivers and lakes without any treatment at all.

State targets aim for sewage treatment rates of 40 percent by 2010, with daily treatment capacity increasing by 50 million to 60 million tons. This will require investments of as much as RMB 200 billion to

300 billion ($24.2 billion to $36.2 billion), excluding operating costs.

Industrial Discharge

According to World Bank estimates, Chinese industries discharged over 20 billion tons of wastewater in 1999. Discharge rates rose sharply between 1990 and 1995 and then declined through 1999 due to the economic slowdown, restructuring, increased regulatory effectiveness, and new measures for protection. A major incident in the Huai River in 1994 prompted a series of emergency measures and several national regulations, including the closure of 15 categories of TVIEs throughout the country.

Nevertheless, little progress in regard to more conventional approaches to industrial wastewater management was made during the 1990s. The enforcement efficacy of EPBs at the local level remains wanting, and Chinese industries continue to install treatment facilities to meet requirements and then shut them down when not monitored in order to save on operation costs.

In addition, although the proportion of treated industrial discharge rose considerably throughout the 1990s, the quality of that treatment declined, often falling below Chinese standards. This supports the conclusion that, although increasingly comprehensive regulations are in place regarding discharge treatment, facilities are often of low quality and management and operations skills are tremendously lacking.

Municipal Discharge

In 1998, officials at SDPC estimated that the urban population of China comprises about 36 percent of the nation's citizens. In an effort to manage a host of environmental and resource-related issues, the government intends to increase that number to about 45 percent. However, current and planned municipal sewage systems lack the capacity to manage the accompanying increased waste. Upgrades in both capacity and quality of treatment are required, as are vast extensions and renewals of sewer pipelines and other support systems, many of which date from the 1950s.

Interestingly, although the total sum of wastewater flows and COD loads (from industrial, municipal, and agricultural sources) increased only slightly in the past 10 years, municipal wastewater as a proportion of total discharges nearly doubled in volume and impact. In large urban centers, municipal wastewater surpassed industrial contributions for the first time in 1998.

The rate of municipal sewage treatment is estimated to be around 10 percent to 13 percent per annum, clearly an improvement over the rate of 4 percent in 1991 but still quite low. The World Bank notes that currently installed municipal treatment facilities are only used at about 70 percent of capacity, supporting the view that operators and municipalities need more training and management skills. The government plans to initiate rehabilitation programs and improve operation in many of these existing plants.

Market Opportunities. China began constructing large-scale municipal wastewater treatment plants in the 1980s. According to one industry authority, there are currently only 178 large-scale, modern municipal wastewater treatment plants in the country, with about 100 more under construction. The government hopes to increase the total number to 1,000 by 2010 and plans to invest over RMB 15 billion ($1.8 billion) in order to raise the rate of treated urban wastewater to at least 50 percent within the next decade. In key cities such as Beijing, the goal for the rate is set still higher, at 70 percent to 80 percent.

According to several sources, the Ministry of Construction is restructuring the water treatment sector. Officials indicate that the state will sell operating licenses for city sewer systems, water distribution, and water treatment. Businesses will still be state regulated and state owned, but not majority owned. This should significantly increase foreign firms' access to profitability.

Late 2000 saw the approval of China's first domestic build-operate-transfer (BOT) municipal sewage treatment project. The Beijing Sangde Environmental Protection Industry Corporation will invest in, construct, and operate two sewage treatment plants in Xiaojiahe and Tongzhou. In mid-2001, the Beijing Sound Environmental Protection Enterprise Group committed to building sewage treatment plants in a dozen Chinese cities using the BOT model. Service fees paid to companies operating the plants following construction will service the debt incurred by the Sound Group, which expects to recoup investment and begin turning profits after the first 10 years of operation.

Foreign investors with both the financial resources and the capacity to enter long-term markets may be able to devise favorable arrangements for investment. A number of foreign companies are already engaged in water management projects, which, although they are not currently generating significant profits, are allowing for market entry, pilot project development, networking, and other key preliminary steps to large-scale market entry.

Box 6. PACT Case Study

PACT is an engineering company specializing in the custom design, manufacturing, and contracting of water treatment, wastewater treatment, and membrane separation equipment. PACT China acts as a WFOE that conducts design and construction activities primarily for foreign industries operating in-country.

Although the bulk of current PACT projects are for foreign multinationals, the company is moving toward the Chinese market. The management believes that economic and market factors are slowly changing, thus making such a move possible; Chinese end users are increasingly willing to purchase JV or WFOE wastewater management products because they believe the additional costs of higher-quality products are worthwhile over the long term.

Unlike Vivendi, Suez-Lyonnaise des Eaux, Thames and Bovis, and other large conglomerates, PACT pursues a smaller subset of projects, utilizing an "economies of scale" principle in order to maximize profits. The majority of its projects are completed for considerably lower fees than would normally be received for similar operations in the U.S. However, many of the materials and pieces of equipment are manufactured in China, and by increasing market size as a result of reduced retail prices, PACT has managed to increase its client base and balance its expenditures.

As one PACT representative sees it, multinationals tend to use criteria such as references, financial stability, and successful reputation when choosing a contractor. However, personal relationships are most often the deciding factor when Chinese parties are investing in water treatment projects.

All in all, the company feels strongly that, despite some difficulties, PACT has already developed a reasonably strong market presence, something widely seen as a key for success in this developing market.

Smaller-scale exporters, particularly those not looking to invest in the market long-term, might look to these investors for marketing opportunities. There is also reason to believe that domestic investors in water management (for instance, those mentioned above, or local governments in relatively affluent areas) may begin to provide increasingly viable markets for such exporters. As demand for water management increases and local budgets and central financing continually shrink, investors will seek better long-term values when making investments. According to one domestic expert in the field, some in the industry are finally waking up to the fact that an initial investment in more expensive but higher-quality equipment is more viable than purchasing poorer-quality domestic materials and then covering maintenance costs down the line.

Erosion, Agriculture, and Livestock Runoff

Non-point water pollution resulting from fertilizer and pesticide runoff, intensive livestock production, soil erosion, and other agriculture-related factors are exacting significant tolls on China's ecology and can be expected to increase in severity due to difficulties in prevention and enforcement.

Nutrient-rich runoff, low-quality fertilizers, and soil erosion are contributing to the growing eutrophication of major water bodies. Overapplication of pesticides and the use of hazardous pesticides are responsible for significant contamination of groundwater, the detection of pesticides in a variety of Chinese foods, and the degradation of over 13 million hectares of cropland. Untreated livestock wastes already account for a disproportionate amount of industrial COD loads in some farming regions. A World Bank study estimated that livestock production in Chengde might account for 80 percent of its current industrial COD load. Unfortunately, little data exists on the issue of non-point pollution, and few prospects for an improved situation in the near future present themselves.

Market Opportunities. The government's role in directing farming activities appears to be declining, making agricultural and livestock runoff more difficult to control. Current efforts seem to focus on identifying the sources of problems, which will involve increased water quality monitoring and more elaborate and complete analyses of data. However, the current monitoring system is in disarray, and both SEPA and the Ministry of Water Resources maintain separate monitoring systems with little coordination. Additionally, the location of stations, the frequency of sampling, and issues involving other methods and standards must be overhauled in order to generate an accurate overview of the state of water within China. The government is hoping for a complete overhaul to upgrade existing monitoring capabilities, including extensive investments in technology and equipment.

Additionally, the government is seeking innovative and large-scale solutions, such as prevention of soil loss and degradation, improved irrigation schemes, and reclamation of livestock wastes for fertilizer use. (See Chapter 8 for further details on management of resources.)

Water Supply and Market Prospects

According to 1999 statistics, the amount of groundwater extracted in China totals more than 100 billion

Table 4.3 Total National Investment in Antipollution Projects, 1999

	Projects Under Construction	*Completed Investment in Antipollution Projects*	*Investment in Wastewater Treatment*
National Total	14,374	RMB 12,204.61 billion	RMB 7,167.94 billion

Source: Chinese Statistical Yearbook, 1999. (Available online at *www.stats.gov.cn/english*).

tons annually, accounting for more than 20 percent of total water use in the country, in comparison with the 2 to 3 billion tons extracted per year in the 1960s. Serious overextraction of groundwater is resulting in significant effects such as subsidence at rates exceeding 25 to 40 millimeters per year in some cities. The groundwater tables of more than 100 cities are declining at a rate of 2 to 3 meters per year. In coastal cities of eastern China, the continued water table decline has caused more than 1,500 square kilometers of seawater intrusion into underground reserves.

Inefficient use of the limited water supply exacerbates the country's situation. China recycles only 20–30 percent of its industrial water, and consumption per industrial product is 13 times higher than in the United States. Similarly, only 25–30 percent of irrigation water is effectively utilized due to the inadequacy of most irrigation schemes. It is estimated that 2.5 million tons of potential grain yield are lost each year due to inefficient water usage.

Municipal End Users

Following the lead of cities such as Tianjin, Beijing introduced its first water conservation mandate, as well as a water resources committee headed by the mayor, in December 2000. Under the new regulations, retailers selling flush toilets with a volume of over nine liters are fined, as are car-washing facilities that do not install water-saving or water-reusing devices. Coupled with a water price hike, these measures have already helped boost sales of water-efficiency devices such as low-flow showerheads and taps. Nanjing, Guangdong, and a number of other municipalities announced water-saving rules in 2001.

The services and equipment most needed by local and municipal governments are both high- and low-technology products, including monitoring systems, pumps, valves, detection devices, and aerators. Guangdong Province, for example, is installing a world-class water-monitoring system over the next 10 years with an investment of over RMB 450 million (about $54 million). Throughout China, small to medium-sized cities need technologies custom-tailored for size, economic, and logistical requirements. As investment opportunities increase, the ability to provide "total water management" is also important.

Industrial End Users

Increasingly, industries find the water in their areas too polluted to use in manufacturing processes or for aquaculture purposes. The pharmaceutical, food-processing, and fish-farming industries are only a few of those affected by this development. On-site water purification systems are thus sought out, and demand is increasing. As both private and state-owned enterprises are increasingly subjected to the demands of intensifying market competition, Chinese industries investing in such systems may once again find it wise to acquire more expensive, higher-quality equipment rather than cover the costs of maintaining lesser-quality equipment over the long term.

According to Tenth Five Year Plan targets, industrial water use increases will be stabilized at 1.2 percent per annum, while the volume of industrial water that is recycled and reused will increase by 60 percent, again producing demand for both equipment and management skills. The government has also announced aggressive plans in the aquaculture sector to reduce waste, resulting in the implementation of water-saving and water-reuse technologies. Hotels and housing developments also need water treatment systems to service their own needs.

Equipment suppliers should find the most receptivity to their products among multinationals, JVs, and WFOEs. While the importance of quality and the merits of foreign technology are increasingly important, cost differentials and local protectionism continue to influence a considerable percentage of Chinese end-user demand for some time to come. As stated throughout this report, there are indications that this is changing; nonetheless, the changes will be slow in coming.

Sales Prospects, Technology, and Equipment

Despite the fact that it is more expensive than that of domestic competitors, U.S. technology (along with that of Germany and France) is recognized throughout China as being high quality and state of the art. On a number of occasions, in implementing demonstrations of high-tech water treatment infrastructure and facilities, attempts have been made to secure as much U.S. or other foreign technology and equipment as possible. If this is any indication of future market trends, demand for foreign equipment may rise.

Water Monitoring Equipment

The U.S. remains strong in the field of water monitoring equipment sales and operational training. China desperately needs methods to gauge the extent of its water problems accurately and to monitor the effectiveness of treatment and projects. Monitoring equipment and management remains a key sector for U.S. manufacturers, as Chinese production in this sector is lacking.

Turnkey Solutions to Large-Scale Water Treatment Problems

Many authorities and enterprises cite the need for "turnkey" solutions. Strong competitors in the water market must provide solutions tailored to the individual needs and requirements of the client, be it a municipality, an economic zone, or an industry. The most successful foreign companies in water infrastructure have invested heavily in China, are in the market for the long term, and maintain some degree of in-country presence.

Home Water Filter Systems

A plethora of home water treatment and filter systems exists in department stores and retail shops. However, quality treatment systems are not affordable or in some cases even available; thus, most home- or apartment-owning families purchase Chinese-made filters of low quality. Research indicates that the majority of Chinese families would pay more for a unit that was known to be first-rate if it was assured to stand up to several years of use with low-quality Chinese water and if replacement or servicing of core parts was available and affordable.

U.S. Market Share in Large-Scale Investments and Foreign and Domestic Competition

There is fierce competition in the Chinese water treatment and supply market. Leading companies, such as France's Degremont, utilize worldwide subsidiary networks to obtain projects involving bilateral financing. These projects require a large initial investment, considerable time to generate returns, and significant experience in large-scale water infrastructure development. Similarly positioned operators include France's OTV, Holland's DHV, Germany's Siemens, Belgium's Seigas, and a number of other German, Austrian, and Spanish companies (see Table 4.4).

Additionally, U.S.-based ITT Industries and its Chinese JV partners announced in November 2000 two contracts in different provinces to supply water pumps at a cost of almost $1.8 million. The operations of PACT (see Box 6) are also of significance for smaller-scale operations.

Multilaterally financed projects represent the largest opportunity for U.S. firms. However, companies that want access to these opportunities must monitor developments long before project bids are announced. Most deals in the water industry, and for that matter in almost every industry in China, are the result of serious investigation and long-term pursuit.

In addition to the major multilateral institutions, such as the World Bank and the Asian Development Bank, there are a variety of domestic and internationally supported programs that focus on water treatment infrastructure in China. Of particular interest to the water industry are the Trans-century Green Project Plan (1997–2012), in which approximately 50 percent of all projects are water-related, and the Center for Environmentally Sound Technology Transfer (CESTT), sponsored by China's Ministry of Science and Technology.

Table 4.4 Examples of Large-Scale Investors in Chinese Water Management

Country	*Company*	*Investment Amount and Project Locations*
France	Suez-Lyonnaise des Eaux	Total investment: $120 million, including $28 million for Shanghai Huangpu River project
	CGE	Total investment: $780 million for projects in Huizhou (Guangdong Province), Xi'an, Shanghai, Tianjin, Chengdu, and other areas
	Degremont	Investment in 50 water treatment systems in Beijing, Guangdong, Hangzhou, and other areas
Germany	Siemens	Has invested or capitalized on aid finances in excess of $300 million
United Kingdom	Thames Water and Bovis	$68 million for Shanghai water treatment project; $25 million for Guiyang water supply system
	Anglian Water	Total investment: $16 million
United States	Nalco Chemicals	$3 million for Suzhou project
	Lemna International	$120 million for Guangzhou Xilang project

Source: *Xin Kuai Bao,* August 5, 2000.

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Chapter 5
The Solid Waste Sector

In general, Chinese municipal solid waste collection systems, although somewhat obsolete, are reliable and maintain a consistent level of sanitation. In contrast, transfer and disposal systems are inefficient and of poor quality, endanger public health, contaminate groundwater, and consume already scarce amounts of arable land.

Due to a combination of scarce funds, inadequate infrastructure, poor enforcement of disposal and treatment standards, a lack of skilled waste facility operators, and the inability of local companies to produce modern waste management equipment, the explosive growth of solid waste produced annually in China threatens to overwhelm the infrastructure and become a severe economic and environmental burden.

By the end of 1999, Chinese cities produced 940 pounds of trash per person annually, with that rate increasing by 8–10 percent each year. Disposal methods are so inadequate that over 200 of more than 650 cities surveyed are surrounded by hills of waste. As of August 1999, more than 6 billion tons of municipal refuse had accumulated and claimed 5.4 billion square feet of land in China.

Over half of the municipal solid waste in China is composed of organic content such as food wastes, and plastics and polystyrene compose the majority of the bulk, as most metals and other resalable materials are scavenged.

China generated between 600 and 750 million tons of industrial solid waste in 1999. Hazardous waste statistics vary wildly, but estimates range between 5 and 30 million tons annually, much of which goes untreated. Hazardous wastes are often incinerated and disposed of improperly and are frequently mixed in with non-hazardous waste in landfills and dumps. China hopes to improve its management of hazardous wastes by developing facilities, training workers, increasing awareness, and at some point implementing international hazardous waste standards.

Waste Management Legislation and Policy Priorities

Fundamental waste management legislation in the PRC consists primarily of the 1996 Solid Waste Management Law, pre-1996 municipal waste regulations, and the 1997 Hazardous Waste Management Regulations.

The responsibility for municipal solid waste collection and disposal rests primarily with municipal and district governments (districts are semi-autonomous subunits of a city). Municipal solid waste management administrators, refuse collectors, street sweepers, and refuse transportation and disposal personnel are all government employees.

Municipal solid waste management is funded directly by the municipal government. A uniform tariff on waste collection and treatment has yet to be established, but in some cities residents are charged a fraction of a percentage of their monthly income for this service. Waste collection fees cover only a portion of the cost of managing the waste. Commercial waste is managed in conjunction with residential waste, while industrial waste is supposed to be managed separately by the industry that generates it.

Several entities at the municipal level are responsible for solid waste treatment. These include municipal sanitation bureaus, EPBs, municipal construction bureaus, and municipal planning and development bureaus.

The municipal sanitation bureaus are responsible for daily waste collection, transportation, and centralized garbage treatment including landfills and incineration plants. These bureaus control solid waste collection, transfer, and treatment technologies and equipment. The municipal EPBs are responsible for the issuing of local solid waste control regulations, compliance monitoring, and enforcement. Municipal construction bureaus plan and manage construction projects including the establishment of landfills and incineration plants. The municipal planning and development bureaus coordinate, evaluate, and approve solid waste treatment projects.

Government Priorities and Trends

Since the second half of 1999, 10 cities and provinces have initiated tariff systems for waste disposal, among them Beijing, Chengdu (Sichuan Province), Nanjing (Jiangsu Province), Shenyang (Liaoning Province), and Zhuhai (Guangdong Province). In Beijing, for example, households with permanent resi-

dents must pay RMB 3 ($0.36) monthly, and households with non-permanent residents RMB 2 ($0.24) monthly.

The national government has also expressed support for the "polluter pays" scheme used in most developed countries. In line with this, China plans to levy an industrial solid waste generation and disposal fee on plants and enterprises and an urban domestic refuse treatment fee on citizens. These fees will be used to finance solid waste infrastructure. However, for the next few years, funding for waste projects will remain unavailable except through multilateral or bilateral agencies, as heavy priority is being placed on water and air pollution projects.

The use of market-based instruments has not been sufficiently developed to make public utilities projects such as waste management economically feasible for municipalities or attractive for private investment. Thus, the domestic prioritization of air and water management has left local governments in perpetual search of foreign funding in order to meet their waste management needs. Until such measures as fee-based waste disposal become profitable, there will be little market for high-technology goods except through international projects, innovative schemes formulated by equipment suppliers, and possibly technology and financing consortia.

Although private investment remains unattractive into the near future, timely market positioning is key. Precisely because waste management services in China have not yet become mainstream, now may be the best time to begin a market positioning strategy. After this sector begins to become profitable, those companies that have been nudging the doors open for several years are likely to reap the greatest benefits, provided they have ample funding to wait out the market developments. This will certainly require active and persistent effort.

Waste Reduction and Recycling

As is the case in many developing countries, China's best hopes for environmentally friendly and practical solutions to its immense waste management concerns lie largely in the reduction of waste. There is much dis-

Table 5.1 Solid Waste Management–Related U.S. Exports to China (thousands of U.S. dollars)

HTS Number	*HTS Description*	*As of April 2001*	*2000*	*1999*
84178	Waste incinerators	766.2	3,322.9	827.8
84179	Parts for 84178	1,459.3	14,155.4	7,317.4
842220	Machinery for cleaning and drying bottles and containers	70.1	410.4	1,372.2
846291	Shredders, balers for metals, hydraulic presses	69.4	375.9	231.0
847290	Paper shredders	624.3	4,570.0	4,155.7
84741	Waste foundry sand reclamation equipment	1,225.7	1,530.8	1,694.9
847432	Asphalt-recycling equipment	0.0	70.0	2,240.9
847989	Radioactive waste presses, trash compactors	29,864.4	196,572.2	112,721.1
84799	Parts for 847989	12,550.5	48,727.9	40,740.1
85059	Electromagnets	247.5	899.2	894.7
851410	Electric or resistance-heated waste incinerators or other waste treatment appliances	1,584.9	4,104.7	4,689.0
851420	Electric, induction, or dielectric waste incinerators or other waste treatment appliances	8.4	810.1	330.3
851430	Electric, other waste incinerator or other waste treatment appliances	9,484.6	24,095.3	4,913.6
851490	Parts of waste incinerators	3,141.2	6,330.0	10,815.9

Source: U.S. International Trade Commission, USITC Trade Database, *www.dataweb.usitc.gov.*

cussion now of sustainable development through an integrated approach to waste management, including minimization of the production of wastes and maximization of waste recycling and reuse. Throughout China, cities have been formally practicing source separation and recycling for the past 10 years, and informally for a much longer period.

With the exception of large cities, municipally-funded recycling systems are limited in most Chinese locales. Typically, however, the percentage of recyclable waste is lower than in developed cities of analogous size, due to lower consumption rates and a brisk trade in reusable and recyclable materials.

Recyclable items are bought and sold in the streets of China. Refuse collection containers, drop-off points, and landfills are continuously scavenged for recyclables. Middlemen purchase recyclable items based on an established market value, then in turn sell the items to additional middlemen who deal in specific classes of items, such as glass. End buyers include recycling facilities and factories that can use the recyclables directly.

China is also experiencing an upsurge in waste imports for recycling from other countries, including waste paper and scrap metals. However, recognizing that these imports are relatively expensive and often contaminated, policy-makers are determining that it would be more cost-effective and safer to recover domestic materials. Regardless, the recovery industry will soon be expected to cope with significant increases in recyclable materials; it may not be capable of decontaminating or reprocessing those materials due to a lack of capacity and possibly saturated markets.

Municipally-Sponsored Recovery

Waste recovery and recycling procedures are administratively supervised in both private and state-owned enterprises. Many major cities have large recovery companies that collect recyclables from offices, institutions, and factories. Neighborhood deposit/trade centers are often located at transfer stations, where people can sell recyclable bottles, paper, and clothes. State policies govern the trading of materials and prices, and these companies are often inefficient.

Private enterprises, of which there are thousands, also participate in recycling, mostly in the southeastern provinces of Guangdong and Zhejiang. In the past few decades, there has been a shift to trading in mainly profitable recyclables, such as metals, rather than in most household wastes. Other materials are now collected and traded by private entrepreneurs, who may sell either to the government companies or directly to factories for reuse.

The government encourages recycling but has not yet generated the momentum that could arise through awareness and a well-developed market. Tax incentives have been implemented to support enterprises engaged in recycling, and greater emphasis on source separation is considered desirable, particularly the separation of plastics from organic material, in order to make both composting and incineration of residuals more viable.

Best Sales Prospects

Battery Recycling. Management of products such as glass, paper, cardboard, drums, containers, and so forth is adequate, but there is a complete lack of know-how regarding battery recycling and that of other hazardous commodities. Chinese cities have launched battery-recycling programs and have collected millions of disposable batteries. However, there is no feasible recycling or disposal program for those batteries, which usually end up buried in disposal sites in order to limit the area of contamination. Since the most common batteries in China are still mercury-lead, the challenge and need for recycling is significant.

Metals and Components. Recycling, compared with other waste management sectors, generates a quicker return on investments. However, as in developed countries, the truly profitable recycling enterprises are those such as metals and electronic components recycling. Larger recycling facilities with more financial resources may be able to purchase foreign equipment or form JVs to take full advantage of this, and larger manufacturers with the requisite financial resources may be able to establish in-house facilities to do so. Smaller enterprises and municipal recycling facilities might not be able to do this, and may have no choice but to rely on local equipment manufacturers to outfit their facilities due to both local protectionism and a lack of funds.

Materials Recovery. According to one multinational health, safety, and environment specialist, a considerable amount of reasonably useful industrial waste material is stockpiled throughout the country, and is neither moved nor disposed of. Companies do not wish to write these resources off, as this reduces earnings, but there is currently no opportunity or push to reuse the material or search out secondary markets. This may change as dumping regulations and fees become more stringent and enforcement is improved.

The recycling and materials recovery industry is one area that the Chinese government intends to foster. China has traditionally been successful with this concept despite the fact that the proliferation of plastics and

polystyrene has done marked damage to the pre-1970s mentality of reuse. Nonetheless, due to funding problems and materials costs, China is always open to new methods of recycling that help achieve profitability or reduce costs.

Collection and Transfer Equipment

The process of waste collection in China's large cities is generally effective. In contrast, however, due to outdated equipment and a scarcity of vehicles, waste transfer processes are poor and inefficient. Almost 10 million tons of urban domestic waste annually does not reach a waste disposal site.

Urban waste is collected on a daily or twice-daily basis in China. The most common refuse collection systems in urban China are central drop-off spots in each neighborhood, often located at street corners. A drop-off spot may be as simple as a designated spot to pile garbage or as advanced as a transfer station. Residents either deliver their garbage to a drop-off spot or deposit it in a garbage chute, from which maintenance staff collect the refuse and deliver it to a transfer station.

Outside of urban centers, there is little controlled refuse collection, but there is a higher tendency to reuse and recycle materials prior to disposing of them. Unfortunately, particularly at the village level, refuse accumulates on any unused piece of land and often ends up in water sources.

Locally-produced solid waste containers are generally of poor quality, and because they are uncovered and of low-grade materials, they must be replaced every six months to one year. Recently, municipalities such as Shanghai and Shenzhen, with an eye to saving money, have begun investing in higher-quality containers with longer life spans.

Transfer and Treatment

Currently, all collection devices and locations, including three-wheeled bikes, trucks, and buildings, are owned by municipalities. The vehicle fleets are generally outdated and of insufficient size and capacity. Most collection vehicles are open, converted dump trucks that do not adequately contain waste. Authorities would like to upgrade and enlarge these fleets, but generally speaking there are no funds available for this. Until waste management fees are implemented profitably, this sector will remain unappealing to foreign investment outside of internationally-funded projects and direct aid.

Other important areas are pre-treatment and waste processing. Before delivery to an incinerator or landfill, waste in most industrialized countries is sorted by type and then treated in order to maximize disposal efficiency. Most sorting in China today is performed at the disposal site by scavengers and workers, with little pre-treatment, making disposal not only inefficient but also hazardous.

Street Sweeping

Most Chinese cities provide street-sweeping services on a daily basis, using everything from bamboo brooms to mechanized sweepers. Japanese companies that have been aggressively courting the waste industry for years dominate the market for equipment.

However, the process of sweeping is hampered by inefficiency. Since the minimum-sized street sweeper must fit through the narrow alleyways that line the traditional housing complexes of Chinese cities, municipalities often purchase many street sweepers of just that size. A sound market-entry strategy might make use of a convincing argument to persuade decision-makers to purchase street-sweeping equipment in a variety of sizes and types in order to increase efficiency in cleaning up urban highways and construction sites. Market potential exists for a U.S. company that can demonstrate the efficacy of such a strategy and then provide the most cost-effective fleet of equipment to implement the strategy.

In reality, refuse collection does not appear to present a whole host of opportunities for the near future, primarily due to a lack of funding and interest. One area of improvement may be in large-scale transfer stations capable of pre-sorting and some initial treatment; local governments have demonstrated some interest here. Street-sweeping and other service equipment sales may prove profitable if prospective exporters invest adequate time and resources in their market studies.

Management Strategies

Composting

Many cities in China have established simple in-vessel composting systems to process municipal solid waste. Mixed municipal solid waste is delivered to the facilities, and following hand sorting, the material is fed into digesters. After digestion, the compost is either sold as is or with the addition of supplemental chemical fertilizers.

Overall, composting treats a very small percentage of the total municipal solid waste generated in China. Composting systems were initially set up to process municipal solid waste into compost and sell the compost at a profit. Experience in China has shown, however, that the value of the compost is less than the cost of producing it. Additionally, systems are plagued with operating problems and do not generally meet their processing objectives. As a result, the majority of composting facilities have shut down, and cities that were previously composting municipal solid waste have reverted to uncontrolled land filling.

At present, composting seems to have fallen by the wayside. China's cities would profit, however, if they were to reinvestigate possibilities for regional or community composting facilities. China's solid waste, compared with that of developed countries, is high in food and organic waste content. This makes both land filling and incineration less efficient because of compaction problems and low BTU value. Add to this China's lack of arable land and land management problems in general, and composting begins to appear a promising alternative. Given the government's emphasis on incineration techniques, some pre-sorting of waste into organics and burnable materials would prove rewarding.

Until the technical expertise and investment necessary to demonstrate that composting may be profitable is introduced, authorities will continue to focus on expanding and improving incineration and landfill capacities.

Incineration

In addition to strengthening the recycling industry, the construction of incineration facilities and landfills represents further priorities for Chinese authorities within the waste management sector.

While presented as a panacea for the waste management problem, incineration remains a controversial subject in China. Among the various methods of dealing with municipal solid waste, the Chinese show great interest in expanding their incineration capacity despite the fact that the capital and operating requirements for such plants often surpass those for landfills. There have been several arguments raised against incineration (presenting integrated solid waste management as the alternative) for reasons such as the exacerbation of already critical air pollution and a lack of capacity for burning toxic wastes. Additionally, China has in the past been extremely successful in separating out paper, glass, and other recyclables from the stream of municipal solid waste so that the remaining waste, which may be more than 50 percent organic matter, is not highly combustible. Nonetheless, China insists on developing "cutting-edge technology," in the words of one sector specialist. Incineration is looked on favorably by many cities due to the small land requirement and the supposed potential for electricity generation.

Currently, incineration treats only 1 percent of municipal solid waste in China, although industries generally maintain their own incineration systems for in-house processing of wastes. There are only three types of incineration systems used: the most common is the smaller, often manually loaded, incinerator employed by industries, with no environmental protection controls in place (some efforts at cleaning these up are underway). The second is the municipal waste treatment incinerator, of which there are only a few throughout the entire country. Finally, China is experiencing an explosion in waste-to-energy plants. It should be noted that, despite the above distinctions, incineration has a very broad definition in China and may include the open burning of mixed wastes.

Since 1987, Shenzhen has operated a 300-to-450-ton-per-day incinerator for hazardous and medical wastes. However, data as to its effectiveness, costs, and hazards is not available. In January 2001, the first Chinese-made hazardous and industrial waste-to-energy incinerator opened in Wenzhou, with a capacity of 320 tons per day. One large-scale municipal solid waste incinerator in Shanghai was under construction at the time of writing and should be completed by 2002: its expected operating capacity is 1,000–1,500 tons per day (tpd). Guangzhou plans to build two waste-to-energy plants by 2005 that will convert half of the city's trash to electricity. Several small-scale incinerators are in the five-year pipeline. The coastal city of Tianjin has announced an agreement with France to build a 30-tpd hazardous waste incinerator, and Wuhan plans to build three 40-tpd hazardous waste plants using Swiss loans.

Emissions and Ash Management

The country bearing the distinguished reputation of having the world's worst air pollution has good reason to express concern over the implementation of incineration methods to treat solid and hazardous waste. Yet China tends to look to Japan, which incinerates the vast majority of its waste due to limited land resources, as a model for solving its domestic waste problems. China, however, has neither the funds nor the skills to implement Japanese processes with adequate control and precision and therefore risks further contamination of its air, land, and water.

In an apparent contradiction, China seems intent on both reducing air pollution from its coal-burning industries and increasing its incineration capacity, which if poorly implemented will exacerbate air pollution issues. If this strategy is pursued, China will increasingly require methods of emissions reduction and ash management within the incineration industry that conform to the strictest standards. Incentive to do so may develop from the progress that has been made in expanding ash management abilities to facilitate the use of the ash for road building and other construction initiatives.

Worst Sales Prospects

Large-Scale Incineration Technologies. Unfortunately, without the benefit of tied aid, U.S. companies often find the incinerator market saturated with cheap Chinese incineration materials and foreign-funded equipment financed by tied aid programs.

Best Sales Prospects

Monitoring Equipment. U.S. companies are well positioned to provide monitoring equipment and instrumentation, and this market continues to grow in China.

Ash Management and Emissions Technologies. Companies that provide technologies to capture ash, treat contaminated ash, and render the ash useful to other industries are sought after. Authorities within the transport and road-building industry and the recycling industry are pursuing incinerator-ash-use techniques.

Management and Consulting Services. Operating skills and training are required if China intends to keep incineration facilities safe. As in the wastewater treatment industry, many facilities deteriorate due to poor maintenance or lack of qualified staff. Opportunities exist through multilateral and some governmental projects for capacity building in these areas.

Due to a lack of tied aid from the United States, American companies in the incineration sector may have to content themselves with the provision of smaller technologies associated with that sector. Large projects facilitated through multilateral financing may present an area of opportunity, although the World Bank and other funding sources appear to be concentrating on landfills at present.

Landfills

Land filling is the most common municipal solid waste management method used in China, and landfills are the final resting place of over 99 percent of all municipal solid waste. In general, Chinese landfills do not meet best practices from either a design or a management perspective. Although there is some dissemination of the available literature on land filling and a variety of regulations and standards, modern landfills suffer after the design phase from a lack of construction knowledge and implementation control. According to the World Bank, of all waste management facilities possible, China would profit most sustainably from the development of modern sanitary landfills.

Landfills fall into two categories in China. The most prevalent type is the "controlled dump site." These landfills allow scavengers on-site, have no leachate collection systems, employ infrequent or no cover systems, have limited or no compaction, have no gas control systems, keep few or no records, and have no waste-screening systems in place. It is not at all uncommon for untreated hazardous and medical wastes to be mixed in with municipal solid waste and industrial refuse.

The second and far less common type consists of those landfills currently built near a number of urban centers according to more modern land-filling standards, and facilitated by outside financing and design. Although efforts are made to design and build these in line with high standards, it is still unclear how well they are operated.

Worst Sales Prospects

Because most waste projects in China are at least partially funded by multi- or bilateral sources, several factors affect the viability of landfill equipment sales. The following are examples of products that typically have no market access in China.

Compactors and Compacting Equipment. Steel-wheeled and other advanced compactors are rarely used in developing countries because of their prohibitive cost. Instead, cheap Chinese bulldozers perform compacting, sloping, and other functions. In addition, the high organic content of most Chinese solid waste makes compacting less effective, and the intense rains in some regions of China turn the waste into muck that traps compactors for the duration of the rainy season.

Liner Materials. As in most developing countries, liner materials are cheap and locally made. Clay liners, for example, are inexpensive and function relatively well if managed properly. Some of the multilateral landfill projects utilize foreign liners, but manufacturers prospecting in China are limited to such projects.

Leachate Collection Materials. Expensive leachate management technologies find no place in China's landfills. Typically, the most efficient method used is to collect leachate in concrete-lined holding ponds in order to evaporate as much as possible or to dilute it during rainy times. Some wastewater management techniques have been adapted to this function.

Best Sales Prospects

Monitoring Equipment. The United States excels in the production of cost-effective and reliable monitoring equipment. Equipment is required for gas, leachate, and groundwater contaminant measurements in order to enforce new regulations.

Management Technologies. Often, a landfill is constructed with a modern and effective design but then left to "run itself," without proper supervision and controls in place. Corresponding to needs in the wastewater treatment industry, there is a need in the solid waste industry for landfill maintenance and operational know-how. A company with an innovative and cost-effective turnkey solution to landfill design and management that can be adapted to the various regions of China may be suited to market entry.

Technology to Improve Existing Landfills. Landfill managers in smaller cities are often told to close open-area dumps and to construct controlled landfills. However, due to costs and lack of expertise, the dumps are more likely to be converted simply to conform to regulations. Hence, there is a need for firms that are equipped to provide low-cost equipment and expertise to enable this conversion under a variety of conditions.

U.S. companies find it difficult to advance in China's solid waste sector for several reasons. First, the U.S. provides extremely limited development aid to China; hence, large landfill projects go to foreign competitors backed by bilateral programs. Second, the U.S. lags behind most developed countries in maintaining efficient and cost-effective landfill operations. Third, many U.S. companies suffer from an attitude of "watch and wait" as opposed to early market entry, which will render them uncompetitive at a later stage of market development.

Besides monitoring equipment and engineering expertise, U.S. vendors must present a unique and innovative land-filling solution particular to China's various problems, in order to have an impact on the landfill sector in the near future. The most promising areas of opportunity include multilaterally-financed projects and services such as consulting for the upgrading of landfills to conform to new regulations.

U.S. Strengths and Opportunities

"Complete Package" Solutions

Within all sectors related to solid waste management, there is a tremendous need for engineering expertise, from financing and site selection to design, construction, and maintenance of facilities. Concepts that parallel innovations in the wastewater treatment industry, such as the BOT model, are even more valuable as waste management gradually becomes profitable. The Chinese eagerly seek solutions to their waste problems, and a company that is willing to provide experience and expertise in this area will discover a variety of interested parties, from municipalities to state-owned and private enterprises coping with their own waste concerns.

Lack of funding and a lack of local knowledge in the waste disposal area mean that, as national government regulations tighten, every sector of society that produces solid waste feels pressure to manage waste in a well-planned and cost-effective manner. Some funding is available from multilateral and bilateral sources, as well as from various levels of Chinese government. As the waste problem intensifies, individual entities are increasingly forced to seek out financing schemes that make waste management possible and profitable.

Knowledge Transfer and Training

Current facilities and ongoing projects already suffer from a lack of operational skills and management. Services in which U.S. companies excel, including consulting and engineering, are required not only for new projects but for completed and ongoing waste disposal projects for which funding has expired. The Chinese government cannot combat the waste explosion without maintaining or increasing current investments, and the pressure brought to bear by the deterioration of hastily planned facilities is increasingly felt. Needs include employee and managerial training for the operation of facilities as well as maintenance and monitoring services that local staff cannot provide.

Trends and Conclusions

The solid waste management sector in China is currently in a stage of development similar to that of the wastewater treatment industry there three to five years ago. Current financing for solid waste projects is scarce. Competitors rely on bilateral aid or take bold investment steps in order to position themselves for the time when the waste industry in China becomes profitable.

Box 7. SULO Case Study

In 1998, SULO, a German-based waste management company, established a joint venture in Beijing. SULO is Germany's number-three provider of waste services, with activities in New Zealand, Australia, and Singapore in addition to China. Although SULO provides a variety of services internationally, including composting, pre-treatment, and waste sorting, it is currently producing only garbage bins in China, for both local consumption and export markets.

SULO has experienced many problems with regard to the Chinese solid waste market. Local Chinese authorities are unwilling to invest in new waste management systems due to insufficient funds, and SULO expects that the market will remain unsuitable for the next few years. Despite many efforts to convince municipal governments, SULO has been unsuccessful in providing services other than the sale of garbage bins. An example is SULO's recent attempt to experiment with a new waste management system in a small city in Inner Mongolia. Half the project was to be financed by the German Ministry of Cooperation and half by the Chinese government counterpart; after much deliberation, the latter refused to provide financing and the project was aborted.

SULO now has three representative offices in China, based in Shanghai, Guangzhou, and Kunming (where it controls 100 percent of the market share). In three to five years, the company hopes to offer waste treatment technologies and services. Only three Chinese competitors exist in the whole country, all of which produce garbage bins of much lower quality; similarly, no foreign competition has stepped up. Some foreign companies have established offices in Hong Kong from which to watch the Chinese market and perhaps await more favorable conditions. Nevertheless, SULO feels it is well positioned, having prospected for the past two years and built up a solid network of governmental and organizational relations.

The development of this market, according to SULO, will be a result of changes in attitudes as opposed to policies, although policy will play a large role in strengthening the market in smaller cities and municipalities.

Considering the estimated growth rate of this industry over the next five years and the promulgation of additional regulations that will force municipalities and industries to take a closer look at their own pollution disposal strategies, U.S. companies would do well to investigate and enter the market in order to position themselves. According to CRAES, the total amount of waste generated increases by 25 million tons a year. Seventy-five percent of this waste must be treated. In order to do this China must increase its waste management capacity by 55 million tons a year.

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Chapter 6
Air Pollution

Air pollution in China represents the most serious threat to public health and to the continued economic development of the country. Half of the 322 largest Chinese cities have serious air pollution problems and total suspended particulate (TSP) concerns exist in every city in the country, causing an estimated $3.65 billion in losses each year. Air pollution in a number of Chinese cities is among the highest ever recorded worldwide, reaching more than 10 times WHO standards. Beijing itself ranks high on the national list of cities with excessive nitrogen oxide emissions, and Taiyuan, in Shanxi Province, and Lanzhou, in Gansu Province, rank among the 10 most polluted cities in the world. The threat to public health and welfare is significant: it is estimated that air pollution-related health problems are responsible for over 300,000 deaths and over 11 million emergency clinic and hospital visits annually in China. Similarly, air pollution is responsible for tremendous agricultural and other economic losses. At least 30 percent of China's total territory suffers from acid rain, most of it falling in the southern part of the country.

Coal consumption remains a major contributor to poor air quality, but throughout the 1990s the profile of contaminants has been changing. After peaking in 1996, growth in energy demand turned negative, leading to current reports indicating that China's recent CO_2 and SO_2 discharges are lower than expected. Yet nitrogen oxide pollutants (of which automobiles are a significant contributor) are on the rise; barring significant changes in transport technology, Chinese oil demand could double in the next 20 years. Similarly, despite moderate reductions in the median TSP levels of many of China's largest cities over recent years, total TSP exposure has actually increased, as the numbers of exposed individuals have outpaced pollution reductions. Dust from construction sites and windblown soil are increasingly important TSP components. In addition to these parameters, a host of other equally important air pollution factors such as carbon monoxide, ozone, and lead are not systematically monitored, and therefore their prevalence and impact are unknown.

Large point sources remain key contributors to air pollution, which in some ways could ease the process of mitigation; the power sector, for example, could account for 50 percent or more of total coal use in the next 20 years.

Policy Framework

The Air Pollution Prevention and Control Law

China has made marked progress in the area of air pollution management since 1987, when the first Air Pollution Prevention and Control Law went into effect. Recent amendments of the law (which was first amended in 1995) illustrate the Chinese government's pursuit of increasingly sophisticated legislation. The most recent changes, effective on Sept. 1, 2000, substantially revised the law. In the law's newest form, its jurisdiction is extended beyond industrial enterprises and power plants to pollution sources such as automobiles, ships, construction dust, and domestic heating and cooking stoves. The new amendments also increase the number of regulated parameters, introduce total emissions control (TEC) to bolster concentration-based standards, provide for far more rigid penalties, and clarify the responsibilities of relevant authorities. The potential enhancement of enforcement capacity resulting from these final two changes may affect impact upon market demand for pollution-reducing technologies if they are faithfully carried through.

If the amendments are fully implemented within the next 10 years, the law could reduce the total volume of air pollutants to 1995 levels, control sulfur dioxide emissions within the SO_2 and acid rain control zones at 10 million tons, achieve national level II air quality standards in 34 of the 47 currently identified key cities selected by the State Council, and reduce dust emissions from construction sites in Beijing by as much as 70 percent.

A notably significant amendment is the shift to TEC, an initiative attempted thus far on a limited scale in areas such as the Liao River and the SO_2 and acid rain control zones. The policy shift clearly indicates a progression in regulation that moves from point-source and concentration-based approaches to a holistic, "ecologically based" regulatory framework. Additionally, TEC establishes a basis for market-based air pollution control tools such as emissions trading.

Priority Issues

SO_2 Emissions. China's national standards for allowable SO_2 emissions are comparatively strict at 50 micrograms per cubic meter; the WHO standard is 60 micrograms, and the U.S. standard is 80 micrograms per cubic meter. From 1991 to 1998, levels of SO_2 in some of the worst-polluted cities dropped due in part to increased regulation and control. Despite this, most cities experienced worsening pollution over the past decade due to the previously noted increases in pollutants such as nitrogen oxides.

Revisions in the Air Pollution Prevention and Control Law aim to keep annual SO_2 emissions at 10 million tons until 2010 in the acid rain and SO_2 control zones. Three main policy measures in the acid deposition control program are directed toward SO_2 emissions:

1. There will be a gradual phasing out of coal with sulfur content of 3 percent or more. Presently the extraction of such coal is restricted, although not forbidden, since the western regions of China have access only to low-quality coal. Thus, enterprises wishing to burn coal with sulfur content of over 3 percent must install environmental control technologies.
2. Newly built or renovated coal-fired power plants using coal with sulfur content of over 1 percent must install sulfur-scrubbing technology. Existing facilities must adopt SO_2 reduction technology including flue gas desulfurization (FGD) by 2010.
3. The current fee level of RMB 200 ($24) per metric ton of SO_2 emissions represents a shift in policy from the former scheme, in which charges were imposed only on air emissions that exceeded standards. However, the margins remain far too low to encourage investment in abatement.

These regulations face a number of criticisms and constraints. First, the prohibited use of coal with more than 3 percent sulfur content means that even facilities utilizing FGD technology cannot use low-quality coal, despite the fact that environmental requirements could be met in a cost-effective manner. Additionally, the installation of FGD equipment is considered prohibitively costly for China.

Second, improving the quality of the coal supplied to large power plants has actually increased the supply of high sulfur coal to industrial and residential facilities (as an alternative market), which are less likely to employ clean and efficient utilization systems, therefore maintaining high pollution outputs in urban areas. Issues of coal pricing must also be noted; in general, coal prices do not reflect coal quality and sulfur content. Counterproductive subsidies are sometimes provided to power plants.

Finally, since mass-loading criteria are not yet effectively enforced in any city in China, ambient air quality in any given area may not be affected by the initiatives even if all industries and power plants conform to the standards.

Indoor Air Pollution. Indoor air quality parameters are measurable in any environment, from rural domestic spaces to office buildings and industrial plants. In China, however, most concerns over indoor air quality arise from cooking and heating. Poor-quality fuels and a lack of electric and clean fuel facilities contribute to heavy concentrations of pollutants in domestic households, causing widespread health problems.

The severity of indoor air pollution and its resulting consequences are difficult to measure due to a lack of statistical data on both the national and local levels. According to the World Bank, in 1991 there were 40 million people using gaseous (i.e., non-solid) fuels for cooking and water heating; by 1998, that level had risen to 156 million. Additionally, the quality of combustible material rose considerably with the increased utilization of briquettes and gaseous fuels.

Indoor air pollution is also exacerbated by China's rapid urban growth and widespread construction of high-rise buildings. In construction during winter months, urea is used in the concrete mix as a curing and anti-freeze agent. During the hot humid days of summer, the urea hydrolyzes, releasing high concentrations of ammonia into indoor areas and resulting in significant health concerns.

Asbestos is yet another concern. Although asbestos was long considered an issue of little significance in China, heightened awareness is increasingly forcing mitigation and the use of alternative materials.

Auto Emissions. The number of vehicles nationwide grew to over 13 million by 1998, about 10–20 percent of which were private cars. That number has further increased in the past three years, resulting in significant congestion and air pollution. The emissions of motor vehicles in China are quite different from those in industrialized countries, due to obsolete manufacturing technologies utilized in the local automobile industry, inadequate auto maintenance, and poor fuel quality. SEPA and other agencies are currently working to develop effective strategies to reduce vehicle pollution and improve performance.

The State Council issued regulations forbidding the production, distribution, and utilization of leaded gaso-

line by September 1998, and it decided to consolidate the fuel market and close down small refineries that could not meet regulations. Leaded fuel production ceased on Jan. 1, 2000, and sales of leaded gas ceased on July 1, 2000.

In January 2000, SEPA also issued emissions standards equivalent to EURO-1 standards for light-duty vehicles. Heavy-duty vehicles must conform to EURO-2 standards, and all new cars must have electric fuel injection and catalytic converters. According to the law, all vehicles must be inspected annually; however, enforcement capacities present a problem. More reductions could be accomplished with stricter supervision at all levels.

Monitoring. Anecdotal evidence suggests that China's air quality monitoring network has not kept up with regulatory changes over the past 10 years. As the pattern of urban development has shifted, the number of stations and the location of most of them have not changed. For example, government efforts to push small industries outside of cities have led to a worsening of air quality on the outskirts of most urban areas, while the majority of monitoring centers remain in the city centers. Similarly, as noted above, the parameters monitored do not reflect the current profile of contaminants and are not widely established. Monitoring systems exist only in large cities and provide information on SO_2, nitrogen oxides, particulates, and settled dust. Carbon monoxide is measured in a few cities, but pollutants such as hydrocarbons and ozone are not.

As expressed in the Tenth Five Year Plan, SEPA plans to upgrade and expand the country's monitoring network. This is in order to monitor the effectiveness of specific environmental efforts and also to gain a more accurate and comprehensive analytical view of the state of China's environment.

Policy Priorities

According to the Tenth Five Year Plan, SO_2 emissions are to be reduced by 2.5 million tons. Achieving national air quality standards for the 100 key municipalities during the Tenth Five Year Plan requires RMB 200 billion of investment. According to CRAES, overall investment in air pollution requires at least RMB 300 billion.

The monitoring network must be extended, upgraded, and better maintained. China has an enormous need for training toward these ends, as well as a need for effective analysis of monitoring data. Furthermore, to prove effective, monitoring must include SO_2, TSP, PM10, PM2.5, ozone, volatile organics, and nitrogen oxides. These variables are likely to be addressed in future legislation.

Legislative Trends

China is increasingly aware of the steps that must be taken to reduce air pollution. Measures to guard against SO_2 emissions, for instance, are widely seen as steps in the right direction, although current legislation needs to be refined to lower its concentrations effectively. In addition, there is concern that other factors such as nitrogen oxide are excluded from calculations, despite the fact that they play a large role in ambient air quality.

Most regulations pertain to thermal power plants and industrial boilers, which constitute a sound first step in controlling emissions and improving air quality, but they do not comprehensively address the majority of harmful air emissions. For example, the drastic increase in TSP concentrations in Beijing in the 1990s seems to contradict the reduction of ground-level emissions from coal-burning sources. Coal combustion contributes only a portion of urban pollution, whereas natural dust from sandstorms and fine dust from unregulated construction sites around the city requires attention.

Jurisdictional Responsibilities and Enforcement

The national government has made swift progress in adopting air pollution control measures in the past six years. SEPA, through a variety of agencies and enforcers, is responsible for monitoring air quality and making recommendations. However, the responsibility of monitoring and enforcement ultimately falls upon local EPBs, the operations of which are plagued with structural problems. EPBs receive policy instruction through a vertical hierarchy at the top of which is SEPA. However, it is the local governments that currently administer day-to-day operations of the EPBs, such as budgets and personnel. Thus, if a local government views a SEPA policy as contradictory to local ambitions, a hindrance to economic growth, or likely to cause unemployment and similar issues that could affect social stability, it has far more capacity to influence the EPB than does SEPA. Similarly, as with other forms of pollution, EPBs often experience logistical difficulties in enforcing government mandates on air emissions. Insufficient inspection capacities, undertrained staff, shortage of personnel and requisite utilities, and numerous other barriers hinder their operations. Finally, reversion rates are high: although over 1,700 polluting

enterprises were shut down at the end of 2000 to meet state targets, it is believed that as many as 70 percent of them restarted operations shortly thereafter.

The Market

The Chinese air pollution control market is exceptionally competitive. Japan maintains a distinct presence, accounting for over 30 percent of all imports. Foreign imports account for over 50 percent of all sales in this area because of two factors: local manufacturing capabilities are low, and air pollution control projects have traditionally been financed, at least in part, by multilateral or bilateral aid.

While U.S. equipment is seen as very advanced, the price is often too high for use in all but multilaterally financed projects. Several manufacturers have nevertheless made progress in the Chinese air pollution control market due to a variety of factors (see U.S. Strengths and Opportunities). As the government places higher priority on air pollution control projects, U.S. firms will see more opportunities to win bids.

SO_2 Control

SO_2 control equipment is a tough sell in the widespread Chinese market. There is a mandate for highly polluting coal-fired power plants to install waste gas treatment facilities or technology, but many plants are instead utilizing cleaner coal to avoid retrofitting or installing expensive equipment.

With power demands increasing by a rate of 5-6 percent annually, the power market has been restructuring in order to improve efficiency and reduce pollution. Small thermal power plants are being closed, and priority is being given to clean coal-based pilot projects with single-generation capacity in excess of 300,000 kilowatts.

Indoor Air Pollution

Three factors determine levels of indoor air quality: fuel quality, burner technology, and ventilation. Studies indicate that even when solid fuels are used, improvements in flue gas ventilation can achieve a reduction of almost 90 percent in indoor air pollution levels. While cleaner fuels and cleaner-burning technology often provide the best reduction in indoor air pollution, the most cost-effective option has typically been adjustments in ventilation.

Auto Emissions

According to the World Bank, motor vehicle emissions are already a major source of pollutants in the cities of Beijing, Shanghai, and Guangzhou. It is estimated that vehicles contribute to over 60 percent of the air pollution in urban zones: they are the source of 45–60 percent of nitrogen oxide emissions and approximately 85 percent of carbon monoxide emissions. A number of factors contribute to the problem:

- More vehicles. The number of vehicles on the road has nearly tripled since 1990, and the demand for new vehicles is growing by 13 percent per annum.
- Poor manufacturing techniques. Obsolete manufacturing techniques, while slowly advancing, have led to extremely poor fuel efficiency in most Chinese vehicles. The average emissions level of new domestic vehicles is almost 10 times greater than that in developed countries.

Table 6.1 Air Pollution Control: U.S. Exports to China (FAS value in thousands of dollars)

HTS Number	*HTS Description*	*As of April 2001*	*2000*	*1999*
84041	Boiler parts (super-heaters, gas removers)	833.6	29,830.8	112,849.2
84042	Condensers for steam/other vapor power units	81.0	275.9	N/A
84051	Gas generators	443.0	615.2	144.3
840999	Parts for use with engines of heading 8407, 8408	10,091.7	13,482.7	9,931.3
841459	Fans and blowers	542.1	1,850.4	761.8
842139	Filtering or purifying machinery for gases	4,106.3	6,986.3	12,016.8
842199	Parts for 842139	7,025.5	25,592.9	16,126.1

Source: USITC Trade Database, *www.dataweb.usitc.gov.*

- Poor automobile maintenance. Most auto owners and manufacturers are careless about maintenance measures. Promotion of annual safety and maintenance procedures will lead to greater efficiency and fewer emissions.
- Lack of infrastructure. A lack of planning and infrastructure has resulted in vehicle emissions levels comparable to those of industrialized countries 25 to 35 years ago. This lack can be redressed only by efficient policy measures designed to reduce and control the number of cars in key areas and manage traffic effectively.

Air Monitoring

All 100 key cities already identified or to be identified in keeping with the Tenth Five Year Plan are expected to install automatic air quality monitoring systems and transmit this data by satellite to data bases and monitoring centers. According to conservative estimates, this project will require the importation of over $300 million in monitoring equipment and associated technology during its early stages.

The equipment needed for both government (regulatory) and industrial use ranges from sampling and flow monitoring units to analysis equipment. Local manufacturers cannot compete in this market, as they lack the capacity to produce high-quality products.

In addition, employees of monitoring centers require advanced training in the operation of monitoring and analytical equipment. Firms able to provide equipment, effective training, and after-sales service will see increasing demand.

U.S. Strengths and Opportunities

SO_2 Control

Achieving the targets of the Tenth Five Year Plan requires a minimum investment of RMB 100 billion ($12 billion) in desulfurization technology, broken down in the following manner:

- RMB 55 billion ($6.6 billion) in desulfurization technology for thermal power plants
- RMB 30 billion ($3.6 billion) in the control of domestic SO_2 emissions
- RMB 15 billion ($1.8 billion) in desulfurization technology for industrial furnaces

Approximately RMB 6.4 billion ($2 billion) of the RMB 55 billion ($6.6 billion) investment in FGD equipment for thermal plants will go toward installing this equipment on 51 coal-fired power plants within the acid rain control zones.

Clean coal and scrubber technologies such as FGD and circulating fluidized bed (CFB) are prohibitively expensive for the Chinese end user. Often, despite mandates passed down from the central government, no funds or incentives are provided for the use of such advanced air pollution control technology. A key to increasing the use of such technology involves nurturing the capacity to manufacture a substantial portion of the technology within China. Technology acquisition and deployment through licensing agreements, JVs, and other avenues may be critical.

Indoor Air Pollution

As China becomes more aware of the problems of poor air circulation and office building air quality problems, there are opportunities for air cleaners, filters, fans, and blowers of various types as well as coatings and chemical absorbers used for remediation efforts.

Auto Emissions

Several U.S. auto emissions control technology companies are demonstrating a strong presence in the Chinese auto emissions control market. Corning International, in April 2000, moved a large part of its catalytic converter ceramic substrate manufacturing operation to China. While raw materials for this operation are still imported from the U.S., a strong local presence and reduced production costs make Corning a tough competitor in the auto emissions control market.

Air Monitoring

Some U.S. firms, such as Thermo Instrument Systems and Hewlett-Packard, are already well known by Chinese end users. Thermo Instrument Systems has a 70 percent share in the environmental air quality monitoring market in China. In March 2000, Dasibi Corporation, a much smaller player, arranged to install $13.4 million of air monitoring equipment in 33 key cities in China, with the help of the Export-Import Bank of the United States (Ex-Im) and commercial banks. Other active firms include Advanced Pollution Instruments and Environmental Systems Corporation. A strong U.S. capacity to produce high-quality monitoring equipment, coupled with weak capacities among domestic producers to do so, makes this a particularly promising market for U.S. companies.

Foreign Competition, Market-Entry Strategies, and Success Rates

Many Japanese, German, Canadian, Australian, and other foreign firms have gained a solid foothold through numerous tied-aid projects funded by their respective governments. Such strong backing and incentives for export and financing are generally not available to small and medium-sized U.S. manufacturers. Meanwhile, for projects financed solely by the Chinese government, equipment and services will tend to be procured from local Chinese firms—despite quality issues—due to price differentials and protectionism. (As in other sectors, this is starting to change, but only very slowly.)

Nonetheless, Chinese authorities and local decision-makers view U.S. air pollution control technologies as highly respectable. Thus, U.S. companies in the air pollution control field must keep in mind the importance of cutting costs. Outside of multilaterally financed projects, air pollution control technology engineered and manufactured in the United States will have an extremely difficult time penetrating the market in China, but reducing costs will assist in overcoming one of the two primary barriers and will prove vital to obtaining market opportunities as the budding trend of procuring foreign equipment continues to develop.

A Chinese project manager with the Environmental Defense Fund who deals specifically with air pollution has noted, however, the saturation level of the air pollution control market in China. He maintains that unless a foreign company has an innovative or cheap product that can be tailored to fit key policy goals and priorities, it will prove difficult to make headway at this time.

A viable commercial strategy might involve an approach that capitalizes on relatively inexpensive local materials and low manufacturing costs. Of course, intellectual property rights (IPR) protection is a concern, as is quality control of locally-generated equipment, parts, and services. Additionally, as is the case in most Chinese markets, firms must consider the importance of maintaining good relations with Chinese authorities, buyers, and other market players.

The World Bank and other multilaterally financed projects still provide the best opportunities for U.S. technology exports due to the availability of hard currency, an open bidding process, and a number of risk-mitigating factors.

Selected References and Web sites

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Weisbrod, Roberta E. ”Solving China’s Urban Crisis: China’s Transportation Energy Future.” *Journal of Urban Technology* 6, no. 1 (April 1999): 89–100.

Web Sites

Environmental Defense Fund: *www.edf.org*

World Health Organization: *www.who.int* (includes air pollution control standards and regional concerns).

Chapter 7
The Environmental Services Sector

The services sector is among the most challenging sectors in China's environmental market to enter successfully. To a great degree, the sector remains the territory of anointed domestic institutions, monopolies, and those with ties that can only be developed over a long period of time. All services requiring official approval at any point, such as EIAs and engineering services, must be conducted through an appropriately licensed institution; such licenses are not available to non-Chinese operators, making cooperative initiatives requisite for all foreign investors. Additionally, service providers, with the exception of consultants, are required to operate in-country, through either a JV or a WFOE.

Likewise, the sector remains hostile to anyone without a sound, in-depth understanding of both Chinese business culture and China's environmental sector. Past business experiences in China clearly indicate the complications and barriers that all foreign investors doing business in China face. In the environmental services sector, many of these complications are compounded, making extensive in-country experience an arguably more valuable asset than extensive environmental industries experience. Environmental service providers who have been successful in other parts of the world are cautioned against believing that directly transferring service models from elsewhere to China will be categorically successful. It is not unreasonable to assume that non-environmental companies already operating in China that wish to expand their scope into environmental services may have more potential for success than foreign environmental service providers wishing to expand their operations into China.

Although China needs progressive, efficient, and innovative management, service providers offering standard, boilerplate initiatives will not be successful. Generally speaking, the Chinese have a well-founded understanding of basic environmental services; what are needed are high caliber solutions custom designed to meet the unique and complex needs of China. Providing such innovation requires an in-depth and accurate understanding of China's development goals, environmental situation, institutional and regulatory structures, and business culture, which again requires long-term and profound China experience.

While there is no formula for success in China's environmental services sector, several points should be considered: entering the sector is a long-term prospect, requiring years of experience and laboriously cultivated working relationships; innovation is an absolute must, and all innovation must take into account the particular needs of China's unique situation; successful navigation of China's bureaucratic apparatus can be difficult—certain players are to be avoided while others must be courted—an appropriate approach is critical yet difficult to determine; and it is easy to develop a bad reputation in China and difficult to mitigate the effects of a bad reputation after acquiring one, so service providers absolutely must deliver.

Institutional and Structural Points

Registration Requirements for Service Providers

Foreign service providers are able to establish operations in China through WFOEs, JVs, or representative offices. Normally, the lowest-risk and least costly option for small to medium-sized companies is to establish a representative office to oversee marketing and provide a base for operations until enough familiarity is gained to move toward a WFOE or JV. While representative offices have some disadvantages related to restrictions on the signing of contracts, on the direct provision of services, and on the exchange of currency, many small companies have been able to establish firm foundations by operating in China under this category and then moving on to other legal entities once they better understand the market conditions. Such entities have historically been either an equity JV, in which an international company forms a new Chinese-registered entity with a local partner, or a contractual JV, which is usually task or project specific and requires little financial investment. Both these types of legal entities have advantages and disadvantages that need to be thoroughly understood, with the assistance of competent legal counsel, before a decision is made. Finally, in recent years international companies have been able to establish service/consulting WFOEs in certain areas of China, thus circumventing the need to partner with a Chinese entity except for specific projects. While these legal entities make management simpler and more

transparent, they are costly to establish and may be unable to obtain requisite professional licenses and permits that allow the direct provision of environmental services.

Registration of a WFOE, JV, or representative office is a routine, yet at times lengthy, legal process in most areas of China. The majority of the services that can be provided are for multinational companies or multilateral agencies that seek international services of a standard not yet available in China. However, any activity regulated by Chinese law that requires a specific permit, such as undertaking an EIA, laboratory services, engineering design, process fabrication, or equipment installation, requires teaming with a local entity holding an appropriate license. In some cases, even the services provided by a foreign entity in partnership with a local entity are not accepted; thus, the services need to be subordinated to and under the title of the local entity. Foreign consulting service providers are also allowed to offer consulting services via cross-border delivery, but all other service providers must operate in China or through a local partner.

For some services, such as those provided by analytical laboratories, it may be prudent to consider establishing a facility in a bonded zone. These zones, which were primarily developed as export-reprocessing zones that would create jobs and generate revenue without entangling operators in customs formalities, are being increasingly used as bases for certain categories of operations in China. For example, an analytical laboratory wishing to establish operations in China may find the barriers to importing the necessary specialized analytical instrumentation into China prohibitive. But by establishing a base in a bonded zone, the laboratory can bring analytical samples from the mainland into the zone, complete the analysis there, and generate results, avoiding the levies associated with bringing the equipment into the country and bypassing the cost and logistical difficulties of shipping samples overseas. (See Box 10 for further discussion of bonded zones.)

Market Profile

China's environmental services market potentially requires a very broad range of services. However, lack of awareness, protectionism, and opting for conventional engineering solutions currently make the reality of the market quite narrow and limited. As awareness progressively increases in the government and industry sectors, much of the initial need is filled by local environmental institutes and private companies that generally have good engineering skills but lack innovative solutions. Thus, the market is increasingly open to service providers in the fields of environmental impact assessment (in conjunction with local institutions), energy efficiency, water recycling and reuse, waste-to-energy solutions, integrated environmental systems, ecological water treatment methods, waste reutilization, and a range of services classified as cleaner production and sustainable development services.

The market for the above services has grown significantly in the past five years. While the body of environmental regulation has increased greatly, enforcement has not. Environmental protection in China is primarily driven by economic and profit considerations, not by regulation. Because of this, business development strategies must always focus on increased efficiency and profitability, with increased environmental protection as a side benefit. Because many of these solutions fall outside the bounds of normally recognized possibilities in China, the basic concepts must often be communicated and demonstrated in the form of case studies presented in seminars, so that detailed economic justifications are made. However, if approached properly, this strategy can be quite fruitful, as most Chinese managers see environmental protection as an added expense that is required to be put at the end of a dirty process. If an alternate vision of efficiency and process reengineering is presented, particularly in a scheduled format in which the initial investment is minimized, significant interest can be generated.

Generally, U.S. service providers and technologies are respected in China for their professional and timely delivery. A further recognized advantage is the robustness of U.S. technology and services compared with their European and Japanese counterparts. However, several barriers put U.S. service providers at a disadvantage. Foremost among the barriers is the lack of a meaningful U.S. bilateral aid program to China. While most other industrialized countries support their national environmental markets in China through provisions of tied aid, the lack of such a program from the U.S. normally disqualifies U.S. service providers in favor of those bringing bilateral aid with them. This problem is further exacerbated by the lower priority given to U.S. vendors and service providers in multilateral aid programs as a favor to providers from other bilateral aid donors. A further disadvantage often cited by Chinese decision-makers is the often tumultuous political relationship between China and the U.S.: when U.S. goods and services are procured, it is uncertain whether delivery can be completed or after-sales service can be guaranteed, in light of the frequent threats of sanctions.

Additionally, some barriers faced by U.S. companies and service providers are self-inflicted. A lack of understanding of Chinese business practices and sensitivities, unfamiliarity or impatience with the time-consuming process of relationship building, dependence on overseas Chinese expertise (which is often resented) rather than local professionals, and a lack of understanding of laws and regulations all contribute to the creation of misunderstandings and frustrations.

Many of the barriers that U.S. investors face are the same ones that all foreign investors face, providing a relatively level playing field from the perspective of China-sourced complications. Many companies say that the single biggest barrier that limits U.S. competitiveness in relation to that of other foreign service providers is the lack of a U.S. government bilateral assistance program. Bilateral institutions such as the Canadian International Development Agency (CIDA) and Germany's GTZ can exploit mechanisms that allow them simultaneously to act as development consultants to the Chinese and to lay groundwork for private companies (from their respective countries) to win contracts; in some cases, they are able to tie large sums of multilaterally sourced funding to companies in their country by entering into co-financing operations (see Box 9). The return of the U.S. Trade and Development Agency to China is a positive first step; however, the absence of the U.S. Agency for International Development (USAID) is a glaring vacancy in the realm of bilateral operations in China.

WTO and Environmental Services

With China's accession to the WTO, foreign service suppliers now may establish a commercial presence in China and provide environmental services in the form of joint ventures with foreign majority ownership permitted. Language in the U.S.-China bilateral agreement indicates that China's environmental services commitments cover sewage, solid waste disposal, cleaning for exhaust gases, noise abatement, nature and landscape protection, and other environmental protection services, yet they do not cover environmental monitoring or pollution source inspection.

Although foreign service providers are generally kept out of environmental monitoring and pollution source inspection, foreign firms are contracted to provide such services on an ad hoc basis. CH2M Hill, the U.S. company that carried out air-monitoring operations in Sydney prior to the Olympic Games there, has been contracted to perform air-monitoring operations in Beijing as it prepares for the 2008 games.

Capacity and Awareness Building

One of the single biggest breakdowns in China's environmental protection apparatus today is a deficiency of capacity and awareness. As discussed elsewhere in this document, many local EPBs lack clarity regarding how best to approach the diverse and complex environmental problems within their jurisdictions, industrial leaders lack vision regarding the possibilities for clean production and eco-efficiency, and the dearth of comprehensive solutions that can benefit both the environment and the economy sometimes makes environmental protection a secondary priority after economic development. Foreign investors might want to consider marketing equipment and carrying out consulting operations in China through a method that disseminates information in regard to these deficiencies. Investment packages might also include components that seek to implement corporate and industrial training, eco-efficiency capacities, health and safety management, and other initiatives that cover both environmental and economic needs. A number of Chinese companies already recognize economic benefits through efficiency and sound management. As China's socialist market economy continues to develop, the need for such efficiencies is increasing, as are the demands for companies and consultants that can provide the means to achieve them.

Market-Entry Consulting

A successful strategy used by several service providers entering the Chinese market employs market-entry companies to introduce potential partners or projects to prospective service providers. This allows a foothold to be gained with a low financial commitment or risk. Conversely, several U.S.-based associations and market-entry groups have attempted to help their clients enter China with the aid of U.S.-based or U.S.-educated Chinese professionals. Overall, the success rate of such efforts has been low, as the value of market-entry consultants lies with their local presence and contact network.

Below, two specific approaches are presented that may be considered by a group of service providers working through an association or consortium with a well-established office in China.

Specialized Representation Associations

Foreign investors seeking to operate in China might benefit from the development of a number of special-

ized, privately operated associations that simultaneously function as monitors for business opportunities in China and as foreign technology and services sources. In addition to helping form partnerships between end users and suppliers, the associations might facilitate legal, administrative, and logistical consulting. Specialized associations might represent particular U.S. industries in China's environmental sector as a whole or direct attention toward particular industrial sectors in China with environmental needs. A strong need currently exists for an association that monitors opportunities and facilitates participation in multilateral and untied bilateral assistance operations. Such an association should not only monitor for opportunities and keep its constituents informed of potential projects at the very earliest stages of assessment and development, but should also develop the capacity to facilitate viable bidding for such projects, a task that is difficult, particularly for small operations and firms with no experience in doing so.

The Consortium Approach

Because of the logistical and financial constraints of operating in China, as well as the increased capacities resulting from the pooling of experiences and strengths, foreign investors may find it beneficial to enter the market via a consortium scenario. Consultants and other service providers can work together to offer complete packages of planning, design, financing, engineering, implementation, and long-term operation management and training. Service providers with a clear understanding of the needs discussed in the introduction of this chapter might be in a position to play the invaluable role of bringing together the most appropriate players for a particular project and then bridging the gap between those players and the domestic entities. It goes without saying that the central organizers of such a consortium must have extensive and profound experience not only in the environmental sector but in China as well.

Conclusion

The services sector in China presents many opportunities and challenges to U.S. service providers. On the one hand, U.S. services and technologies are respected, yet on the other, they are at a distinct disadvantage compared with many Western countries due to a lack of bilateral funding and the tumultuous political relationship between China and the United States. A bilateral environmental program in China would help level the playing field with other Western countries and encourage Chinese entities to consider U.S. vendors for projects. U.S. companies also need to take a long-term view of the Chinese market and establish long-term representation that actively markets and builds alliances on their behalf. In the case of small and medium-sized companies unable to afford an in-country presence, associations or consortium relationships should be considered as a method of market entry.

Chapter 8
Resource Management

This section includes a number of resource management issues and technologies that have not been covered in other sections. Some subjects may not be appropriate for technology providers, but they may be appropriate for consultants and innovative management and protection systems providers.

China's territory encompasses the third largest land area in the world, after Russia and Canada. However, land resources per capita fall far below world averages. According to the Food and Agriculture Organization, China accounts for 22 percent of the world's population but has only 10 percent of the world's arable land. The arable land totals about 130 million hectares, or only 0.1 hectare per person. Additionally, the quality of the arable land is generally poor, with almost 80 percent classified as low- or mid-yield land. Unsustainable agricultural and irrigation practices, water supply problems, severe degradation due to pollution, deforestation, erosion, and urbanization further exacerbate the problem.

China is rich in grasslands of many varieties, which cover over 40 percent of its territory. A massive push to "improve" the grasslands for agriculture in the 1950s and 1960s led to rapid erosion and ultimately desertification. Intense livestock production, overgrazing, and permanent settlement of traditional nomads contributed to further deterioration. Over a third of the grasslands are overgrazed, and the desertified areas have doubled in size since the mid-20th century.

According to China's fourth forest resources survey, "forested land" covers about 260 million hectares, although only about half of this is actually covered by forests. Forests in China suffer from overlogging, illegal logging, and conversion to agricultural use. The aftereffects of forest destruction are noticeable in the form of serious soil erosion and massive flooding in certain areas. Efforts are underway to arrest this situation. Since the 1970s, deforestation trends have been reversed due to major afforestation efforts. Because of this, the area of forested land has increased, but the state of forests in terms of biodiversity and age continued to decline right up until 1998, when the government imposed a logging ban. Even now, this ban is consistently violated.

The main concern regarding sustainable land management in China is food security. China has been experiencing a net loss of cultivatable land due to massive urbanization, especially in the fertile eastern regions where the majority of the population resides. Even worse, most additions to arable land resources have been made by the reclamation of fragile grassland, wetland and coastal ecosystems. Major land reclamation work, such as that in the desert region of Xinjiang, has generated an increased demand for irrigation water, but unsustainable water practices have led to the deterioration of nearby water-rich areas.

Policy and Legislation

Environmental awareness has significantly increased since 1978, and higher priority has been placed on the strengthening of policies related to land management. Legislation, administrative research, institutional restructuring, and education have all contributed to a much stronger framework for conservation and land resource planning. Administrative actions have included merging the National Land Bureau and the Ministry of Geology into the Land and Natural Resources Ministry and reclassifying the Ministry of Forestry as the State Forestry Bureau. Since the implementation of these changes, SEPA has been the main entity responsible for the administration of rural ecology and conservation. However, at the ministry level, there is still some confusion: while SEPA is the highest authority relating to ecology, the Ministry of Water Resources is responsible for water and soil conservation, and the Ministry of Agriculture oversees farming and productive lands. There is no national parks service or the equivalent, and the setting aside of nature reserves is undertaken in a sporadic and quantity-driven manner.

The government has expressed several ambitious goals concerning land use and management for the next 10 to 20 years. Priority is being placed on undoing the damage of the past half century by increasing and protecting forests and grasslands as well as restoring wetlands, halting the spread of desertification, and

preventing further arable soil loss in order to maintain the current level of self-sufficiency in food production.

Shortfalls of the Ninth Five Year Plan are not affecting the Tenth Five Year Plan. Goals stated in the Tenth plan cite an increase in percentages relative to the amounts and distribution of resources at 1995 levels; however, few 1995 baselines relevant to these percentages exist. In addition, certain definitions are vague, as demonstrated by the overlap between "reduced farmland" and "eroded areas."

Despite the policy advances of the past decade, many government organs and state mouthpieces remain confused, as illustrated by a recent statement issued by the minister of land and natural resources:

> China will strengthen management of farmland and prevent the destruction of cultivated land; it will press ahead with improvement of land, *intensify reclamation efforts*, and *appropriately exploit* the reserve resources of cultivated land. Meanwhile, it will pursue the policy of tapping the potential of land for construction purpose and *vigorously promote the intensive use of land*. (*People's Daily*, Feb. 1, 2001. Emphasis added.)

The effectiveness of resource regulation and policy is hampered by conflicts of interest, often within and among the very entities that are responsible for regulation. The State Forestry Bureau, for example, is on the one hand responsible for protecting and monitoring the national forest reserves. The same bureau has traditionally been involved in the exploitation and use of national forest resources, often benefiting directly from the sale of licenses and contracts for such activities or indirectly from the formation of companies that conduct business using these resources.

Additional and perhaps more dangerous constraints to resource management are coming into focus as the government restructures to meet the demands of a more deregulated and global economy. As the government relaxes control over economic activities, it needs to take steps to ensure firmer control over resource utilization, an outcome that seems unlikely given current efforts.

Desertification

Desert regions, which cover over a quarter of China, are expanding. This expansion accelerated with unsustainable land reclamation, agricultural practices, and livestock production that began in the 1960s and 1970s, as well as urban development and deforestation throughout the 1990s. Desertification affects two distinct regions in China; most notably, the northern plains of Inner Mongolia and several provinces to the south of it, but also the drainage basins in the West, mostly in Xinjiang and Gansu provinces (see the map at *www.din.net.cn*).

Desertification contributes to a host of problems in China, in both rural settings and urban centers. Unfortunately, desertification is often caused by problems to which it contributes, forming a vicious cycle. These include:

- Reductions in farmland. Heavy losses of arable land are devastating the economies of many communities, forcing them to increase their exploitation of marginal land. Overuse of water resources and overgrazing destroy the resources that many rural communities depend on.
- Sandstorms. Dust storms and sandstorms throughout the country are noticeably increasing in both intensity and number. A series of sandstorms that struck Beijing in the springs of 2000 and 2001 caused millions of dollars' worth of property damage. A particularly ferocious sandstorm in 1993 killed 78 people in the western province of Xinjiang, and a sand-and-snow blizzard at the beginning of 2001 killed 39 people.
- Soil erosion. Desertification in some parts of the country affects the resources of other regions. Desertification of the grasslands of the northern regions, for example, adversely affects the rivers of the south. The north also contains the headwaters for many of Asia's major rivers. As grasslands and other types of cover decrease, soil washes downstream, contributing to water pollution and floods farther down the Yangtze and Yellow Rivers.

Anti-Desertification Efforts

Tree and grass planting seems to be the most effective way to combat desertification for now. Reforestation and shelterbelt efforts are increasing. In December 2000, the chief of the State Forestry Bureau announced that $11.6 billion would be spent over the next 10 years on forest protection and reforestation efforts. However, the majority of reforestation consists of plantations of cedar in the South and poplar in the North, which do not adequately compensate for the loss of biodiversity and old-growth forests.

Typical methods of preventing sand movement and stabilizing the advance of sand areas include the erection of barriers and the planting of scrub or grasses on the windward sides of dunes.

One method to control desertification is the planting of seabuckthorn, a local economically valuable and hardy grass. United Nations Development Program (UNDP) and Food and Agriculture Organization efforts

are concentrating on the viability of this plant as an economically profitable solution to the loss of farmland.

Salinization and Irrigation

China is predisposed to heavily salinized lands, especially in its western regions. Furthermore, ongoing salinization in China results from poor irrigation and other water-use techniques in areas with scarce water resources. According to recent World Bank estimates, salinized land occupies about 80 to 100 million hectares, 10 percent of which are cultivated land. Salinized coastal zones in the east also serve as a source of sandstorms.

The Ministry of Water Resources estimates that the rate of salinization is actually decreasing due to prevention and remediation measures introduced in the late 1980s.

Best Sales Prospects

Soil Reclamation Technology

In order to increase overall crop yields, the agricultural sector is in great need of innovative and low-cost equipment or technology that can improve the yield of highly alkaline soil. A Sino-Japanese cooperative project is underway to improve the quality of saline soil in North China's Shanxi Province by applying soil conditioners that are a byproduct of Shanxi power plants.

Soil Remediation Technology

Pollution caused by landfill leakage, pesticides, industry, and heavy mining has harmed over 13 million acres of farmland in China. Although soil remediation technology is typically expensive, innovative approaches may find a niche, as the government sees this as a high priority.

Irrigation Technology

The key to alleviating China's flood and drought problems is water efficiency. Implementation of water-efficient irrigation systems does not require high technology or great expense. It does require a knowledge transfer in regard to system design, efficient use of resources, and the manufacture of parts that are designed for efficient purposes. Multilaterally financed irrigation projects use efficient equipment and design in isolated projects, but these techniques are not replicated and do not spread.

Box 8. Plantation Timber Products Case Study

Plantation Timber Products, a Singapore-based company, recently made headlines as one of the most successful foreign-funded companies in China. After embarking on an ambitious economic development project that helped restructure the timber industry in inner China, the company secured an International Finance Corporation (IFC) loan for an afforestation project in Hebei Province.

Plantation Timber Products' efforts encourage farmers in poverty-stricken western regions to substitute sustainable tree-farming techniques for traditional agriculture. The switch has had several effects: an improved economy in the region with direct effects for farmers, the stabilization of large tracts of flood-prone Yangtze valley areas, and the development of sustainable wood reserves.

In some cases, timber plantations are criticized for encouraging the destruction of biologically diverse native forests for the plantation of one species of fast-growing timber. China's case is different. With so much of the country's natural forest completely devastated, timber plantations represent a reforestation effort that provides economic benefits through the transmission of sustainable development practices. Plantation Timber Products is gaining the approval and trust of the government as well as of major multilateral lending organizations such as the IFC.

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Web Sites

Hunan and Nature in Harmony; China Environment and Development Information: *www.enviroinfo.org.cn*
(Categories include: land resources, land use, desertification, salinization, soil erosion, land degradation, sandstorms. Consists of a collection of articles pertinent to this subsector.)

ChinaOnline agriculture section:
www.chinaonline.com/industry/agriculture/agriculture_center.asp

United Nations Food and Agriculture Organization:
www.fao.org
(Contains project documents and publications of interest in the area of land resources.)

Chapter 9
Finance Programs and Resources

There are five financial sources pertinent to environmental investment in China today:

1. Government investment funds
2. Policy and commercial bank loans
3. Enterprise investment (SOEs, the domestic private sector, JVs, and WFOEs)
4. Multilateral and bilateral assistance programs
5. Securities

Government investment funds are capitalized primarily through central budget funds earmarked for a specific use, or through national and subnational governments and affiliated agencies via charges and levies on individuals and enterprises. Theoretically, these resources are available to all Chinese legal bodies, including JVs and WFOEs. However, in reality they are primarily reserved for SOEs and occasionally for high-profile JVs that authorities consider to be of special importance. Although these funds are rarely made available to foreign investors, they should be understood, as they constitute a significant source of funding for SOEs that may contract foreign-invested enterprises to service their needs.

The structure and availability of policy and commercial bank loans, like those of government investment funds, are important to foreign investors in terms of how they apply to the Chinese enterprises that may contract their services. Both policy and commercial banks continue to function as the tools of government-directed spending, but commercial banks are becoming increasingly independent in the decision-making process when extending loans to operations that have not been anointed by government planners. Both types of banks claim to be increasingly cognizant of commercial viability when making loan decisions, and at least in theory they are granting loans to those ends. Nonetheless, the ultimate function of Chinese banks is to service the financial needs of state and provincial planners. Very little in the way of preferential environmental loans is available.

Enterprises themselves are expected to produce increasing amounts of money to furnish environmental protection investments. Pressure to do so stems both from government policies decreeing pollution abatement and from commercial competition, which necessitates increased production efficiency. Additionally, access to many governmental funds requires enterprise contributions.

As discussed further in Chapter 10, projects funded by multilateral and untied bilateral assistance offer the most secure point of market entry for foreign exporters and foreign-invested enterprises due to relatively strict assessment and implementation standards as well as guaranteed available hard currency. This chapter includes a brief introduction to the major assistance programs active in China, including points on how best to monitor their current affairs.

Although securities may one day play a significant role in environmental financing, the financial sector remains generally inaccessible to the environmental sector at this time. The securities markets of China are far too unregulated and immature to support creative environmental finance tools, and they are much too protected (i.e., reserved for the purposes of larger, anointed SOEs) to service capital demands for environmentally oriented startups (although a number of environmental enterprises are listed). There is some discussion regarding the development of a green investment fund in China; however, its implementation is still a long way off, and the financial climate requisite for its success is arguably even farther away. Because securities are not immediately applicable, there is no further discussion of them in this chapter. See Chapter 2 for more information on China's macroeconomy and economic issues.

Government Investment Funds

Local Environmental Funds

Local environmental funds are essentially rotating funds capitalized by pollution levies, or non-compliance charges, imposed upon enterprises discharging pollutants in excess of relevant national standards. Approximately 80 percent of the revenues generated by these funds are redirected to the polluting factories from which they came, in the form of grants (or loans in the case of the "special fund"), with the intention of financ-

ing pollution abatement projects. The remaining 20 percent augments EPB budgets and is theoretically aimed at enhancing capacity-building programs. Enterprises submitting proposals for grants from this source are required to match a proportion of the funds sought through means of their own.

Various models for the collection and distribution of these funds exist throughout the country, but in each case procurement and disbursement responsibilities do not extend beyond the provincial government. In all cases, city, county, and provincial government bodies have various degrees of involvement in collecting and redistributing these finances; however, the central government neither receives a share of the revenues nor plays a role in determining how they are used. In most cases, the funds are jointly managed by environmental and financial agencies, and in some cases commercially-oriented investment corporations have been established. The corporations are not, however, completely independent, as they are established and monitored by the associated EPBs.

The Special Fund for Pollution Control

The efficiency of local environmental funds is low because: local environmental funds traditionally have been disbursed as grants; the finances are recycled to enterprises that initially capitalized the funds through levies (reportedly reinforcing a perception among the contributing enterprises that they own the funds); and, after environmental funds have been granted to enterprises, project selection is left mainly to the enterprises' discretion. In 1998, environmental investment policy began shifting from grants to loans and, in keeping with this shift, a special fund for pollution control was initiated.

The working mechanisms of the special pollution control fund are established by EPBs at provincial or municipal levels and remain entirely under the control of the EPB finance departments, except in some regions where semi-independent investment corporations have been established under EPBs to manage the accounts. The fund is capitalized by transfers of 20–30 percent of the revenue from pollution levy funds each year, interest payments on loans paid out through the fund, allocations from local governments, and so forth. Loans are provided at low interest rates (2.4–3.0 percent) to enterprises that previously paid pollution levies, are clearly capable of repaying the loan, can match a determined proportion of the loans from their own finances, and have project objectives (which must be clearly stated at the point of application) that are deemed feasible.

Priority applications for loans through these funds include demonstration projects addressing key pollution issues and projects with eco-efficiency capacities, as well as the closure, revamping, or removal of major polluting enterprises.

Although finance use under the special fund provisions is reportedly more efficient, effective, and directed toward specified and appropriate uses, a number of issues are notable, including the fund's relatively small size, inaccessibility to enterprises that have not paid pollution levies, continued government intervention, and various other administrative issues.

The National Environmental Fund

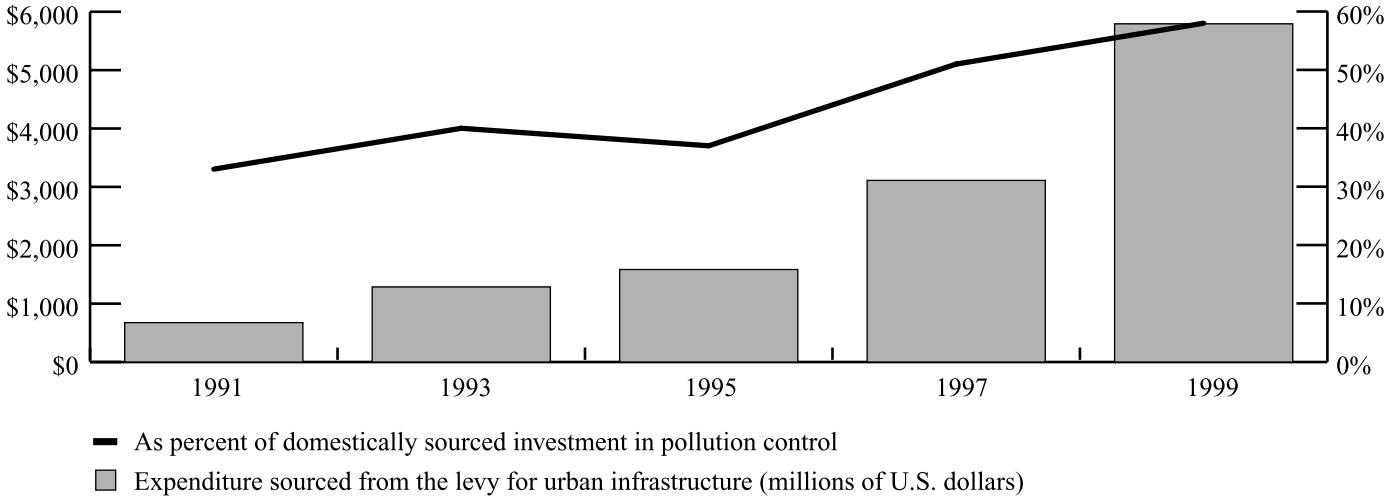
There has been some discussion of the development of a national environmental fund, ostensibly to facilitate comprehensive, large-scale projects and to act as a high-level monitor of overall investment practices. SEPA has on several occasions solicited opinions from a number of domestic government bodies, as well as the World Bank and the Asian Development Bank, in regard to the merits of establishing such a fund, its feasibility, and what form it might take. There is little indication that such a fund might come into existence any time soon. Many national-level government bodies would need to collaborate and agree upon its form and function, something yet to be attempted or accomplished.

Other Levy-Based Funds

Two other government funds used to finance environmental protection, the levy for enterprise renovations and redevelopment and the levy for urban infrastructure projects, are capitalized through various fees and levies as well as government allocations. Only a small portion of the funds generated by the levy for enterprise renovations and redevelopment is focused on environmental protection (in 1998, 0.28 percent of the fund's total expenditure was environmentally oriented, down from 1.68 percent in 1991). The fund is a relatively small overall contributor to environmental investment and is viewed as an underachiever in this regard.

Funds from the levy for urban infrastructure projects, on the other hand, have increasingly financed urban environmental infrastructure (see Figure 9.1). Local governments are directing more urban infrastructure development funds to environmentally-specific projects (such as water and waste management) and are increasing their own contributions. This fund accounted for 58 percent of domestically sourced investment in pollution control in 1999, as opposed to just over 32 percent in 1991. Nonetheless, urban environmental infrastructure

Figure 9.1 Expenditures Funded by the Levy for Urban Infrastructure: Total Amounts (in millions of U.S. dollars) and as Percent of Domestically Sourced Investment in Pollution Control, 1991 – 1999



Source: Cao and Sun, *Environmental Financing in China.*

remains woefully inadequate, with urban sewage treatment rates reaching only 30 percent and waste collection rates reaching only 60 percent in 1998. In both cases, the quality of treatment carried out was generally of lesser quality than is necessary to achieve notable results.

Government Support Funds for Environmental Enterprises

The only government ministry-furnished support fund in any way directed toward environmental technology development is the Ministry of Science and Technology's Innovation Fund for Small Technology-Based Firms. The fund's purpose is to facilitate the transformation of scientific research achievements into technological innovations, particularly those that can play a significant role in economic growth. Environmental protection innovations are eligible, and the fund is available to all registered legal bodies in China, including JVs and WFOEs.

The Innovation Fund for Small Technology-Based Firms is gaining attention and is considered to be run relatively well, with accrued finances of over RMB 1 billion as of 1999. Proponents of the development of an environmental industry investment fund may use the Innovation Fund for Small Technology-Based Firms as a model upon which to base a fund specifically geared toward the support of environmental technology development.

A number of other funds and organizations exist, such as the China Foundation for Environmental Protection. However, their activities are minimal. Other than acting as showpieces and bureaucratic administrations, they serve little purpose for environmental protection.

Policy and Commercial Bank Loans

Policy Banks

Of China's three policy banks, the China Development Bank (CDB), the Export-Import Bank of China, and the Agricultural Development Bank of China, only the CDB works to facilitate investment directly associated with environmental protection. CDB loans for environmentally-related projects are generally long-term loans, and they are not offered at preferential interest rates. The China Ex-Im Bank finances environmentally-related investments, but it has no special program geared specifically toward environmental investment.

The CDB apparently intends to draw a balance between functioning as a tool to implement government mandates and granting loans based on commercial viability. All CDB loans undergo thorough feasibility studies that bear significant weight in the final decision to grant a loan. However, political pressure still exerts significant influence, and many loans are provided through the bank to facilitate programs that are deemed critical,

despite poor commercial viability. CDB finances are domestically sourced, including a significant amount of capital drawn through bonds issued directly by the bank.

The World Bank and the Asian Development Bank (ADB) work with the CDB in granting joint loans, which constitute a small percentage of the bank's lending. All joint loans are subject to the relatively strict assessment standards of the multilaterals, thereby increasing the assurance of commercial viability for projects that have received the loans. As a result, the likelihood for timely repayment of joint loans is increased. Because the loans are all long term, it is still difficult to determine the prognosis for their return rates.

It is also difficult to assess the commercial viability of non-joint loans by CDB that do not undergo feasibility studies by the multilaterals. World Bank and ADB involvement in the CDB presumably affects the know-how and standards of the development bank, helping it to hone its future viability. In its current manifestation, the commercial intentions of the bank continue to be waylaid by political pressure from central and provincial planners.

Commercial Banks

China's commercial banks, like its policy banks, claim that increased attention is being paid to commercial standards. Particularly when extending loans to small operations, commercial banks increasingly look at the commercial viability of the projects at hand. Commercial banks are gaining more independence from central planners, particularly in relation to lending practices toward smaller operations. In this context, commercial banks are wary of financing environmental projects that are not government mandated, due to the long-term and low-yield nature of such loans. However, commercial banks, like policy banks, generally heed central and provincial government mandates for financial support of large projects requiring massive expenditure.

For the most part, commercial banks do not offer preferential terms for environmental projects. Any firm that does manage to arrange a commercial bank loan for environmental investments pays the standard interest rate of approximately 5 percent. The exceptions are those initiatives with SDPC (or the appropriate lower-level development and planning commission) approval. Such initiatives qualify for a preferential interest payment program, at the discretion of the lending bank. Investors repay the loan at an interest rate of approximately 2 percent; the remaining percentage of the interest is furnished by budgetary finances from the local government most closely associated with the project. This scheme has not seen tremendous success, however, as local governments choose not to accept the burden, banks consider the extra steps of collecting interest from numerous sources troublesome, and commercial viability remains difficult to achieve.

The State Development and Planning Commission and Bank Loans

SDPC approval is necessary to obtain preferential commercial bank loans, policy bank loans, and bilateral or multilateral financing. Regional and local development and planning commissions must review all such projects for feasibility and approval. Any project over $30 million must be approved at the national level.

Enterprise Investment

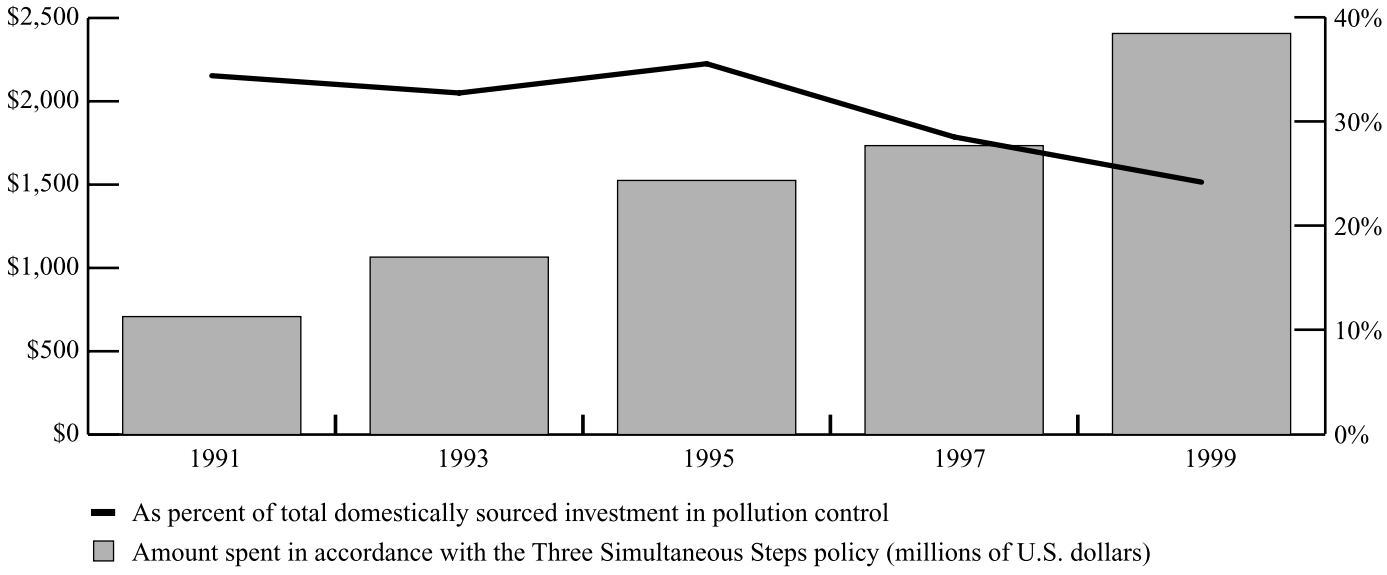
About 55 percent of the $85 billion that CRAES expects is needed to achieve the environmental goals of the Tenth Five Year Plan is likely to be covered by business enterprises themselves. Most loan programs and preferential funding for enterprise development and upgrades require some degree of fund matching from the enterprises, and regulations, particularly the Three Simultaneous Steps policy, impose significant spending.

The Three Simultaneous Steps policy requires enterprises to take steps to prevent and control pollution simultaneously with the design, construction, and operation of projects, as opposed to addressing pollution issues after project implementation is completed. Revenues generated as a result of compliance with the policy have grown steadily since 1991 and have consistently represented about 4 percent of total expenditure on construction projects. However, the policy's share of total investment in environmental protection has trended down, suggesting increased performance on the part of other investment channels (see Figure 9.2).

Multilateral and Bilateral Assistance Programs

About 15 percent of environmental funding in China is sourced from multilateral and untied bilateral lending agencies. Aside from financial assistance, such lending programs aid Chinese development by guiding investment toward feasible and financially viable projects, by pressing for the development of stronger assessment

Figure 9.2 Expenditures Resulting from the "Three Simultaneous Steps" Policy: Total Amounts (in millions of U.S. dollars) and as Percent of Domestically Sourced Investment in Pollution Control, 1991 – 1999



Source: Cao and Sun, *Environmental Financing in China.*

and implementation standards, and by offering technical assistance, policy advice, seminars, and training.

The Project Cycle

Local or provincial governments initiate project proposals that need foreign financial assistance. Some projects are listed on the Agenda 21 or the Trans-century Green Projects list. MOFTEC screens all proposals and is responsible for ensuring that all loans associated with a particular project can be repaid. Ministry of Finance and SDPC approval are usually required at some point in the initial project cycle, and SEPA may screen projects as well. After clearing all domestic hurdles, a project is forwarded to the lending agencies for the lengthy review and approval processes.

The Ministry of Finance meets with donor agencies annually to discuss financing arrangements. Government and lending agencies then collaborate to analyze project details and feasibility further. Consulting firms should position themselves for future involvement in particular projects at this stage. Detailed feasibility studies are required and the borrowers, who are responsible for project preparation, often need to augment their in-house analytical capabilities. Contractors and equipment suppliers should create contacts at this point to determine whether or not their services or goods will be procured for the project. Once the project details are finalized, the lending institution and various Chinese government bodies must approve the final plan. Implementation generally begins within a few months of final approvals, by which time contractors and suppliers should already be in contact with the appropriate implementing agencies.

Chinese implementing agencies, not lending organizations, are responsible for contracting goods and services. Firms that have identified projects suited to their capacities should approach the implementing agencies, not the lenders. This should be done as early on in the project assessment stage as possible, as waiting for projects to go out for bid before initiating contact will result in failure.

There are a number of ways to monitor business opportunities through multilateral and bilateral assistance programs:

- Each institution maintains a Web site, many of which are conscientiously updated. However, not all sites provide information well enough in advance to keep potential bidders prepared to tender in a timely fashion. Firms need to contact these institutions proactively in order to keep a close eye on developments and should demonstrate interest in particular projects as early as possible.
- *UN Development Business*, published by the United Nations Department of Public Information, is a comprehensive resource for enterprises providing

goods and services to projects financed by the major multilateral institutions. It is available by subscription online or in hard copy. Subscription information is available at *www.devbusiness.com/about.cfm*.

World Bank

As of June 2000, World Bank commitments to China were in excess of $34 billion, accounting for a total of 226 projects. About half are still under implementation. The bank's primary targets are poverty alleviation, infrastructure development, and human resource development. Aside from initiatives aimed specifically at environmental protection, many World Bank projects afford residual benefits to those ends; for example, all World Bank–assisted power projects aim to incorporate environmental sustainability in their design and therefore draw on environmental industries.

China's environmental protection sector has been the fastest-growing recipient of World Bank loans over recent years. In fiscal year 2000, the World Bank furnished $700 million in loans for three environmentally oriented projects: the $349 million Second Beijing Environment Project, aimed at air and water pollution alleviation in Beijing; the $150 million Hebei Urban Environmental Project, with a strong emphasis on wastewater management and a lesser focus on capacity building for industrial pollution control; and the $200 million Chongqing Urban Environment Project, with an emphasis on solid waste management, wastewater management, water supply and monitoring, and capacity building for urban management and environmental rehabilitation. The bank also works as an implementation agency for the Global Environment Facility (GEF) and the Montréal Protocol.

Future environmental focuses will include air and water pollution, wastewater treatment, vehicle emissions control, and reduced coal use in urban areas. Focus is also shifting toward the poorer and institutionally weaker inland provinces. As of 2000, nearly 70 percent of recent and proposed World Bank lending targeted the nation's interior, as opposed to 50 percent several years earlier. One intention of this shift is to mitigate environmental impact as development in the region is pushed forward.

The structure of World Bank assistance to China is changing, drawing a mixed reaction from experts. The bank still categorizes China as a "developing country," but it is no longer considered one of the less-developed countries. Thus, China is increasingly being expected to fund its own development as its domestic economy continues to grow. Soft loans (i.e., low-interest loans) and grants are no longer being made available.

The World Bank Group maintains an extensive Web site (*www.worldbank.org/*) that contains a section particular to China (The World Bank Group in China, *www.worldbank.org.cn/English/home.asp*). Included on the site are numerous resources such as the World Bank Monthly Operational Summary, (*www.worldbank.org/html/opr/procure/MOS/contents.html*), research papers, project descriptions, and statistics.

Asian Development Bank

The Asian Development Bank (ADB) is a development finance institution owned by 59 members. The bank's goals, which are effected through loans and technical assistance, are poverty reduction, economic growth, human development, improved status for women, and environmental protection. Only nationals of ADB member countries, of which the United States is one, are permitted to bid on service and procurement contracts for ADB-financed projects. The bank places considerable stock in the BOT and build-operate-own models, which are being put to use in the PRC with increasing support from the government (see Chapter 10).

The ADB's country assistance plan, available online at *www.adb.org/China/default.asp*, outlines the intended assistance program for the PRC. The social infrastructure and environment section of the plan defines urban development and environmental protection goals including waste management; air and water quality issues; capacity building for and implementation of market-based instruments for environmental management; strengthening of institutions, policies, and management systems; promotion of cleaner technologies; and promotion of sustainable natural resource utilization. The plan also portends a shifting focus toward the western regions, in keeping with China's Western Development Plan.

Guidelines for procurement and consulting services are available online at *www.adb.org*. The ADB publication *Business Opportunities* outlines opportunities for vendors and consultants, is updated regularly, and is available online and free of charge at *www.adb.org/business/opportunities/default.asp*. The bank also maintains two data banks, one each of consulting firms and individual consultants, known respectively as DACON and DICON. Bank staff refer to the data banks during the initial consultant selection process for ADB-financed projects. Registration qualifications and information are available online at *www.adb.org/consulting/dacon.asp*. The country assis-

tance plan is available at *www.adb.org/China/default.asp*.

International Finance Corporation

The International Finance Corporation (IFC) operates under the supposition that sustainable economic growth based on private investment and successful entrepreneurship is the cornerstone to poverty alleviation. Thus, it works to further the development of the non-state sector in developing countries, foster the development of financial institutions, and advise private companies and governments in achieving such ends.

In fiscal year 2000, the IFC approved $95 million in financing to China. The current strategic emphasis includes enterprise reform and private sector development, increased involvement in financial sector development, continued involvement in western development, support for industry rationalization and SOE reform, increased private participation in infrastructure and social sector development, and continued limited recourse financing for projects bringing technology and management skills into China.

The IFC's Environmental Projects Unit (EPU) works to accelerate market acceptance of goods and services that benefit the environment and emphasize eco-efficiency by identifying and developing innovative private sector initiatives with environmental benefits and by integrating environmental opportunities into the project cycle wherever possible. The EPU draws on IFC resources and, when applicable, other sources such as the GEF. EPU projects, like all IFC projects, must be within the private sector, be technically sound, have good prospects for profitability, and benefit the local economy. The main sectors targeted by the EPU are biodiversity, climate change and greenhouse gas reduction, energy efficiency, technology development, pollution abatement, renewable energy, solid waste management, sustainable agriculture and forestry, sustainable tourism, water supply and wastewater treatment, and environmental investment fund development. The IFC office in Beijing has expressed a good deal of interest in carrying out environmentally-related projects and can assist investors in accessing the capacities of the EPU.

Enterprises seeking EPU assistance should submit applications via the IFC. There is no formal application process by which to do this. Both Chinese and U.S. companies can directly approach the IFC in Beijing or Washington, D.C. A preliminary review is required

Box 9. Opening Doors Through Co-financing and Concessional Funding

The initial outlay of funds by bilateral government organizations to assist development and environmental protection in China can generate contracting opportunities and financing for private investors. Most bilateral assistance is tied to contractors in the country of origin and helps facilitate the development of a market presence that over time may lead to further contracts. Bilateral spending can open channels by which to tie outside funding to contractors that are nationals of the bilateral's origin. In China, where relationships are of great importance, spending to enhance domestic initiatives (such as Canada's spending in support of the China Council for Sustainable Development) has built relationships that have created well-established inroads. Except for the United States, every major donor country engaging in development assistance throughout the world is active in China. The United States has several small-scale operations, such as the Trade and Development Agency (*www.tda.gov*); however, no U.S. program in China compares to the programs of such countries as Germany, Australia, Canada, and others in terms of scale, financial capacities, or overall impact.

Bilateral assistance agencies that co-finance operations with the World Bank and the ADB are essentially able to tie entire loan packages for technical assistance projects to consultants and technology providers from their own countries. Technical assistance projects through the ADB often draw grants in the neighborhood of $750,000. Bilateral assistance agencies can cover a portion of such loans in the form of a grant, equaling, for instance, $300,000. In doing so, the bilateral can take over procurement operations for the project and source equipment, consultation, and management training, entirely from its own country, in essence transforming the entire $750,000 (the $450,000 grant from the multilateral and the $300,000 grant from the bilateral) into tied financing. Bilaterals engaging in such co-financing operations have created contracting opportunities for private enterprises in their respective countries, generating revenues several times the outlay of the original grant.

The Canadian government has financed both the first and second five-year budgetary rounds of the China Council for Sustainable Development, each equaling investment of around $5 million. The China Council for Sustainable Development's purpose is to maintain high-level consultation on sustainable development between the Chinese government and representatives of governments, donor agencies, and multinational corporations. Through its significant financial and administrative involvement with the council, the Canadian government has provided a tremendous inroad for private Canadian firms. In this way, a country with a relatively small development budget has facilitated good will and private sector contracts for its national industries far exceeding its original investment.

before the IFC decides whether a full feasibility study will be carried out.

The IFC's Web site can be accessed at *www.ifc.org*, where it is possible to link to the EPU's site, *www.ifc.org/enviro/EPU/epu.htm*. In addition, the IFC's "China's Emerging Private Enterprises," the first comprehensive analytical study of China's emerging private sector, is available online at *www.ifc.org/publications/*.

Multilateral Investment Guarantee Agency

The Multilateral Investment Guarantee Agency (MIGA) encourages foreign direct investment in developing countries by furnishing investors with political risk insurance against such possibilities as transfer restriction, expropriation, contract breach, civil disturbance, and war. The agency also helps developing countries promote private investment opportunities through its Investment Marketing Service (IMS). As of late 2000, MIGA had 18 contracts of guarantee, with liabilities totaling $130 million, benefiting infrastructure and manufacturing in China.

Current IMS projects include capacity building for attracting foreign direct investment in Guizhou as well as collaboration with UNDP China and the World Bank's Foreign Investment Advisory Service to promote investment in the Tumen River region, a common border zone delineated for economic cooperation among Russia, North Korea, and northeastern China.

MIGA's Investment Marketing Service manages an on-line information service called IPAnet, which offers information on investment opportunities worldwide. Nearly 300 China-based individuals and organizations participate in IPAnet, and the Web site contains over 200 documents related to business and investment conditions and potential projects as well as links to national and subnational investment promotion agencies.

Applications and other details regarding MIGA are available online at *www.miga.org*, and IPAnet's Web address is *www.ipanet.net*.

United Nations Development Program

The programs of the United Nations Development Program (UNDP) in China are funded via UNDP core resources, the GEF, and the Montréal Protocol. Activities focus on sustainable energy development, air and water pollution, natural resource management, and environmental governance. UNDP activities in China can be monitored via UNDP-China's Web site (*www.unchina.org/undp/*). The site contains descriptions of past and current projects, with occasional brief descriptions of upcoming projects and calls for bidding. Specifics regarding these programs and the potential for business opportunities are generally not noted on the Web site and should be sought directly from UNDP or the implementing agency.

UNDP operational plans in China are laid out through the agency's country programs. CP4, also known as Country Cooperation Framework 1, was completed in 2000. The time is right for interested suppliers and consultants to begin interaction with UNDP and its various implementing agencies. SEPA, Agenda 21, and the China International Center for Economic and Technical Exchanges are UNDP implementation agencies (see Appendix B, China Contacts list).

UNDP's Web address is *www.undp.org*. China-specific UNDP information is available at *www.unchina.org/un/undp*.

United Nations Industrial Development Organization

The United Nations Industrial Development Organization (UNIDO) is a specialized UN program working for the development of sustainable and economically competitive industry in developing nations. Many of UNIDO's current operations in China have components that are directly or indirectly associated with environmental technology providers. Focuses include industrial pollution and waste management, cleaner production programs, the phasing out of ozone depleting substances, and institutional capacity building. Listings of current and past UNIDO programs in China are available online at *www.unchina.org/unido*.

UNIDO is implementing a recently approved GEF-funded UNDP program to improve industrial efficiency in China's town and village industrial enterprises. TVIEs are generally small-scale collective or privately owned enterprises. They are significant contributors to industrial output and local economies, but they slip through many environmental protection regulatory apparatuses and are thus major contributors to overall pollution discharge as well. The project, currently aimed at small-scale brick, coke, cement, and foundry industries, is in its second phase. After identifying and prioritizing the barriers to energy efficiency in the sector in phase 1 and phase 2 seeks to initiate a market transformation and strengthen regulatory capacities to govern clean development in the sector as it grows. Equipment procurement begins in 2002. Interested parties are encouraged to contact UNIDO and the Ministry of Agriculture (the Chinese government implementing agency) as soon as possible.

Registration information for involvement in UNIDO programs, as well as the weekly informational newsletter UNIDOscope, are available online at *www.unido.org*. Reviews of China-specific UNIDO projects are available at *www.unchina.org/unido*. Unfortunately, prospects for the direct participation of U.S. companies in UNIDO projects are uncertain, as the U.S. no longer directly supports UNIDO.

Global Environment Facility

The Global Environment Facility (GEF) is a grant and concessional funding source for environmental and economic growth projects with global implications. Activities focus on climate change, biodiversity, international waters, and stratospheric ozone. Projects are generally implemented through UNDP, the United Nations Environment Program (UNEP), and the World Bank; however, GEF is an independent international institution. GEF financing is intended to cover only the *incremental costs* of activities with environmental benefits. Incremental costs are calculated by comparing the costs of environmentally superior operations with the costs of similar projects undertaken without additional expenditures to benefit the environment. UNDP manages GEF technical assistance projects in China, and the World Bank manages GEF investment projects.

Project development funds (PDF) are also available through GEF for projects in the development phase that are expected to need partial GEF financing during implementation. Three PDF funding levels exist: PDF Block A grants, of no more than $25,000, are intended for initial pre-feasibility studies; PDF Block B grants, of no more than $350,000, fund specific project preparatory and feasibility studies; and PDF Block C grants, of no more than $1 million, can be used to fund detailed engineering design and complex technical and financial preparatory work. Matching funds from the sponsor are usually required for access to PDF.

For specific details on eligibility for GEF financing and documentation on pipeline processes, see the GEF Web site at *www.gefweb.org*.

Japan Bank for International Cooperation

In October 1999, Japan's Overseas Economic Cooperation Fund (OECF) and the Export-Import Bank of Japan (JEXIM) merged to form the Japan Bank for International Cooperation (JBIC). Previously the OECF was Japan's operative institution for extending Japanese donations, loans (including a considerable amount of untied loans), and technological cooperation to China. Under the JBIC, the operations that were previously within the jurisdiction of the OECF remain differentiated from those of JEXIM.

In fiscal year 1999, China was the second largest recipient of Japanese overseas development aid, receiving $1.22 billion in direct aid and soft loans. A considerable amount of those funds were spent on major infrastructure, such as airports, railways, and sewage treatment projects, yet of the 19 projects approved by the OECF itself, 14, or 74 percent, were related to environmental improvement, and 13, or 68 percent, were related to inland development. Unlike many bilateral aid programs, the Japanese program offers untied loans for infrastructure development and environmental protection, thereby opening the bidding for some JBIC-financed projects in China to non-Japanese contractors.

However, Japanese domestic pressures to overhaul its financial aid practices, an increasing perception that China's growing economy warrants a more independent approach to the country's development financing, and concerns over Chinese military spending may begin to affect the JBIC's overseas development aid to China and its availability to non-Japanese contractors. Japan's plans for future financial aid to China remain unclear. Loan programs are evaluated on a project-to-project basis, and loans are no longer provided in lump sums of five years at a time. It is also now unclear to what degree JBIC loans are tied to Japanese contractors. A Foreign Ministry spokesman did tell media sources that JBIC aid policy is shifting from major infrastructure development to poverty reduction, technical cooperation to assist human resource development, and environmental protection. Japanese financing for environmental protection may decrease overall.

The JBIC's Web address is *www.jbic.go.jp*. The OECF Web site is no longer available, but information pertaining to the OECF and its new manifestation is available via the JBIC site.

Export-Import Bank of the United States

For an overview of the Ex-Im's pertinent programs, see Chapter 10 or visit the Web site at *www.exim.gov*.

Selected References and Web Sites

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Wang Jinnan, Wu Shunze and Luo Hong. *Integrating Economic Development and Environmental Protection in China During the 10th Five-Year Plan Period*. Beijing: CRAES, November 2000.

Web Sites

Asian Development Bank:
www.adb.org

Asian Development Bank Business Opportunities:
www.adb.org/business/opportunities/default.asp

Asian Development Bank Country Assistance Plan:
www.adb.org/China/default.asp

Export-Import Bank of the United States:
www.exim.gov

Global Environment Facility:
www.gefweb.org

International Finance Corporation:
www.ifc.org

Japan Bank for International Cooperation:
www.jbic.go.jp

Multilateral Investment Guarantee Agency:
www.miga.org

United Nations Department of Public Information:
UN Development Business:
www.devbusiness.com

United Nations Development Program:
www.undp.org

United Nations Development Program, China:
www.unchina.org/un/undp.

United Nations Industrial Development Organization:
www.unido.org

U.S. Embassy, Beijing:
www.usembassy-china.org.cn

World Bank Group:
www.worldbank.org

World Bank Group in China:
www.worldbank.org.cn/English/home.asp

World Bank Monthly Operational Summary:
www.worldbank.org/html/opr/procure/MOS/contents.html

Chapter 10
Positioning U.S. Exporters in the Market

China's environmental market is highly competitive, somewhat restricted, unwieldy, and not easily understood. Accurate data illustrating demand and market size is scarce, problems are large in scale, and the intricacies of how to address problems efficiently are not well understood by the domestic players, making it difficult for outsiders to determine where their services are needed and how access can be achieved. As a result, making sweeping strategic statements on market entry is unrealistic. Market potential exists for service and technology providers and for consultants with the capacity to gain a deep understanding of needs in specific localities and facilitate solutions that are both economically and logistically feasible.

Market access for foreign companies is further limited in that market demand remains largely aid driven. For U.S. companies, this poses further complications. The severe shortage of bilateral assistance from the U.S. eliminates possibilities for tied financial aid and leaves only the resources of multilateral agencies and the Trade and Development Agency (TDA). As indicated throughout this document, regulatory pressures, as well as the aims of increasing efficiency and positive corporate image, are increasingly contributing to market demand, but they do remain (to varying degrees) limited instigators. At the same time, the bulk of domestically-sourced spending on environmental protection is aimed at domestic suppliers. This, too, is changing (albeit on a small scale), as Chinese buyers realize the long-term benefits of spending more money up front on better equipment as opposed to covering the maintenance costs needed to keep mediocre, locally-produced equipment up and running. Nonetheless, price remains a strong determinant factor for many purchasers.

U.S. exporters also must consider in which sectors they can be most competitive vis-à-vis the strengths of third-country and local competitors. U.S. versus third-country competitor advantages are discussed in some detail in each of the sector analysis chapters; however, it should be restated that, although U.S. technology in a number of sectors is considered superior or of high caliber, prices may remain prohibitive. One sector in which the United States does excel is monitoring equipment, and the inabilities of local producers coupled with increasing mandates for stricter monitoring may play out to the advantage of exporters in this sector. Generally speaking, certain sector strengths (such as the French domination of the water sector) and tied assistance programs constitute advantages for third-country competitors. Various benefits associated with local production account for a large part of local competitor advantage.

Entering the Chinese market requires due diligence and feasibility analyses. Even more important, it requires a willingness to take risks and determined perseverance. This approach of informed risk taking combined with a strategy of starting modestly and allowing natural business growth has been proven in the Chinese market. Many large companies have entered the market with a reasonable budget and, as a result of engaging the government at the wrong level (usually too high), positioning a high-cost expatriate, or hiring an inexperienced Chinese national, have failed and pulled out. Personnel issues also account for the failure of many overseas businesses in China.

The formula for success could in fact be quite simple. A midlevel Western manager with a proven business sense and a desire to prove himself or herself is often the best solution for in-country management in the startup phase. Contrary to conventional wisdom, overseas Chinese and experienced managers from other Asian countries (even Hong Kong and Taiwan) are rarely a better option. Although they may know the language, cultural differences between Hong Kong and the mainland and between Taiwan and the mainland can be as significant as those between the U.S. and the mainland, and while Western-looking American managers are allotted a margin of error by Chinese business partners, non-Chinese Asians and overseas Chinese who purport to have a flawless cultural sense are not. Chinese nationals who were trained in the U.S. and lived abroad for extended periods fall into the same category, while Chinese nationals who were trained in American institutions of higher education but have not worked in the U.S. lack the necessary business experience. While Western-educated Chinese constitute the best of the overseas hiring options, care should be taken to train and immerse them fully in corporate culture, and when transferred to China they should remain under the management of a midlevel corporate manager until they are fully trained. In sum, the best option is typically a for-

eign, mid-level team player who knows the business well and hungers to prove his or her capabilities. High-level corporate executives demanding large salaries and first-class living accommodations are not ideal. Startup managers need a couple of years' time to fully enter the market before achieving financial viability.

To assist in this process, or if local representation is required, a variety of private consulting and law firms are available for consultation, and a growing number of environmentally-specialized firms exist. If a long-term entry plan is not feasible for a U.S. company, then a local representative with a proven track record, which may be a Chinese or a Western company, may be engaged to market on behalf of the U.S. firm. Alternatively, a general representative office serving the interests of environmental industries toward a particular state business or sector may be established to promote the interests of its constituents in-country. Again, the management of such an office should follow a pattern similar to that described above. In all cases, broad-based consultations with the U.S. Embassy, the American Chamber of Commerce's environment, health, and safety forum, and other businesses should be undertaken to achieve the broadest possible perspective before decisions are made.

A number of countries offer bilateral aid and assistance programs to guide environmental protection development while generating investment opportunities for their nation's industries. Although the United States offers very little along these lines, monitoring other programs may help in pinpointing market opportunities that are tangentially related. (See Box 12 for further discussion of U.S.-China bilateral assistance.)

The U.S. and Foreign Commercial Service in China provides environmentally specific market analysis services, works to bring potential Chinese and U.S. partners together, and maintains an informative Web site *(www.usembassy-china.org.cn/english/commercial/index.html*) that contains links to a number of periodical briefs, resources, and statistics and to an introductory pamphlet guide to the Chinese market. The China Country Commercial Guide is available online at *www.usatrade.gov,* and further useful information can be found online at *www.buyusa.com*.

Monitoring the Market

Market Potential Versus Market Demand

Environmental conditions in China often lead investors to believe that opportunities in the environmental market are manifold and that increased legal and governmental pressures to improve the situation are causing even faster growth of market size. While these assessments are theoretically true, it is important to consider them in the context of market potential as opposed to market demand. A number of factors continue to prevent the market's potential from developing into demand. Several of these have been alluded to in other sections of this document; however, their importance cannot be overstated.

Market-Based Incentives. Fees and tariffs levied on services and resources in China still do not reflect their actual costs or values, making it difficult for service and resource providers to generate profits. Authorities have started to implement fees based on the costs of construction, operation, and maintenance of environmental infrastructure facilities and to establish new policies encouraging private investment. Yet, in many cases, these efforts do not constitute a real market approach and remain inefficient.

Enforcement of Legislation. China's environmental legislation has become quite complex and continues to grow more comprehensive. However, the ability to enforce this legislation and affect environmental protection in the localities varies considerably, primarily as a result of conflicts of interest, inadequate capacity and financial resources, and difficulties in locally interpreting and implementing national decrees.

Conflicts of Interest. Several conflicts of interest stymie environmental protection in China today. The primary conflict is between environmental protection and economic development. Officials and business leaders believe that environmental protection costs limit industrial profitability and development plans. A similar conflict of interest exists between various ministries and other administrative bodies within the central government, in which some of the more powerful ministries oriented toward economic and industry development trump the authority of SEPA in the overall implementation of development plans.

A third conflict of interest exists in the administrative structure that governs the local EPBs. EPBs receive their regulatory directives from SEPA at the national level. SEPA has little means to enforce the implementation of those directives. Meanwhile, local government administrations control the budget, personnel, and other administrative details of the EPBs, giving them a vested interest in following the policy objectives of the local government as opposed to those of SEPA. Thus, if national environmental initiatives inhibit local government initiatives, the local government has more leverage to impose its preferences.

Fourth, and most meaningful in terms of commercial interests, is the conflict within regulatory institutions, which usually have a "consulting" institute. Most EPBs are supported by a research institute that acts as both inspector and consultant. Because of this, the market for environmental services and technologies is distorted by the local monopolies of regulatory institutions. Where monopolies are seemingly neutralized, institutional corruption often fills the void.

National Decrees and Local Implementation. There is an old adage in China, "Here, where the heavens are high and the emperor is far away." That still rings true today. The EPB structure discussed above is only one of a number of issues that illustrate this. The ability to monitor local compliance with national standards effectively depends to a great degree on the local government's interest in complying. Similarly, the national government has trouble implementing local-level price, fee, and tax increases aimed at improving market-based incentives. Governments in some localities are apparently concerned that such increases affect industrial productivity and development and could stir social unrest.

Because of these factors, a regulation-driven market in China has yet to emerge, and the potential market remains more promising than actual market demand. In a number of instances, however, signs already exist that some of these factors are changing, particularly in the more progressive coastal areas. Optimistic speculation indicates that future changes will generally err toward the side of improved regulation, increased market demand, and increased liberalism. The timely establishment of a market presence is increasingly important. Nonetheless, it is critical to consider all factors and to assess the degree to which and the speed with which national policies are carried out within a given locality.

Regional Specificity

Because the factors addressed above vary considerably across the country and from locality to locality, it is critical that potential investors think not about the market as a whole but about the market climate of the particular region or locality in which they will be investing. Perhaps the most important aspect of regional specificity is overall development and the ability to finance environmental protection. As previously indicated, development in China has been skewed over the years, resulting in a tremendous gap. This gap continues to play out in the environmental sphere in two ways.

The more underdeveloped regions of the country suffer some of the most severe environmental degradation. Because production capacity, municipal and township infrastructure, and awareness regarding environmental protection all remain underdeveloped, degradation continues. Environmental needs in these areas are often basic but overwhelming in terms of scale. Additionally, these are often the areas that are most hard-pressed to finance their environmental protection.

More developed regions have more financial resources to invest in environmental protection. As a result of relatively rapid development, a higher profile, and a relatively high degree of public awareness and pressure, they have managed to build better environmental protection capacities in recent years. These areas are often more attractive for foreign investors and are able to sustain stronger environmental protection measures. As a result, China's gaps increase.

In researching the market and considering market-entry strategies, technology and service providers need to consider where their strengths most suitably fit local needs. An obvious initial conclusion could be that the more developed and wealthier regions offer the best market opportunities. However, it should be remembered that, as pressure increases upon local governments to improve fundamental environmental quality, they look to experienced and capable technology and service providers for efficient solutions needed to make improvements affordable. Technology and service providers with innovative products and management techniques, who can profitably exploit large market bases with relatively inexpensive solutions, find an increasingly warm market climate. In such cases, selling in quantity and offering money-saving or revenue-generating management techniques is the key to profitability.

Policies and Priorities

China clearly expounds its environmental development priorities through policy initiatives such as its Five Year Plans, Agenda 21, the Trans-century Green Engineering Program, and other programs intended to decree or urge action for environmental investment. These policy drivers are good indicators regarding central priorities and should be consulted by foreign investors while investigating the market; however, they should not be viewed as the only or the ideal path to market access.

Foreign exporters should remember that these central priority plans are just that: centralized policy regarding widespread and intricate local problems. As

indicated earlier in this chapter, central government commitment does not presuppose local government commitment, and any government commitment does not necessarily indicate commercial viability. Government assurances or state priorities are not a satisfactory substitute for standard due diligence. Furthermore, targeting the correct level of government decision-makers for information or permits is critical in order to reduce bureaucratic red tape and the risk of investment losses.

The Tenth Five Year Plan refers to the central economic development plan for the years 2001–2006 and in part refers directly to the environmental protection agenda during that period. Agenda 21 and the Transcentury Green Engineering Program are ongoing environmental development initiatives under the auspices of different and competing government ministries. The structures of these as well as other policies and priorities are outlined in Chapter 3, and contact information provided in the China Contacts list in Appendix B indicates channels for monitoring the most up-to-date developments in regard to these initiatives.

As previously noted, laws and enforcement trends are also key indicators that should be considered by investors.

Environmental Protection Bureaus

It is often stated that the best way to learn about local environmental needs is to contact the local Environmental Protection Bureaus (EPBs). EPBs are a primary inroad for assessing environmental stresses and thereby understanding protection and abatement demands. In theory, EPBs should have up-to-date statistics and indicators categorized by industrial sector on hand and should be knowledgeable about the specific needs of polluting industries under their jurisdiction.

However, it is often the case that EPBs themselves, particularly those in the more backward and environmentally stressed regions, are as much in the dark about how to address local environmental problems effectively and efficiently as everyone else in China. Simply calling various EPBs and inquiring about local needs will yield few specifics of interest. The reply will often constitute an indication that all sectors are lacking and that there is a need to address all of the most basic pollutants. (Additionally, the EPBs often indicate that only affordable, even cheap, solutions are viable, as finances are tight and the scale of the issues quite large.)

This lack of clarity on the part of the EPBs opens yet another market opportunity to highly motivated and entrepreneurial environmental market analysts and consultants who can personally visit locales and gather firsthand insight into regional needs. By becoming well acquainted with the intricacies of issues within the jurisdictions of particular EPBs, such consultants can offer insights to the EPBs regarding efficient abatement schemes and can offer market-entry consulting for technology and service providers. (See the section on monitoring and consulting for market entry later in this chapter.)

Many EPBs maintain Web sites (of varying quality and usefulness) and have departments specifically oriented to working with international contacts. The China Contacts list in Appendix B contains updated contact information for EPBs. Where possible, the names and contact information of those members of each EPB who focus specifically on business affairs dealing with international parties and who can speak English have been provided.

Other Government Agencies

EPBs represent the first line of inquiry regarding environmental conditions and needs in an area. Agencies such as local economic and trade bureaus, planning bureaus, and bureaus of foreign trade and economic cooperation are often more knowledgeable and focused on servicing business needs. In many cases, local-level branches of these agencies outside the more developed regions may be unable to respond to international inquiries. In such cases, the next level (possibly the provincial level) of government must be consulted. Unless an extremely large investment is being considered, contact with national-level agencies is unnecessary and often inefficient.

For an overview of the various roles played by individual government agencies in the project cycle, see the section on market-entry procedures later in this chapter, as well as Chapter 3.

Special Zones and Industrial Parks

Special economic zones and industrial parks provide another channel for gaining insight into environmental protection needs. Administrators within the zones and parks may be interested in addressing the environmental needs of the zone as a whole (for example, through a common waste management facility), and many administrators have insights into the particular needs of the entities operating under their jurisdiction. (A list containing contact information for most Chinese development zones has been provided at the end of this document as Appendix F.)

Box 10. China's Bonded Zones

Business operations in China's 16 bonded zones (see the map in Appendix A) operate under the most liberalized albeit least clearly delineated regulations in the country. Originally conceptualized as extraterritorial export reprocessing zones where foreign manufacturers could establish operations and employ Chinese labor without being subject to various taxes, the zones have developed into leniently regulated trading hubs facilitating various operations, some of unclear legality. Extraterritoriality allows foreign investors to avoid certain regulations, quotas, foreign exchange issues, and taxes that hinder foreign investors operating elsewhere, and trends indicate that leniency in the zones is increasing.

As a result of regulatory leniency with regard to national policy enforcement, foreign investors operating in the zones can increasingly circumvent restrictions to facilitate their commercial operations in China. Among various creative arrangements, companies inside bonded zones have been established to administer sales and marketing outside of the zones (which is not intended under the preferential tax and incentive policies available only to operators within the zones), retailers have arranged to provide after-sales services (a sector currently reserved for Chinese operators and JVs), and foreign investors have even become involved in domestic trading. However, each bonded zone operates under its own set of rules, and what is possible in one zone may not be possible in another. Investors considering operating out of a bonded zone should fully understand the intricacies of each zone before determining which best suits their needs.

Service providers doing laboratory work for environmental analysis might consider establishing operations in a bonded zone. Customs and fixed asset investment taxes, which are normally levied on facilities and equipment brought into the PRC when establishing such an operation, are waived inside the zone. The service provider could then partner with a Chinese laboratory holding a Class A license (required to approve and validate samples tested) and offer services to clients throughout the mainland. A number of laboratories have already established such arrangements and are operating successfully.

The potential for foreign environmental industries to exploit the possibilities afforded by the bonded zones is broad; however, pushing the outer limits of the law runs risks. With the assistance of competent lawyers experienced in the operations of bonded zones, foreign investors can get quite creative and remain safely within the ambiguous bounds of the law. Those who wish to push those bounds should seek reliable counsel in determining the benefits and potential costs of doing so. As liberalizations associated with WTO entry increase market accessibility, the benefits of operating in bonded zones are dissipating, as the regulatory leniency currently governing the zones is reined in.

Additionally, there are parks specializing in environmental industries (such as the Yixing Environmental Industry Park), acid rain and SO_2 emissions control zones, and priority regions, rivers, and lakes and "key" cities, all of which can offer insights into what technology and services are needed, and where.

Market Entry

Market-Entry Vehicles

There are essentially three general methods by which to enter the Chinese market, each with its own positive and negative aspects. Potential vendors must assess which market-entry strategy is best suited to their needs based on what services or technologies they provide, who their potential customers are, their financial constraints, and their various strengths and weaknesses. Investors should also be certain to understand the inherent benefits and complications of each market-entry method. Choosing one over another often constitutes exchanging one set of complications for another (see Table 10.1).

Local Presence. Foreign investors hoping to provide equipment, component parts, consulting, contracting, or engineering services should consider establishing a presence in China. Establishing a local presence, either through a JV with a Chinese company or through a WFOE offers a number of advantages:

- Due to high import tariffs and reduced labor and raw material costs in-country, local foreign-invested operations can provide goods at a lower cost than competitors that are importing foreign-produced goods into China.
- Local foreign-invested operations can take advantage of the above-mentioned points and benefit from the local perception that American-made environmental protection products (including those produced in China under the supervision of a Western company) are of a consistently higher caliber than wholly Chinese-produced goods.
- Companies with a local presence can accept payment in renminbi, important because foreign currency is tightly controlled and domestic companies and government organizations are often hard-pressed to pay in U.S. dollars.

- A local presence facilitates the development of personal relationship networks, which are vital for successful business operations in China. Ideal local partners have a relatively strong, established network.
- China's regulatory environment is lacking in transparency. Although this is changing since WTO entry, a reliable and capable local partner well versed in the daily procedures of Chinese business is invaluable.
- Chinese customs procedures are notoriously opaque and troublesome. Local producers that can minimize reliance on imported goods are able to reduce those complications.

It is to be noted that, in addition to the above-mentioned advantages, establishing a local presence may generate difficulties:

- Locating and partnering with competent, trustworthy, and commercially viable Chinese counterparts can be difficult. Protecting intellectual property is a very real challenge, financial disclosure regulations for enterprises are minimal, bookkeeping is often creative, and potential partners are known to present themselves deceptively.
- Investors have reported complications as a result of conflicting interests between JV partners. Chinese counterparts have sometimes been described as unreliable in the long term and competitors in the short term. Furthermore, due to financial pressures, the local partner often views the overseas partner, not the success of the project, as the source of income.
- Drafting the JV contract can be a trying experience, yet the frustrations may pale in comparison with the difficulties involved in seeing that the contract is honored in its entirety.
- The opaque legal system previously discussed can also create difficulties for foreign JV partners. The lack of a rule of law makes contract disputes and other partner-related affairs difficult to manage, often leaving the foreign investor at a disadvantage.
- Establishing a WFOE as opposed to a JV can alleviate some of the above issues, and with regulations easing, the establishment of a WFOE is becoming an increasingly popular option. However, WFOEs must make up for the relationship network gap that is not filled by a Chinese partner, making the recruiting of very capable and experienced local players requisite if the foreign players lack their own network.
- In the past, foreign-invested companies have been urged to focus on producing for export unless they are bringing technologically-advanced production methods or products into the country. Priorities and policies are constantly changing, but it remains difficult to predict what might be expected of foreign-invested enterprises operating in various parts of the country.

Cross-Border Entry. Some investors considering the establishment of a local presence may be able to achieve their goals via cross-border entry. Others may want to enter the market initially through cross-border entry with the intention of establishing a local presence over time.

Technology and equipment providers can export directly to China, but they face high import tariffs, making it difficult to offer competitive pricing. Additionally, current industrial reform policies are aimed at developing domestic production capacities, placing exporters at a disadvantage. Such an approach does, however, open exporters up to certain preferential treatment by the Ex-Im (see the section in this chapter that discusses U.S. government programs facilitating environmental exports to China, on page 90) and eliminates the necessity of establishing a corporate body in the country. Nonetheless, a local representative office, local partner, or hired representative remains necessary to maintain a market presence. For those uninterested in establishing an office or partnership in China, an increasing number of market analysts and representatives are available. The well-established players in this field have a strong understanding of the China business climate, the ins and outs of day-to-day business, and pre-established relationship networks.

An option that is increasingly being considered by overseas investors is the establishment of a base in one of the coastal bonded zones in China. These areas are designed for importation of parts for assembly and re-export without the encumbrance of duties and taxes. The benefits provided by this mechanism are that while a physical presence is established in China, in effect all activities are technically "cross-border." If the legal mechanisms for such a presence are properly understood (with the assistance of an experienced law firm) and properly utilized, significant operational flexibility and access can be achieved. (See Box 10.)

Chinese procurement agencies work to bring buyers and suppliers together. Traditionally these agencies, particularly those carrying out government procurement, have targeted domestic producers or unscrupulous agents of foreign companies (a strategy that may create difficulties for U.S. companies with regard to the Corrupt Foreign Practices Act). Although this entry

method is still somewhat tight, insiders have noted that, as a slowly increasing number of domestic contracts are being opened to unrestricted bidding, opportunities are increasing for foreign producers offering unique products at competitive prices.

Foreign providers are also allowed to offer consulting services via cross-border delivery. All other service providers must operate in China or through a local partner. Any foreign service provider requiring official approval at any stage of project execution needs a local partner. Some areas of activity, such as undertaking EIAs or providing engineering services, are severely restricted and require collaboration with a properly licensed local agency. To carry out baseline studies, EIAs, sample analysis, or other services in which final reports or designs require official approval, a foreign provider must establish either a permanent local presence or a contractual JV. Contractual JVs may be established for a prescribed period of time or may be project specific.

Foreign investors might also consider the direct needs of multinational and other large foreign enterprises operating in China. Such enterprises generally seek to outsource procedures that are not considered profit generating; however, they often have difficulty finding local service providers that can manage these procedures in accordance with their relatively strict internal standards.

Multilateral and Untied Bilateral Projects. Entering the Chinese market via multilaterally funded and untied bilaterally funded projects remains one of the

Table 10.1 Advantages and Disadvantages of Various Market-Entry Vehicles

Vehicle	*Advantages*	*Disadvantages*
Local production	Can accept payment in renminbi. Can (possibly) compete better on cost. Proximity to end user allows faster delivery time and other such benefits. Offers many options for manufacturing.	Requires investment. Could require higher operating costs. Presents potential dangers in technology transfer.
JV	Partner may provide some benefits. May make it easier to get investment approval.	Loss of technology is possible. Must run business with partner. Involves more difficult exit strategy.
WFOE	Lack of partner allows a free hand in the market.	No partner is available for assistance.
Direct imports	Technology is easier to protect. Costs lower all around. Poses less risk and exit strategy is easier.	Cannot accept payment in renminbi. May face import restrictions. Products will likely cost more.
Representative office	Offers cost-effective market entry. Can understand market better before setting up production.	Unlike other direct import options, involves operating costs for China presence.
Agents/distributor	Can be very useful for broad footprint of end users. Can provide service.	Poses dangers of losing control of marketing. Does not cover all products.
Franchise	In-country presence is not needed.	Poses risk of technology theft. Monitoring and controlling are very difficult. Little recourse is available in disputes.
Direct sales (no distributor or representative)	In-country presence is not needed.	Presents operational difficulties. Covers only products with small end user footprint.

Source: U.S. Department of Commerce, International Trade Administration, *Partnering in China's Environmental Sector* (Washington, DC: U.S. Department of Commerce, 2001). Available online at *www.ita.doc.gov/media/publications.html*.

most secure methods. These projects have available hard currency, undergo lengthy feasibility assessments, and are subject to the internal policies and standards of the implementing agency. Although bidding for some Chinese government-funded projects is opening up to foreign contractors, multilateral and untied bilateral projects have the further advantage of employing reasonably transparent and competitive bidding procedures.

Bidding for multilateral projects, however, is highly competitive and remains a difficult task for inexperienced vendors. Potential bidders that have no experience in tendering a multilateral project are best advised to work cooperatively with one that does. It is also necessary to monitor the development of projects from the earliest possible stage. Most competitors are usually quite well positioned for the bidding process long before the call for bids is issued.

The barriers to untied bilateral projects are similar to those mentioned above, but they are compounded by the scarcity of such projects. Essentially, the only consistent untied bilateral aid donor to China that has significant operations in this sector is Japan's JBIC (formerly the OECF; see Chapter 9). However, the country's overall aid to China may yet decrease, as pressure in Japan to review its China aid program has been mounting.

Most other bilateral aid programs of significance are tied to contractors within the country from which the aid stems. Tied bilateral aid has in fact helped many companies establish a very strong presence in China. U.S. companies complain they are at a decided disadvantage resulting from a lack of tied bilateral aid from the U.S. government (see Box 12).

Public Private Partnerships and Build-Operate-Transfer Projects

Several large foreign companies have entered the Chinese environmental infrastructure market via models known as public private partnerships (PPPs) and build-operate-transfer (BOT) projects. Currently, most of these projects take the form of BOT and are water-management oriented. Although PPPs are less commonly seen in China, the possibilities for them also exist, and at least one clear example of a successfully initiated PPP is known. Official press coverage of infrastructure projects being developed through these models has been positive and outspoken, and insiders have indicated that the official sphere looks on them with increasing favor. As other infrastructure markets open up in China, these models, while challenging to implement, may grow in importance.

A BOT project differs from a PPP project in that, although it does constitute a relationship between the client (the public entity) and the supplier (the private entity), it is not a partnership in which the players cooperatively invest in and operate a facility. Rather, the building and operation of a facility in a BOT project is 100 percent funded and owned by the private investor prior to its transfer to the public entity at a pre-determined time. In contrast, a PPP project is a partnership in which both the public and private entities make equity investments in a facility, each maintaining a percentage of ownership. It is possible for a BOT facility to be included as part of a larger PPP project in which part of the private entity's agreement is to build a facility that is to be transferred at a pre-determined time in the future.

The current number of BOT and PPP projects in China amounts to little more than a handful.

BOT Projects in China. Currently, BOT projects in China are limited to the building, operation, and transfer of facilities whose specifications are defined by government planners prior to contracting the foreign investors. This approach limits the capacity of the contractor to develop a comprehensive service infrastructure and fails to take advantage of foreign expertise and know-how, thus affecting overall efficiency. Concession agreements, in which a firm is contracted to develop a comprehensive system to service a given geographical area in its entirety, are preferred by foreign investors because such agreements afford them the flexibility to develop an efficient system suited to the greater needs of the locality. Currently, contractors are rarely consulted in the planning of such projects, and product distribution, pricing, and billing remain under the control of the local government. Industry insiders have indicated that local governments are beginning to recognize the decreased efficiency resulting from these constraints, and they appear optimistic regarding the potential for more comprehensive BOT agreements in the future.

Many of the foreign BOT operations in China have been funded through official aid programs, helping the involved firms to develop a strong market presence. Tied bilateral aid has been a significant contributor, but the ADB is also a strong proponent of the BOT model. The tied bilateral aid option is not available to U.S. companies; however, the potential markets are far from saturated in China. Companies seeking to enter them are well advised to establish a market presence sooner rather than later.

A number of domestically-generated BOTs were announced in the first half of 2001, indicating further

acceptance of the model by both Chinese authorities and Chinese enterprises. Several proposed projects are quite large in scale; however, it is not at all clear what opportunities they might hold for foreign vendors.

PPPs in China. PPPs are less commonly seen in China than BOTs. They have considerable potential to become important. In one instance of a true PPP in China, a subsidiary of a large multinational entered into what is essentially a JV with a state-owned municipal facility. The public entity contributed its previous facility for a lesser stake in the company, while the multinational subsidiary agreed to build, operate, and transfer additional facilities, establish sound management, and train local hires. Contract negotiations included agreements with the local government regarding pricing structures that the private entity deemed sufficient. The public entity viewed the training (including training modules based in the U.S.) and positioning of locally hired high-level managers as beneficial to the socioeconomic development of the locality.

The managing director of the private entity conceded that this operation has been fortunate in that the public sector partner is progressively oriented and willing to compromise. Additionally, the project is located in a relatively affluent region, thereby facilitating pricing structures that are sustainable. The director also explained that such a project would not have been possible at this time without funding from the parent multinational. The project is expected, however, to function as an influential pilot program that will attract other local government leaders in search of similar arrangements, and it has afforded the foreign investor a market presence without the assistance of any outside funding. As is the case in any partnering scheme in China, the compatibility of PPP partners and their goals is critical to success.

Potential Complications and Requisite Precautions

Whether foreign investors choose to enter the market via JV, WFOE, cross-border entry, or any of the various other methods, a number of potential complications exist. China remains a country with an underdeveloped rule of law, and investors have been victims of robbery, embezzlement, IPR infractions, and similar issues with little or no recourse to the law. Nearly all entry methods require some degree of partnering or interaction with local entities. Each method should be carefully screened and well understood.

Below is a list of some of the most commonly encountered complications to watch for. It is not, however, exhaustive, and investors considering entering the Chinese market are strongly urged to consult experts in the field.

- Partnering in China can be confusing. Expectations must be very clearly communicated and understood. The most common issue that arises is that overseas investors do not understand their partners well and do not nurture a trusting relationship over time. The agreements reached need to be simply stated and put in writing regardless of the goodwill that may exist in early negotiations. Seeking out progressively-oriented partners that have worked with foreign investors before or that have worked overseas is ideal.
- Delinquent payment for goods and services is a serious problem faced by both exporters without an in-country presence and locally operating firms. It is

Box 11. Protecting Intellectual Property Rights in China

Intellectual property rights violations are a fact of life in the Chinese marketplace. Foreign investors of all types and sizes, from single-person operations to multinational conglomerates, are subject to the possibility of IPR infringement. Unfortunately, breakdowns in the rule of law, the pervasiveness of the issue, and the ingenuity of the perpetrators make it difficult for companies to protect themselves completely. Some enterprises accept IPR infringements as a cost of doing business in China; however, those that cannot afford that cost should seriously consider whether potential successes in the Chinese market justify the risks.

Environmental equipment providers producing technologically unsophisticated yet innovative equipment must be cautious. Enterprising Chinese can easily reverse-engineer such products and flood the market with cheap copies. One market consultant with years of experience in the China marketplace insists that the best method to prevent such a scenario is to network an awareness of a particular product heavily, making clear to end users, local officials, and other producers its origin and rightful owner, and then to establish the necessary relationships to ensure its protection. Other companies invest large sums in contracting firms to manage IPR issues, some becoming deeply involved in local politics. Ongoing efforts to dismantle vast production and distribution networks of pirated goods, upon which entire local economies are based, continue in China today and will likely continue for some time.

advisable to seek out creative means by which to ensure delivery of payment.

- Regulations governing business practices in-country can be restrictive and can vary from place to place. As an example, companies operating in the Suzhou Industrial Zone are required to hire only local Suzhou residents unless the employee is a university graduate. Some firms operating in the zone have expressed dissatisfaction with the restricted labor pool while competitors operating in a nearby zone are not hindered by such restrictions. Investors establishing operations in-country are advised to understand not only the intricacies of local policies where they will invest but the likelihood that those policies will remain consistent in the future.
- Intellectual property rights are constantly infringed upon in China, resulting from a weak rule of law, enforcement difficulties, and a local failure to understand the importance of personal property rights as they apply to intellectual property. This problem continues to frustrate even the most seasoned investors in China. Those without creative means to protect themselves are advised to consider the costs of potential IPR infringements seriously and to determine whether the benefits of market entry justify the risk. (See Box 11 on page 88.)
- Corruption in China is an unavoidable fact. Many investors have encountered situations in which progress cannot be made without delivery of "gifts," "favors," or expensive dinners. Some operations have been held up due to the absence of "suitable transportation," such as four-wheel-drive vehicles or new sedans. Few investors in China can honestly claim never to have encountered one type of corruption or another. Some try to fight or avoid it, while others accept varying degrees of it as a cost of doing business.

Market-Entry Procedures

Contracting in the Chinese market is best facilitated through a "bottom-up" approach, meaning that U.S. investors and suppliers should establish preliminary contact with local purchasers, partners, or government bodies as opposed to national-level ministries. Provincial- or municipal-level government offices directly or indirectly involved in potential projects are ideal places to begin. If possibilities for a project materialize, such partners are instrumental in facilitating various permitting processes and obtaining necessary authorization; foreign investors should take advantage of local partners' capacities to do so.

- For industrial pollution control projects, local EPBs are the primary contact point (generally via a well-established consultant or market representative). Despite the lack of overall clarity alluded to earlier, EPBs are well situated to report on the state of affairs for individual point sources of pollution within their jurisdictions, and interaction with them is almost always requisite in one manner or another. SEPA is not involved in the implementation of such upgrade projects; however, national level approval from SEPA, SETC and SDPC is needed if overall expenditure exceeds a certain amount. The dollar level at which national-level authorization is needed varies among provinces and municipalities.
- For municipal water, wastewater, and solid waste management projects, the Ministry of Construction and local construction bureaus are the primary contact points. The ministry may be useful in directing investors to local construction bureaus, through which project implementation is conducted. The Ministry of Construction should also be consulted as project plans materialize to verify that all national requirements are met throughout implementation.
- For facilitation of partnerships with equipment producers, investors should seek advice from private consulting firms, the U.S. and Foreign Commercial Service in Beijing, and EPBs at various levels.
- For facilitation of the sale of equipment, whether it consists of cross-border sales or sales of domestically produced JV or WFOE equipment, providers should proactively monitor the interactions of potential buyers with the Ministry of Finance, various-level development and planning commissions, and various-level economic and trade commissions. Projects that are preparing to procure equipment go through a series of approvals with each of these government bodies, and may apply for financing, before publicly announcing a call for bids. In reality, however, arrangements for procurement are likely to be firm before the call for bids is made. The best way to secure a contract is to interact cooperatively with project facilitators as they move through the bureaucratic processes and establish a solid working relationship. Those equipment providers lacking the capacity to do this should hire a consulting firm or market representative to do it for them.

The Approval Process

The approval process for environmental and infrastructure projects in China is confusing and relatively opaque. All projects require approval at some level

(state, provincial, or municipal) by SDPC, SETC or MOFTEC, as well as EIA approvals from SEPA. The required administrative level of approval is based upon the investment size of the project:

- Investment of less than RMB 30 million ($3.6 million) requires approval at the municipal level.
- Investment of RMB 30 million to RMB 200 million ($24.1 million) requires approval at the provincial level.
- Investment of over RMB 200 million requires approval by SDPC or SETC and the State Council.

In some cases, coastal special economic zones and some municipalities have increased discretion when approving projects with investments of up to RMB 200 million. Ministries or bureaus that are directly sponsoring a particular project also have a considerable say in approval processes regarding that project. EPB approval is necessary for all projects, and national-level SEPA approval is required for projects with investments of more than RMB 200 million, transprovincial projects, projects with potential for causing transprovincial pollution, nuclear facility projects, and projects that involve a degree of state secrecy or state security concerns.

The approval process—which can take from 12 to 24 months, contingent upon project complexity, financial sourcing, and requisite approvals—generally proceeds as follows:

1. Project proposal and pre-feasibility study
2. Review meeting of all associated local officials
3. Initial approval by the appropriate-level planning commission, trade commission, or finance bureau
4. Completion of feasibility study and EIA
5. Second review meeting of all associated local officials
6. Feasibility study approval
7. Project implementation

For a detailed discussion of the approval process, as well as of project financing, see the U.S. and Foreign Commercial Service's *Environmental Project Approval and Financing in China: A Perspective for U.S. Companies*.

For up-to-date information on customs regulations and procedures, import documentation, finance regulations, economic and market information, laws and procedures for licensing and investment, and U.S. government regulations and restrictions, see the China—Country Information section of the U.S. Department of Commerce's International Trade Administration Web site (*www.trade.gov/td/tic/*) and consult the U.S. Embassy's *Country Commercial Guide* available online at *www.usatrade.gov*.

The following three documents published by the General Customs Administration of the PRC provide comprehensive information on Chinese customs regulations:

1. *The Practical Handbook for Custom Clearance* (March 2002; price: RMB 240; includes CD; Chinese only)
2. *Customs Import and Export Tariff of the People's Republic of China* (December 2001; price: RMB 220; Chinese and English)
3. *Administrative Measures for Tariff and Import/Export Trade* (February 2002; price: RMB 240; Chinese only)

All three books are issued yearly. They can be purchased from the General Customs Administration Bookshop, No. 6 Jiannei Dajie, Dongcheng District, Beijing 100730; tel. +86 (10) 6519-4173.

Facilitating Market Entry

U.S. Government Programs Facilitating Environmental Exports to China

There are several U.S. government programs that specifically support environmental exports to China. The U.S. Ex-Im offers several applicable programs. In addition, the U.S. and Foreign Commercial Service in Beijing assists exporters and facilitates ad hoc arrangements with other federal- and state-level government agencies.

The Export-Import Bank of the United States. The Ex-Im has a number of non-environmentally specific short-, medium-, and long-term programs to support U.S. exports to China. Spare parts, raw materials, quasi-capital goods, consumer goods, and bulk agricultural commodities can be supported by the bank's short-term credit insurance policies, while capital goods and related services can be supported by medium- and long-term loan and guarantee programs.

Operational agreements between the Ex-Im and both the Bank of China and the CDB are in place. Several other banks can and do work with Ex-Im, and loans to other entities are considered provided they meet all necessary standards to the satisfaction of the Ex-Im and PRC law. Prior to October 2000, Ex-Im lending and finance relationships were mainly restricted to government entities. The bank now allows U.S. exporters and

Chinese buyers of U.S. goods to apply for financing of private sector transactions.

The Ex-Im's Environmental Exports Program supports exporters of applicable goods and services as well as exporters involved in foreign environmental projects. The program includes the following elements:

- A short-term environmental export insurance policy for small businesses, which offers as much as 95 percent commercial coverage and 100 percent political coverage with no deductible.
- Enhanced medium- and long-term support for environmental projects, products, and services, including local cost coverage equaling 15 percent of U.S. contract price, capitalization of interest during construction, and maximum repayment terms allowed under OECD guidelines.

Foreign currency-denominated debt through the Ex-Im's medium- and long-term programs requires Chinese government approval, and final Ex-Im approval is contingent upon proper documentation indicating that this approval has been granted. The Ex-Im Web site (*www.exim.gov*) contains all pertinent details, as well as standards for environmental qualifications.

In March 1999, the Ex-Im, the U.S. Department of Energy, and the CDB signed a memorandum of understanding to initiate a $100 million clean energy program. Under the memorandum, the Department of Energy and Ex-Im encourage U.S. private industry to work cooperatively with Chinese planners in identifying, assessing, and implementing projects by which to showcase cost-effective and environmentally sound energy technologies. The terms associated with this fund are the most favorable that Ex-Im offers; however, it remains unused because local purchasers believe that the interest rates are too high.

Environmental Technologies Industries Office. The U.S. Department of Commerce's Environmental Technologies Industries (ETI) Office provides U.S. environmental technology enterprises with valuable resources and contact information pertinent to environmental markets around the world. ETI works collaboratively with the U.S. and Foreign Commercial Service in Beijing and other public and private organizations to monitor the market and to assist U.S. enterprises in market entry.

The ETI Office's China-specific resources are available online at *www.environment.ita.doc.gov*. The U.S. Department of Commerce's International Trade Administration offers assistance on more general aspects of trade. Information is available online at *www.trade.gov/td/tic/*.

U.S. Trade and Development Agency. In mid-January 2001, President Clinton lifted the suspension of TDA activities in China. TDA programs had been suspended in 1990 in line with the legislative reaction to the Tiananmen incident of 1989. The legislation permits the president to terminate the suspension if doing so is determined to be in the interests of the United States.

The TDA is an independent government agency charged with promoting U.S. private sector participation in projects based in developing and middle-income countries. The agency supports market development with pre-feasibility studies, orientation visits, training programs, and technical symposia focused on helping U.S. firms enter new markets. Prior to its suspension in 1990, the TDA committed approximately $24 million to projects in China. Over $1.4 billion in U.S. exports have been associated with those projects. Environmental protection is a focus for TDA in China. Information about TDA projects and activities is available at *www.tda.gov.*

Monitoring and Consulting for Market Entry

Several consulting firms in China monitor market-entry potential and specialize in bringing technology and service providers together with clients. However, the consulting sector is not saturated, and given the potential for growth, an increasing number of knowledgeable, experienced, and innovative specialists are needed. Consulting firms can select from several specialized approaches as follows.

Monitoring Multilateral Opportunities for Small Manufacturers. As noted earlier, bidding for multilateral projects can be difficult, particularly for small manufacturers and companies with little experience in tendering for such projects. Part of the difficulty stems from the necessity to monitor projects and prepare to bid from the very earliest assessment stages of project development. Keeping close watch over all the opportunities can be difficult, particularly for small operations watching for opportunities in more than one country. Another difficulty stems from the logistical challenge of bidding successfully, something not easily overcome by small companies with no experience tendering for multilateral projects.

Small foreign manufacturers could benefit from the presence of a small manufacturers' association or private consultants that would simultaneously monitor multilateral project development and the capabilities

Box 12. Market Development and Bilateral Assistance

Of all officially assisted environmental exports to China, approximately 60 percent are from Japan, 35 percent from Germany, and less than 1 percent from the United States. Industries from countries with strong bilateral aid programs to China are quickly establishing significant market presence by capitalizing on opportunities generated by publicly funded development assistance programs.

Most end users of environmental technology and services in China have a tremendous need for guidance and consulting regarding equipment manufacture and procurement, as well as general planning and management. Bilateral assistance programs providing this guidance often lead to opportunities for numerous types of contracts.

The U.S. Agency for International Development (USAID) remains inoperative in China. Economic support funds cannot be used in China without specific legislation waiving sanctions imposed after the Tiananmen incident of 1989. Occasional sums of money from the Department of Energy or the EPA are available to facilitate bilateral assistance. The recent reintroduction of the U.S. Trade Development Agency into China is a positive first step in addressing this issue.

of small manufacturers bidding for such projects. The consultants might not only work to match potential clients with business opportunities but also assist in the bidding process for those manufacturers lacking the experience to manage the bid on their own successfully.

Local Assessments and Partner Facilitation. Given many EPBs' lack of clarity in assessing overall local environmental needs and efficient strategies to address them, ambitious and savvy consultants may find success by proactively approaching EPBs, comprehensively assessing the regional situation, and facilitating the implementation of environmental protection plans that can deliver the greatest impact possible, based on budgetary and social constraints. Such players would have the dual function of consulting for EPBs on the best overall abatement strategies and bringing appropriate technology and service providers into contact with the appropriate EPBs.

Consultants interested in such a scenario should look to various BOT and PPP projects currently existing in China as operational models, draw lessons from successful and unsuccessful implementation schemes, and consider undertaking pilot projects to illustrate their potential to local officials. Consideration should be given to which environmental issues in the region can be most effectively addressed for the lowest possible abatement costs. Efforts should be made to draw funding from diverse sources while simultaneously working to exploit opportunities presented by various programs (such as UNIDO's program to address the issues of town and village enterprises).

Consortium Development. Foreign investors might want to consider addressing potential projects through a consortium scenario. A consortium would ideally bring together planners, designers, engineers, managers, and financial support. Some European groups are currently experimenting with this model, with some degree of success. In effect, a consortium able to address issues within smaller cities travels to the cities (in the form of a traveling exhibition) and—through consultations and demonstrations—provides cost effective modular solutions, which include technology inputs as well as management tools.

Creating and Maintaining a Market Presence

Many foreign-invested environmental industries in China currently operate with small profit margins. Their initial purpose is to establish market presence and name recognition that facilitates future market expansion rather than to reap immediate profits. Creating and maintaining a market presence in China now could be vital to future success; however, it requires more than innovative products and a solid marketing plan. Firms without reasonable budgets, innovative personnel, patience, and solid relationships are unlikely to succeed.

Timing Market Entry

Establishing a market presence sooner rather than later is important for several reasons:

- Many large firms already maintain strong market presence in several sectors. Some claim to hold as much as 50 percent of market share in their respective sectors. Name recognition is important in the Chinese market, and a select few are well established. Few markets are saturated, and opportunities arise for those well positioned to exploit them.

- Those hoping to introduce relatively innovative methodologies and technologies need to prove their feasibility to convince local planners and enterprises of their worth. Pilot projects can be useful in doing this; however, it takes considerable time and effort to establish a sound operation. Having a strong pilot program in operation may be invaluable as the market continues to open and planners begin looking for the most effective and efficient methodologies to address particular issues. However, attempts to introduce unproven technologies into China are not usually welcome.
- Understanding the market and key relationships is critical to success in China. As in most business climates, personal relationships and networks can open doors that otherwise would remain closed. However, in China, relationships are arguably more important than in other markets. It takes time to develop the connections and trust that good relationships are based on. As market opportunities increase in the near- to medium-term future, those most able to capitalize on the opportunities will be companies that have established a presence and have the proper connections to exploit them. It must be clearly understood, however, that relationships do not necessarily need to be with powerful national figures or those who claim to be such figures. Rather, through proper research, government functionaries who are reliable decision-makers can be found. Such relationships need to be nurtured and used gently.
- Chinese guanxi (relationships) can be stronger than foreign guanxi, regardless of the quality of particular operations and products. Chinese companies with little or no experience or name recognition have won contracts over foreign competitors, seemingly based on guanxi. Therefore, the role of reliable Chinese personnel in local operations is critical in order to understand the politics of such relationships, which appear totally mysterious to most U.S. businesspeople regardless of their experience or business acumen. A longer-term in-country presence provides ample time to bring such local players into an enterprise and fully train them in its intentions and operations.

Opening Doors

Those having difficulty breaking into the market or establishing a pilot program might consider donating a piece of equipment or services to a wholly Chinese-initiated project. Many Chinese environmental initiatives are hard-pressed for financing and equipment and could benefit greatly from financial and technical support. The Chinese partner's successes may in time open doors and help establish valuable connections for the foreign partner, particularly if the Chinese entity is con-

Box 13. Seeking Market Representation and Entry Facilitation

Exporters and foreign investors entering China's environmental protection market are often directed toward one or more of a variety of Chinese environmental protection foundations or societies, or governmental research and policy institutions. These institutions, such as the China Environmental Science Society, the China Environmental Protection Foundation, and even Agenda 21 and the CRAES, are not ideally positioned to assist foreign investors in entering the market. Some are research institutions with no commercial capacities, some are bureaucratic gateways designed to attract and absorb inordinate amounts of foreign capital, and almost all of them lack a sound understanding of commercial viability and the savvy to facilitate market entry successfully.

In contrast, an increasing number of Chinese industries and Chinese and international private consultants are available to provide market analysis, partner facilitation, legal consultation, and numerous other commercially-oriented services. The best suited of these entities are usually companies that were founded in China by experienced expatriates or Chinese nationals with substantial international experience. They have an in-depth understanding of China's public and private marketplaces, extensive partnership networks with industry and government leaders at all levels, and well-tuned communication skills. Additionally, such entities benefit from a privatized commercial business orientation and a definitive separation from centralized planning and bureaucracy. Investors are advised to forgo, as much as is possible, any dependence on cumbersome bureaucratic obstacles and to seek out private entities with the capacity to streamline bureaucratic interactions and facilitate market entry by commercially-oriented means. A partial list of these organizations is provided in Appendix D.

Investors should not, however, be misguided into believing that analysts and consultants based in Hong Kong or Taiwan are tantamount to such entities based on the Chinese mainland. The Taiwanese and Hong Kong marketplaces are separate entities from China. Operators based there are also, in essence, foreign investors. Enough capable and experienced facilitators operate with extreme dexterity within the mainland; little logistical or financial incentive exists to seek consultation from outside sources.

tracted to implement its scheme on a larger scale and subcontracts the foreign entity as a supplier.

This approach, however, requires extreme caution. As a single example, one French company attempted the strategy by donating a piece of equipment to a Chinese firm establishing a pilot program. The expectation was that the French company would be contracted to provide the equipment if the Chinese firm developed a commercial project. Instead, the Chinese firm simply reverse-engineered the equipment and facilitated its delivery through other means.

Dispelling "Neocolonialism"

Chinese planners are wary of anything resembling "neocolonialism," fearing that foreign investors will profit while not contributing to the overall advancement of the locality. Investors working with local planners may find that offering training and high-level positions with good wages to local hires, as well as various tangential initiatives such as the renewal of public space, supporting local education, and furthering overall social advancement, will ease such concerns.

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Web Sites

BuyUSA:
www.buyusa.com

China Economic Information:
www.cei.gov.cn

ChinaOnline:
www.chinaonline.com

State Statistics Bureau:
www.chinastatistics.com

U.S. Department of Commerce:
www.doc.com, *www.usatrade.gov*

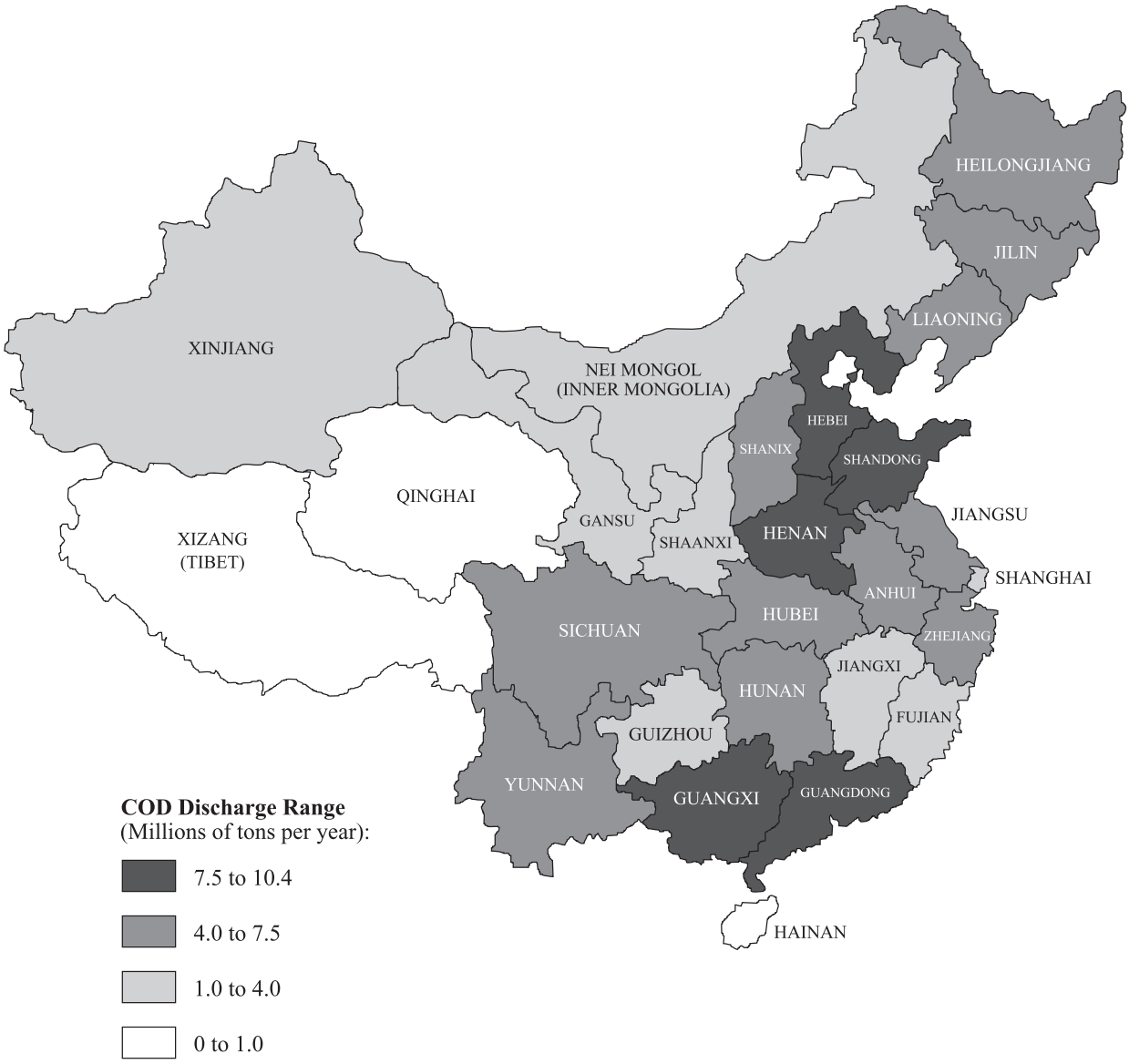
U.S. Department of Commerce,
International Trade Administration,
Office of Environmental Technologies Industries:
www.environment.ita.doc.gov

U.S. Embassy, Beijing:
www.usembassy-china.org.cn

U.S. Embassy, Beijing. *Country Commercial Guide: China:*
www.usatrade.gov

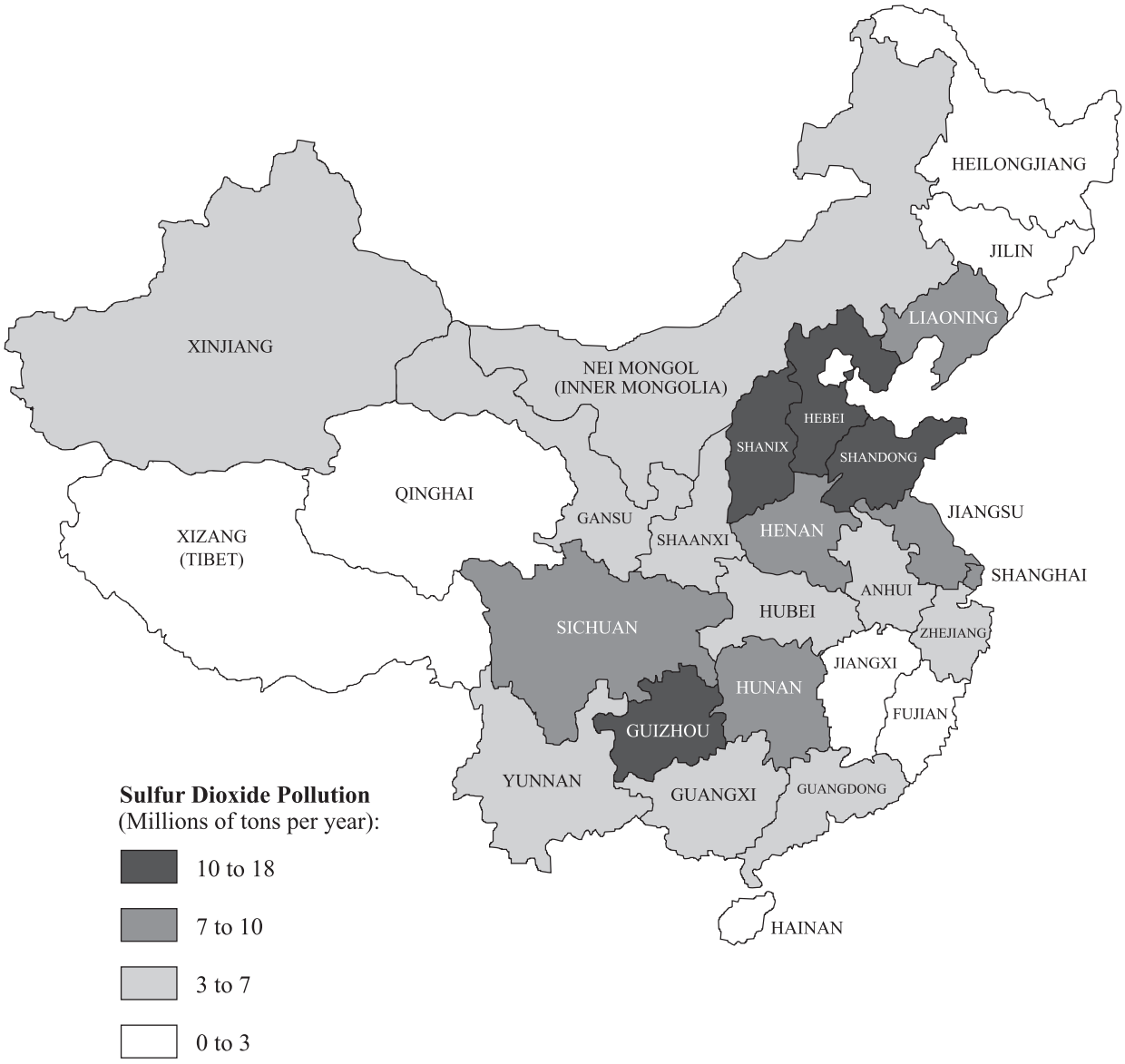
Appendix A
Maps

Map A.1 Levels of COD Discharge by Province in the People's Republic of China, 1999



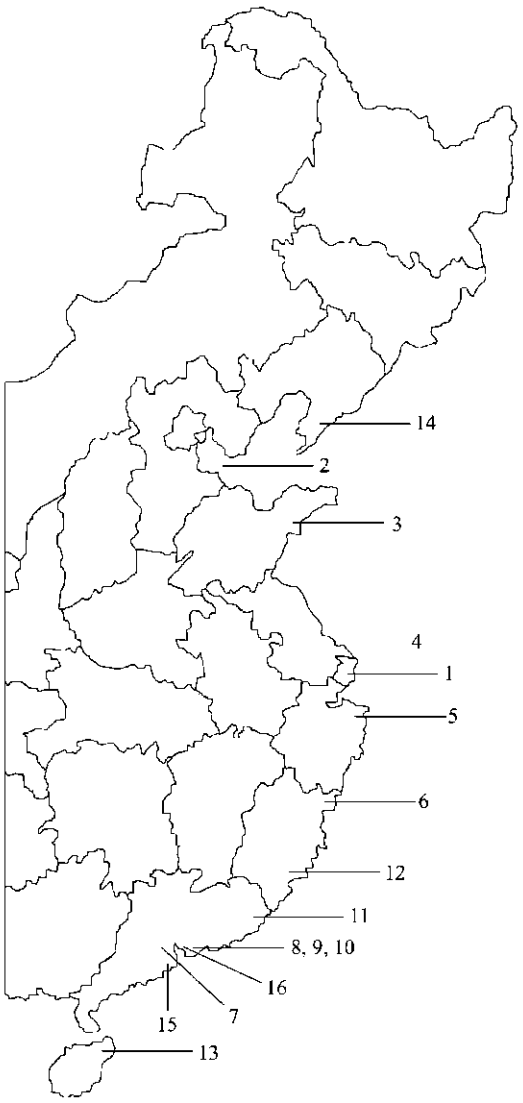
Source: SEPA Environmental Protection Yearbook, 1999.

Map A.2 Levels of SO_2 Pollution by Province in the People's Republic of China, 1999



Source: SEPA Environmental Protection Yearbook, 1999.

Map A.3 Bonded Zones in the People's Republic of China



Bonded Zones:

1. Shanghai, Waigaqiao Bonded Zone
2. Tianjin Port Bonded Zone
3. Qingdao Bonded Zone
4. Zhangjiagang Bonded Zone
5. Ningbo Bonded Zone
6. Fuzhou Bonded Zone
7. Guangzhou Bonded Zone
8. Shenzhen Futian Bonded Zone
9. Shenzhen Yantian Bonded Zone
10. Shenzhen Shatoujiao Bonded Zone
11. Shantou Bonded Zone
12. Xiamen Xiangyu Bonded Zone
13. Hainan Haikou Bonded Zone
14. Dalian Bonded Zone
15. Zhuhai Bonded Zone
16. Panyu Lianhuashan Port Bonded Zone

Appendix B
China Contacts

Ministries and Agencies

State Environmental Protection Administration (SEPA)
Address: No. 115 Xizhimennei, Nanxiaojie
Beijing 100035, China
Tel: +86 (10) 6615-3366
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ADB Business Opportunities publication:
www.adb.org/business/opportunities/default.asp
DACON and DICON data base information:
www.adb.org/consulting/dacon.asp
ADB Country Assistance Plan and other, China-specific information: *www.adb.org/China/default.asp*

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www.unido.org/doc/50130.htmls
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Guangdong
Guangdong International Hotel, M-1115
339 Huanshi Donglu
Guangzhou 510098, China
Tel: +86 (20) 8335-1476/8331-1898
Fax: +86 (20) 8332-1642
E-mail: *amcham@gitic.com.cn*

Shanghai
Portman Ritz-Carlton Hotel, #435
1376 Nanjing Xilu
Shanghai 200040, China
Tel: +86 (21) 6279-7119/7180
Fax: +86 (21) 6279-7643
Web site: *www.amcham-shanghai.org*

Shenyang
City Plaza Shenyang, Tower 1, #1107
206 Nanjing Beijie, Heping District
Shenyang 110001, China
Tel: +86 (24) 2334-1888, ext. 2117
Fax: +86 (24) 2334-1198

Tianjin
Sheraton Tianjin Hotel, Apt. 2205
Zijinshan Lu, Hexi District
Tianjin 300074, China
Tel: +86 (22) 2334-3388, ext. 2205
Fax: +86 (22) 2353-7765
E-mail: *amchamtj@public.tpt.tj.cn*

Wuhan
David Perry English Training Center, #302
32 Dazhi Lu
Wuhan, Hubei 430021, China
Tel: +86 (27) 8277-3508
Fax: +86 (27) 8284-2730

Hong Kong
Bank of America Tower, #1904
12 Harcourt Road
Central, Hong Kong
Tel: +852 2526-0165
Fax: +852 2810-1289
Web site: *www.amcham.org.hk*

U.S.-China Business Council

Washington, D.C.
1818 N Street, N.W., Suite 200
Washington, DC 20036
Tel: (202) 429-0340
Fax: (202) 775-2476
Web site: *www.uschina.org*

Beijing
CITIC Building, Suite 902
19 Jianguomenwai Dajie
Beijing 100004, China
Tel: +86 (10) 6592-0727
Fax: +86 (10) 6512-5854
E-mail: *USCBC@eastnet.com.cn*

Shanghai
Jinjiang Hotel
2312 West Building
59 Mao Ming Road
Shanghai 200020, China
Tel: +86 (21) 6415-2579
Fax: +86 (21) 6415-2584
E-mail: *uscbc@uninet.com.cn*

Hong Kong
2802 Admiralty Centre, Tower 1
18 Harcourt Road
Hong Kong, China
Tel: +852 2527-5397
Fax: +852 2527-1516
E-mail: *uscbc@netvigator.com*

Appendix D
Legal and Market Consultants

This list provides contact information for a small number of legal and market consultants specializing in China's environmental industry market. This list should not be considered comprehensive, and it does not imply the endorsement of the listed entities by the U.S. and Foreign Commercial Service.

Future Trends International (Group) Corporation
Web site: *www.future-trends.org*

Shanghai Office:
Central Plaza, Suite 801
227 North Huangpi Road
Shanghai 200003, China
Tel: +86 (21) 6375-8886
Fax: +86 (21) 6375-8887
E-mail: *ftichina@public.sta.net.cn*
Contact: Farzam Kamalabadi

Virginia—USA:
13876 Park Center Road
Herndon, VA 20171
Tel: (703) 471-1984
Fax: (703) 471-1909

California—USA:
Coronada Plaza, Suite I
1085 N. Main Street
Orange, CA 92867
Tel: (714) 997-0120
Fax: (714) 997-1334

PACT Industrial Water and Wastewater Treatment Processes

Shanghai Office:
9E Aibang Building
585 Lingling Road
Shanghai 200030, China
Tel: +86 (21) 6481-2155/6481-2156/6439-9468
Fax: +86 (21) 6427-6210
Web site: www.pactchina.com
E-mail: *pact@uninet.com.cn*

Seattle—USA:
5808 Princeton Avenue, N.E.
Seattle, WA 98105
Tel: (206) 524-5611
Fax: (206) 526-1588
E-mail: *info@pactusa.com*
Web site: *www.pactusa.com*

Sinosphere Corporation
Suite 1720, Sunflower Tower
37 Maizidian Street
Beijing 100026, China
Tel: +86 (10) 8527-5700
Fax: +86 (10) 8527-5701
Web site: *www.sinosphere.com*
E-mail: *anwar@sinosphere.com*
Contact: Husayn Anwar

Golden State
Suite B343 Sunshine Plaza
68 An Li Road
Chaoyang District, Beijing 100101, China
Tel: +86 (10) 6492-6688
Fax: +86 (10) 6492-9388
Web site: *www.chinaenvironment.com*
E-mail: *bjogsiee@public.bta.net.cn*

Environmental Resources Management (ERM)
Web site: *www.ermchina.com*

Beijing Office:
1603 Peng Run Mansion (B)
26 XiaoYun Road
Beijing 100016, China
Tel: +86 (10) 8458-4031/2/3
Fax: +86 (10) 8458-4030
E-mail: *post@ermchina.com*

Guangzhou Office:
37th Floor, Guangfa Finance Center
83 Nonglin Xia Road
Guangzhou 510083, China
Tel: +86 (20) 8731-0216
Fax: +86 (20) 8731-0199
E-mail: *guangzhou@ermchina.com*

Shanghai Office:
Suite 2401, Harbour Ring Plaza
18 Xizang Zhong Road
Shanghai 200001, China
Tel: +86 (21) 5385-3050/1/2
Fax: +86 (21) 6469-2185
E-mail: *shanghai@ermchina.com*

Beverage and Diamond
1350 I Street, N.W., Suite 700
Washington, DC 20005-3311
Tel: (202) 789-6000
Fax: (202) 789-6190
Contact: Richard J. Ferris, Jr.

Paul, Weiss, Rifkind, Wharton & Garrison
Beijing Representative Office
2918, China World Tower II
1 Jianguomenwai Dajie
Beijing 100004, China
Tel: +86 (10) 6505-6822
Fax: +86 (10) 6505-6830
Contact: Lester Ross

Appendix E
Web Sites

China Environmental Web Sites

SEPA English-language Web site: *http://english.zhb.gov.cn*

Chinese Agenda: 21 *www.acca21.edu.cn*

Center for Environmentally Sound Technology Transfer: *www.cestt.org.cn*

- Asia-Pacific Economic Cooperation Virtual Center, information on environmental technologies: *www.cestt.org.cn/apec-vc*
- List of Environmental Web Sites in China: *www.cestt.org.cn/apec-vc/Web site.asp*

"Sinosphere," a free on-line journal providing well-researched articles pertaining to Chinese environmental issues: *www.chinaenvironment.net/sino*
www.chinaenvironment.com

- Selection of reports and articles written by environmental specialists
- Articles classified according to main environmental issues: water treatment, air pollution
- Lists of projects

www.enviroinfo.org.cn

- Selection of main Chinese newspaper articles (in English translation) about environment; updated daily
- List of Chinese environmental technology companies and contact details
- Environmental legislation
- Forum and other services

www.ied.org.cn

- Links to other environmental Web sites
- Case studies
- Environmental research engines
- NGO forums
- China facts

www.environment.ita.doc.gov

- U.S. Department of Commerce, Environmental Technologies Industries
- Analysis of Chinese environmental market by American experts
- Description of environmental projects in China
- Schedule of international exhibitions
- News on the environment
- Financing assistance
- Detailed contacts of U.S. local bureaus for export of environmental technologies

www.ita.doc.gov

- U.S. Department of Commerce, International Trade Administration
- Chinese trade relations working group report on China permanent trade relations

Golden State's home page: *www.chinaenvironment.com/english/whorwe/index.html*

German Embassy: *www.ahk-china.com*

World Resources Institute: *www.wri.org*

Ondeo Nalco Co.: *www.nalco.com*

Degremont: *www.degremont.fr*

European delegation in China: *www.delchn.cec.eu.int*

Links to Chinese newspapers (see selections in the "news" repertory) *www.chinadaily.com.cn*

- Selected articles are inserted in "Newspapers and Magazines articles" chapter; to access them, go to repertory "News/China Daily Online"

ChinaOnline: *www.chinaonline.com*

- Specialized independent on-line source for business-related China news

www.eco-web.com

- Listing of environmental technologies companies, environmental organizations, and governmental institutions
- Links to each body's country of origin
- Classification by sector of activity (see listing of environmental technologies repartition per sector, which can be used as a data base reference)
- "Green Pages Editorial," list of projects with contact details
- Apparently has not been updated for a long time

TUV: *www.tuv.com*

China Quality Certification Enterprise Network: *www.isochina.com*

The U.S. Embassy, Beijing (connect to Environment, Science, Technology): *www.usembassy-china.gov*

Links to provincial and local environmental regulatory agencies including the SEPA's English-language reports on the state of the environment in China: *www.usembassy-china.gov/english/chenvlnk.html*

Reports of recent developments in China's environmental marketplace (including Hong Kong) via ETI's Web site at *www.environment.ita.doc.gov* (visit the "Market Plans" section)

Daily updates (in English translation) on water-related environmental projects: *www.h2o-china.com*

Search on China for trade-related information: *www.tradeport.org*

U.S. Department of Energy's "Energy Information Administration": *www.eia.doe.gov*

U.S. Department of Energy's "Energy Information Administration" analysis of, China: *www.eia.doe.gov/emeu/cabs/china.html*

U.S. Department of Commerce's International Trade Administration Trade Information Center; includes up-to-date tariff and tax information, resources, links, and assistance: *www.trade.gov/td/tic*

UN Development Business, a comprehensive resource on business opportunities for enterprises providing goods and services to projects financed by the major multilateral institutions: *www.devbusiness.com*

U.S. Government Sites

Department of Commerce, Office of Environmental Technologies Exports: *www.environment.ita.doc.gov*

Department of Energy, Energy Pollution Prevention Information Clearinghouse: *http://epic.er.doe.gov/epic*

Energy Information Administration: *www.eia.doe.gov/environment.html*

Department of State: *www.state.gov*

Bureau of Oceans and International Environment and Scientific Affairs: *www.state.gov/www/global/oes*

Environmental Protection Agency: *www.epa.gov, www.epa.gov/oia/crp.htm*

Envirofacts Database: *www.epa.gov/enviro*

Export-Import Bank of the United States: *www.exim.gov*

Global Network for Environmental Technologies (GNET): *www.gnet.org*

National Technology Transfer Center (NTTC): *www.nttc.edu*

Overseas Private Investment Corporation: *www.opic.gov*

Small Business Administration: *www.sbaonline.sba.gov*

Trade and Development Agency: *www.tda.gov*

U.S. Bureau of Reclamation: *http://usbr.gov*

United States Information Agency (USIA): *www.usia.gov*

Environmental Issues and Resources: *www.usia.gov/topical/global/environ/content.htm*

USAID, Center for Trade and Investment Services *www.info.usaid.gov/business/ctis/index.html*

Environmental Technologies Network for Asia/Americas (ETNA): *www.info.usaid.gov/business/ctis/etna.html*

U.S. Business Advisor: *www/business.gov*

U.S. House of Representatives Law Library: *http://law.house.gov*

U.S. International Trade Commission: *www.usitc.gov*

USDA Foreign Agricultural Service: *www.fas.usda.gov*

White House: *www.whitehouse.gov*

President's Council for Sustainable Development: *www2.whitehouse.gov/WH/EOP/pcsd/index.html*

State Government Environmental Sites

California EPA Envirotech Program: *www.calepa.ca.gov/envtech.htm*

California Environmental Exports: *www.environmentalexports.com*

International Trade Council of New Mexico: *www.itcnm.org*

Wisconsin Environmental Industry Export Forum: *www.dnr.state.wi.us/etef*

International Organizations/Foreign Government Sites

Asian Development Bank: *www.asiandevbank.org*

Electronic Embassy: *www.embassy.org*

Environment Canada (the Green Lane): *www.doe.ca*

European Environment Agency: *www.eea.eu.int*

International Atomic Energy Agency: *www.iaea.or.at*

International Institute for Sustainable Development: *http://iisd1.iisd.ca*

ISO (International Organization for Standardization): *www.iso.ch/welcome.html*

Interamerican Development Bank: *www.iadb.org*

United Kingdom Environment Agency *www.environment-agency.gov.uk*

World Bank: *www.worldbank.org*

Global Environment Facility: *www.worldbank.org/html/gef/gefgraph.htm*

World Trade Organization: *www.wto.org/Welcome.html*

United Nations Sites

United Nations Environment Program (UNEP): *www.unep.no*

CEDAR (Central European Data Request Facility): *www.cedar.univie.ac.at*

INFOTERRA: *www.cedar.univie.ac.at/unep/infoterra*

UNEP publications: *www.cedar.univie.ac.at/unep*

United Nations Trade Leads Network: *www.unicc.org/untpdc*

Business/Private Sector Sites

Environmental Industry Association: *www.envasns.org*

Aqua Online: *www.aquaonline.com*

EcoTradeNet: *www.ecotradenet.com*

Eldis (Electronic Development and Environmental Information System): *www.ids.ac.uk/eldis/eldis.html*

Envirolink Network: *www.envirolink.org*

Environment Expert: *www.environmental-expert.com*

Environmental On-Line: *www.cleanwater.com*

CNN Environmental News: *www.cnn.com/EARTH/index.html*

Environmental Law: *www.webcom.com/staber/welcome.html*

Envirotech-Online: *www.envirotech.org/index.html*

Global Recycling Network: *grn.com/grn*

Great Lakes Information Network (GLIN): *www.great-lakes.net*

Environmental Systems Corporation: *www.envirosys.com/corp.html*

Envirobiz: *www.envirobiz.com*

International Trade Law Monitor: *http://itl.irv.uit.no/trade_law*

ISO 14000 Infocenter: *www.iso14000.com*

MVTI Technologies: *http://members.aol.com/mvti/mvti.html*

Water Online: *www.wateronline.com*

Engineers Online: *www.engineersonline.com*

Pollution Online: *www.pollutiononline.com*

Public Works Online: *www.publicworks.com*

Recycler's World: *www.recycle.net/recycle/index.html*

Rubber Waste Technology: *www.interpublish.com/rwt/index.html*

Sedgwick Insurance: *www.sedgwickna.com/infocen.htm*

Solid Waste Online: *www.solidwaste.com*

U.S. Council for International Business: *www.imex.com/uscib*

Water and Wastewater Utilities: *www.magicnet.net/~metzler/page4.html#WaterInterna-tional*

WaterWorld: *http://waterworld.com*

World Trade Exchange: *www.wte.net*

Yahoo: *www.yahoo.com/Business/Corporations/Environment*

Associations

American Waterworks Association (AWWA): *www.awwa.org*

WaterWiser: *www.waterwiser.org*

Environmental Export Council: *www.ecotradenet.com*

Environmental Industry Associations: *www.envasns.org*

Hemispheric Center for Environmental Technology (HCET): *www.hcet.fiu.edu*

International Environmental Liability Management Association: *www.magic.ca/ielma/ielma.home.html*

International Tire and Rubber Association: *www.itra.com/recycle.htm*

National Groundwater Association (NGHWA): *www.h2o-ngwa.org*

Water Environment Federation: *www.wef.org*

Water and Wastewater Equipment Manufacturers Association: *www.wwema.org*

World Resources Institute: *www.wri.org*

Trade Show Information

Envirobiz: *www.envirobiz.com*

Expoguide: *www.expoguide.com*

Pollution Engineering: *www.pollutioneng.com*

Trade Show Central: *www.tscentral.com*

Magazines, Journals, and Periodicals

Asia Environmental Review: *www.asianenviro.com*

Canadian Environmental Journal: *www.greenware.ca/cejindex.htm*

Corporate Environmental Strategy: *www.rpi.edu/dept/mgmt/SOM.pages/EMP/ces.html*

Electronic Newstand: *www.enews.com*

Pollution Engineering: *wwwpollutioneng.com*

Riskworld: *www.riskworld.com*

Soil and Groundwater Cleanup Online Magazine: *www.sgcleanup.com*

The Wall Street Journal: *www.wsj.com*

Directories and Indexes

The Amazing Environmental Web Directory: *www.webdirectory.com*

Biz Web: *www.bizweb.com*

EcoTradeNet: *www.ecotradenet.com*

Environmental Industry Web site: *www.enviroindustry.com*

Environmental Route Net: *www.csa.com/routenet*

IMEX Exchange: *www.imex.com/imex/menu.html*

Infomanage—International Trade Resources: *http://infomanage.com/International/Trade*

International Business Network: *www1.usa1.com/~ibnet*

International Trade Zone: *www.std.com/intltrade*

Export Yellow Pages (includes Green Pages): *www.export.uswest.com*

Trade Compass: *www.tradecompass.com*

Yahoo Business and Economy Page: *www.yahoo.com/Business_and_Economy*

Chinese Business, Economic, and Financial Web Sites

WTO and PNTR documents and information: *www.pntrchina.gov*

U.S.-China Business Council magazine: *www.chinabusinessreview.com*

China Country Commercial Guide: *www.usatrade.gov*

U.S. Embassy, Beijing: *www.usembassy-china.org.cn*

APEC, China meetings: *www.apec-china.org.cn*

U.S.-China Business Council WTO page: *www.uschina.org/public/wto*

National Bureau of Asian Research WTO page: *www.nbr.org/publications*

Singapore International Business Institute links: *www.chinaupdates.com*

Translated articles from Chinese sources: *www.sinopolis.com/Archives/Focus/WTO.htm*

Harvard University trade negotiations page: *www.cid.harvard.cidtrade*

China economic information, Hong Kong Trade Council: *www.tdc.org.hk/mktprof/china.htm*

Gallup survey on China: *www.gallup.com/poll/reports/china.asp*

CNN news and information roundup: *www.cnn.com/ASIANOW*

Chinese stock information: *www.stockstar.com*

Official Chinese Xinhua news agency: *www.xinhua.org*

People's Daily Web site with government information: *www.peopledaily.com.cn*

China Daily business weekly: *www.chinadaily.com.cn/bw/bw_cate1.html*

Information on marketing and advertising on China: *www.shanghai-ed.com/j-market.htm*

China Council for Promotion of International Trade: *www.ccpit.org/engVersion/index.html*

China information: *www.chinainfornet.com*

Chinese Business World: *www.chinesebusinessworld.com*

U.S.-China Business Council: *www.uschina.org/press*

World Trade Data Base: *www.wtdb.com/investment/ininvest.htm*

China Web: *www.comnex.com/stocks/stocks.htm*

People's Bank of China: *www.pbc.gov.cn*

State Administration of Foreign Exchange (SAFE): *www.safe.gov.cn*

Bank of China: *www.bank-of-china.com*

Ministry of Foreign Trade and Economic Cooperation: *www.moftec.gov.cn*

PRC Embassy in Washington, D.C.: *www.china-embassy.org*

State Development Planning Commission: *www.sdpc.gov.cn*

China tax laws and news: *www.chinatax.gov.cn*

Soho: *www.soho.com*

Net Ease: *www.netease.com*

China Economic Information: *www.cei.gov.cn*

Beijing Economic Information: *www.beinet.cn*

State Statistics Bureau: *www.chinastatistics.com*

Icapital, China data service, Hong Kong: *www.statchina.com*

China Pages directory: *www.china.pages.com.cn*

China Business Net: *www.china-businessnet.com*

Foreign Trade Cooperation Network: *www.bcic.com*

Beijing Business Administration Network: *www.bigs.cn.net*

China Business Resources: *www.chinatrading.com*

Chinabyte: *www.chinabyte.com*

Shanghai Stock Exchange: *www.shstock.cn.net*

UNIDO investment network: *www.cci.com.cn*

Securities Times: *www.securitiestimes.com.cn*

South China Morning Post, China news: *www.scmp.com/news/china/topchina.idc*

China Market: *www.chinamarket.com.cn*

China Standard Service Net: *www.cssn.net.cn*

The Economist: *www.economist.com*

Far Eastern Economic Review: *www.feer.com*

China Big Yellow Pages: *www.chinabig.com*

Chinalaw Web: *www.qis.net/chinalaw/index.html*

Government White Papers: *www.china.org.cn/WhitePapers*

China information: *www.chinainfo.gov.cn*

Industry Web Sites

Chemical sector e-commerce: *www.chemease.com*

Chemical sector e-commerce: *www.chemross.com*

Chemical trade information: *www.chem-trade.net.cn*

China Chamber of Commerce of Metals, Minerals and Chemicals Importers and Exporters: *www.cccmc.org.cn*

Capital Steel: *www.shougang.com.cn*

China copper market information (in Chinese): *www.copperchina.com*

Oil market news information (in Chinese): *www.oilnews.com.cn*

China Oil, Gas and Petrochemicals magazine: *www.chinaogp-online.com*

China Chemical Reporter (magazine): *www.ccr.com.cn*

Chemical Products Purchase Information: *www.chem.sinobnet.com*

Chemical Business Web Sites

Chemicals information: *www.chempages.com*

Chemicals information: *www.cheminfo.gov.cn*

Chemicals information: *www.chemhot.com*

General industry information: *www.ChinaCCM.com*

Chemicals information: *www.chem-trade.net.cn*

Chemicals information: *www.chem.com*

Chemical information in South China: *www.qjy-chemonline.com*

Plastics: *www.cpinfo.net*

Chemicals information: *www.chchin.com*

Chemicals information: *www.chem.com.cn*

Chemical Products: *www.chemmarket.gov.cn*

Chemical Policy Making Information: *www.jcw.gov.cn*

Chemical Technology: *www.techmarket.com.cn*

China Chemical Week (English newspaper): *www.chemweek.com.cn*

China Chemical Daily: *www.ccin.com.cn, www.chem35.com*

Technology transfer information: *www.chemmarket.gov.cn, www.techmarket.com.cn*

Chemical information:
www.jcw.gov.cn, www.sinoproject.com

SINOPEC: *www.sinopec-ec.com.cn*

China and Asia rubber information:
www.asiarubbernet.com, www.asiarubber.com.cn

Steel: *www.chinasteel.com.cn*

Copper: *www.copperchina.com*

Metals: *www.worldmetal.com*

Coal: *www.coalinfo.net.cn*

China coal information: *www.chinacoal.com*

China coal information: *www.coalnews.com.cn*

Appendix F: Development Zones

China Development Zone List

Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
北京 Beijing	1	北京经济技术开发区	Beijing Economic-Technological Development Zone	北京经济技术开发区万源街4号 100076	No.4 Wanyuan Street. Beijing Economic-Technological Development Area 100076	8610 6768 1240 8610 6768 1209 8610 6768 1107 8610 6768 1457	8610 6768 1118
	2	北京兴谷经济开发区	Beijing Xinggu Economic Development Zone	北京市平谷兴谷开发区大街 101200	Xinggu Development Zone Street Pinggu, Beijing 101200	8610 6996 4071	
	3	北京新技术产业开发试验田	Zhongguancun Sscience and Technology Park	北京市海淀大街1号 100080	No.1 Haidian Street. Beijing, 100080	8610 6256 9636	8610 6257 4150
	4	北京新技术产业开发试验区－海淀园	Zhongguancun Sscience and Technology Park-Haidian Sector	北京市海淀白石桥路甲七号 100081	No.7 A, Baishiqiao Raod Haidian District, Beijing 100081	8610 68915118	8610 68915214
	5	北京新技术产业开发区试验区－丰台园	Zhongguancun Sscience and Technology Park-Fengtai Sector	丰台科学城海鹰路2号 100070	No.2 Haiyingroad Science Zone Fengtai District, Beijing 100070	8610 6371 3737 8610 6381 6081 8610 6382 5607	8610 6371 5608 8610 6382 5608
	6	北京新技术产业开发区试验区－昌平园	Zhongguancun Sscience and Technology Park-Changping Sector	昌平环路 102200	Round Road Changping, Bejing 102200	8610 6974 4527 8610 6974 4532	8610 6974 5549
	7	上地信息产业基地	ShangDi IT Industrial Base	北京市海淀大街1号 100080	No.1 Haidian Street. Beijing, 100080	8610 6254 1698 8610 6257 0942	8610 6254 0491
	8	北京大兴工业开发区	Beijing Daxing Industrial Developemnt Zone	大兴工业开发区广茂大街9号 102600	No.9 Guangmao St. Daxing Industrial Development Zone, Beijing 102600	8610 6924 3300 8610 6924 2974	8610 6924 2817
	9	北京天竺空港开发区	Beijing Airport Industrial Development Zone	首都国际机场西侧 101312	West Side of Capital Airport 101312	8610 6456 6837 8610 6456 9394	8610 6456 9394

China Development Zone List

Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
上海 Shanghai	10	上海虹桥经济技术开发区	Shanghai Hongqiao Economic-Techological Development Zone	娄山关路55号 200336	Loushanguan Road 200336	8621 6275 6888	8621 6275 1745
	11	闵行经济技术开发区	Minhang Economic-Techological Development Zone	上海市闵行江川路1251号 200245	No.1251 Jiangchuan Road Minhang, Shanghai 200245	8621 6430 0888	8621 6430 0789
	12	上海市外高桥保税区网络发展公司	Shanghai Waigaoqiao Free Trade Zone Network Development Co.Ltd	上海市杨高北一路88号港务大楼101室 200131	Room101, Gangwu Building No.88 Yanggao Bei Yi Road Shanghai, 200131	8621 5861 3632 8621 5861 2137	8621 5861 3338
	13	上海陆家嘴金融贸易区开发公司	Shanghai Lujiazui Finance & Trade Zone Development Company	上海浦东大道981号 200135	981 Pudong Ave.Shanghai China 200135	8621 5887 8888	8621 5887 7110
	14	上海浦东新世纪经济城	Shanghai Pudong New Century Economic Zone	上海市浦东新区凌桥镇草高路1740号 200137	No.1740, Caogao Road Lingqiao Zhen, Pudong New Area Shanghai 200137	8621 5864 3493	8621 5864 0199
	15	大众工业园区	Shanghai Volkswagen Ind.Park	上海嘉定安亭于塘路108号 201805	No.108, Yutang Rd, Jiading, Shanghai, 201805	8621 5956 3324 8621 5956 2394	8621 5956 3324
	16	上海东方经济城	Shanghai Orient Economic Park	闵行区浦东三鲁路1598号 201112	No.1598 Sanlu Road Pudong Minhang District Shanghai, 201112	8621 6491 1020 8621 6491 1421 8621 6491 1474	8621 6491 1155
	17	上海市工业综合开发区（奉浦工业区）	Shanghai Industrial Conglomerate Development Zone (Fengpu Industrial Sector)	上海市工业综合开发区奉浦大道111号, 201400	No.111 Fengpu Ave. Shanghai Industrial Conglomerate Development Zoen, 201400	8621 6710 0345	8621 6710 0460
	18	上海金桥出口加工区	Shanghai Jinqiao Export Processing Zone	新金桥路28号 201206	Xinjinqiao Road 201206	8621 5899 1818	8621 5899 1399 8621 5899 1557
	19	上海蓝天经济城	Shanghai Lantian Economic Centre	上海南翔镇真南路5008号 201802	No.5008 Zhennan South Road Nanxiang Zhen, Shanghai 201802	8621 5912 4988 8621 5912 2274	8621 5912 2274
	20	上海浦东合庆工业园区	Shanghai Pudong Heqing Industry Park	上海浦东龙东大道6111号 201201	NO.6111 Longdong Avenue Pudong Shanghai P.R.C. 201201	8621 5897 3000	8621 5897 1330
	21	上海市星火开发区	Shanghai Xinghuo Development Zone	上海市民乐路72号星火开发区，201419	No.72 Minle Lu, Shanghai Torch development zone, 201419	8621 5750 4110	8621 5750 3249
	22	上海辛庄开发区	Shanghai XingZhuang Industrial Zone	上海市闵行区春申桥沈北路8号 201108	8 Shen Bei Rd., Chun Shen Bridge, Minhang District, Shanghai 201108, P.R.China	8621 6489 0467 8621 6489 5589 8621 6489 1200	8621 6489 5589

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		Chinese	English	Chinese	English		
天津 Tianjin	23	天津宁河经济开发区	Tianjin Ninghe Economic Development Zone	天津宁河经济开发区 301500	Tianjin Ninghe Economic Development Zone 301500	8622 2559 4002	8622 2559 4001
	24	和平科工贸发展园区	Heping Science Industrial Trade Development Park	天津市和平区查哈尔路 11号 300020	No.11 Chahaer Road Heping District, Tinajin 300020	8622 2723 3070	8622 2723 3045
	25	天津市科技贸易街	Tianjin Science-Tech-Trade Street	南开区白堤路42号, 300193	No.42 BaidiRoad, Nankai District Tianjin, 300193	8622 2737 0240	
	26	天津新技术产业园区	Tianjin New Technological Industrial Park	南开区科研西路8号 300192	No.8 Keyan West Road Nankai District 300192	8622 8789 1904	8622 8789 3218
重庆 Chongqing	27	重庆市涪陵桥南经济技术开发区	Chongqing Fulingqiao Nan Economic Technological Development Zone	重庆市涪陵兴华中路45号 408000	No. 45 Xinghua Zhong Raod Fuling Chongqing, 408000	8623 7286 4926	8623 7286 7957
	28	重庆高新技术产业开发区	Chongqing Science & Technology Industrial Park	重庆市石桥铺科园1路5号 400039	No.5 1 Lu Keyuan Shiqiaopu Chongqing 400039'	8623 6860 1972	8623 6860 6272
河北 Hebei	29	沧州经济技术开发区	Changzhou Economic Technological Development Zone	沧州经济技术开发区渤海路8号 061000	No.8 Bohai Road Cangzhou Economic Technological Development Zone, Hebei ,061000	86317 309 2104	86317 309 1483
	30	秦皇岛经济技术开发区	Qinhuangdao Economic Technologcial Development Zone	河北省秦皇岛经济技术开发区 066000	Qinhuangdao Economic Technologcial Development Zone Hebei 066000	86335 805 1736	86335 805 1519
河北 Hebei	31	唐山高新技术暨经济技术开发区	Tangshan New&Hi-Tech/Economic & Technological Development Zone	河北省唐山高新技术暨经济技术开发区 063020	Tangshan New&Hi-Tech/Economic & Technological Development Zone Hebei 063020	86315 320 8040	86315 320 8027
	32	保定市国家高新技术产业开发区	Baoding National New and High-tech Industrial Development zone	河北省保定市化纤路118号 071000	No.118 Huaxian Road Baoding Hebei, 071000	86312 310 8801	86312 313 2060
	33	石家庄国家高新技术产业开发区	Shijiazhuang National Hi-Tech Development Zone	石家庄高新区黄河大道151号 050035	No.151 Huanghe Ave. Gaoxinqu Shijiazhuang 050035	86311 596 2924	86311 596 3266
山西 Shanxi	34	山西忻州经济技术开发区	Shanxi Xinzhou Economic Technological Development Zone	山西省忻州市经济技术开发区 034000	Shanxi Xinzhou Economic Technological Development Zone 034000	86350 312 0741	86350 312 0501
	35	风陵渡经济开发区	Fenglingdu Economic Technological Development Zone	山西省风陵渡经济开发区 044602	Fenglingdu Economic Technological Development Zone Shanxi 044602	86359 335 0629	
	36	山西省侯马经济技术开发区	Shanxi Houma Economic Technological Development Zone	山西省侯马市呈王东路 56号 043000	No.56 Chengwang East Road Houma Shangxi 043000	86357 423 4652	86357 408 0016
	37	太原高新技术产业开发区	Taiyuan Hi-Tech Technological Industrial Development Zone	太原市长治路441号 030006	No.441 Changzhi Road Taiyuan, 030006	86351 702 7007	

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		Chinese	English	Chinese	English		
内蒙古 Inner Mongolia	38	呼和浩特经济技术开发区	Huhehaote Economic Technological Development Zone	呼和浩特如意经济技术开发区 010010	Huhehaote Economic Technological Development Zone- Ruyi Sector 010010	86471 460 3547	
	39	呼和浩特如意经济技术开发区	Huhehaote Economic Technological Development Zone- Ruyi Sector	呼和浩特如意经济技术开发区 010010	Huhehaote Economic Technological Development Zone- Ruyi Sector 010010	86471 492 9893	86471 492 9877
	40	内蒙古临河经济技术开发区	Inner Mongolia Linhe Economic Technological Development Zone	内蒙古临河经济技术开发区 015000	Inner Mongolia Linhe Economic Technological Development Zone 015000	86478 821 2492	86478 821 8323
	41	内蒙古包头稀土高新技术产业开发区	Baotou National Rare Eart New & High Techological Industrial Development Zone	内蒙古包头稀土高新技术产业开发区 014030	Baotou National Rare Eart New & High Techological Industrial Development Zone 014030	86472 515 6625	86472 515 6391
辽宁 Liaoning	42	大连经济技术开发区	Dalian Economic Technological Development Zone	大连经济技术开发区 116600	Dalian Economic Technological Development Zone 116600	86411 761 1285	86411 761 1720
	43	辽宁虎石台经济技术开发区	Liaoning Shihutai Economic Technologicial Development Zone	辽宁虎石台经济技术开发区 110141	Liaoning Shihutai Economic Technologicial Development Zone 110141	8624 2581 0324	8624 2581 2748
	44	鞍山高新技术产业开发区	Anshan Hi-Tech Industrial Development Zone	千山路科技街 114044	Qianshan Road Keji Street 114044	86412 521 1009	86412 521 1056
	45	鞍山市开发区	Anshan Development Zone	鞍山市铁西区兴盛路248号, 114014	No.248 Xingsheng Road Tiexi District Anshan Liaoning, 114014	86412 884 8840 86412 881 3210 86412 881 3860 86412 884 8675	86412 884 3027
	46	沈阳经济技术开发区	Shenyang Economic Technological Development Zone	沈阳经济技术开发区 110141	Shenyang Economic Technological Development Zone 110141	8624 2581 0324	8624 2581 2748
	47	抚顺市开发区	Fushun Economic Technological Development	抚顺市李石镇 113122	Lishi Zhen Fushun 113122	86413 6601 650	86413 6603 777
	48	沈阳高新技术产业开发区	Shenyang Hi-Tech Technological Industrial Development Zone	沈阳高新技术产业开发区35号 110004	No.35 Shenyang Hi-Tech Technological Industrial Development Zone 110004	8624 2391 1667	8624 2390 4631

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Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
吉林 Jilin	49	长春经济技术开发区	Chuangchun Economic Technological Development Zone	长春经济技术开发区 130031	Chuangchun Economic Technological Development Zone 130031	86431 464 4211	86431 464 4215
	50	长春净月潭旅游经济开发区	Chuangchun Jingyuetan Tourism Economic Development Zone	长春市净月潭 130117	Jingyuetan Chuangchun Jilin, 130117	86431 451 3533 86431 451 6508	86431 451 3533
	51	吉林经济技术开发区	Jilin Economic Technologcial Development Zone	吉林市吉林经济技术开发区 九站街工农路1号 130061	No.1 Gongnong Road Jiuzhan Street Jilin Economic Technologcial Development Zone 130061	86432 305 5128	86432 305 5138
	52	长春高新技术产业开发区	Changchun New & High Technological Industrial Development Zone	吉林省长春市前进大街 95号, 130012	No.95 Qianjin Street Changchun, Jilin 130012	86431 517 1636	86431 517 1636
黑龙江 Heilongjiang	53	哈尔滨经济技术开发区	Harbin Economic Technological Development Zone	哈尔滨市南岗区华山路 99号 150090	No.99 Huashan Road Nangang District Harbin Heilongjiang 150090	86451 231 2774	86451 231 0931
	54	大庆国家高新技术产业开发区	Daqing National New & High Technological Development Park	大庆国家高新技术产业开发区 163316	Daqing National New & High Technological Development Park 163316	86459 628 2082 86459 628 2929 86459 628 1237	86459 628 2082
江苏 Jiangsu	55	江苏省张家港经济开发区	Jiangsu Province Zhangjiagang Economic Development Zone	张家港市张杨公路悦丰大厦 215600	Yuefeng Tower Zhangyang Calzada Zhangjiagang Jiangsu Province 215600	86520 867 3996 86520 867 6968	86520 867 3996
	56	江苏省苏州新区	Suzhou New Zone Jiangsu Province	苏州新区运河路8号 215011	8 Yunhe Road,Suzhou,Jiangsu Province, P.R. China 215011	86512 825 2677 86512 825 1888	86512 825 1579
	57	江苏省泰州经济开发区	Taizhou Economic Development Zone Jiangsu Province	江苏省泰州市泰高路长途运输中心北侧 225300	Wuli Birdge West,Taizhou,Jiangsu Province,China, 225300	86523 688 1662 86523 688 1660	86523 688 1660
	58	江苏省太仓民营科技园区	Taichang City Civilian Run Science & Technological Park	中国江苏省太仓市城厢镇县府街1号 215400	No.1, Xianfu Street, Chengxiang Town, Taicang City, Jiangsu Province, China 215400	86520 352 2392 86520 352 2771	86520 352 2771
	59	连云港经济技术开发区－海州区	Lianyungang Economic Technological Development Zone-Haizhou Sector	江苏省连云港海州区 222062	Haizhou Lianyungang Jiangsu Province, 222062	86518 591 0484	86518 591 0483
	60	江苏武进高新技术产业开发区	Wujin New & High Technological Industrial Development Zone Jiangsu Province	中国江苏省武进市人民中路187号 213161	No187,Renmin Middle Road, Wujin, Jiangsu, China 213161	86519 655 0029 86519 655 0847	86519 655 0019

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		Chinese	English	Chinese	English		
	61	常州高新技术产业开发区	Changzhou New & High Technological Industrial Development Zone	常州河海中路85号 213022	No.85 Hehai Zhong Road Changzhou 213022	86519 510 6070	86519 510 5661
	62	南京高新技术产业开发区	Nanjing New & High Technological Industrial Development Zone	中国南京浦口 南京3209信箱 210061	Mailbox 3209 Nanjing Pukou Nanjing 210061	8625 884 3666	8625 884 3843

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Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
安徽 Anhui	63	安庆市经济技术开发区	Anqing Economic Technological Development Zone	安庆市经济技术产业开发区管委会大楼 246005	Economic and technology industry development zone management community building, Anqing city, 2460005	86556 531 5397	86556 531 4390
	64	合肥经济技术开发区	Hefei Economic Technological Development Zone	合肥市南郊18港 230601	18 Gang Nanjiao Hefei, 230601	86551 381 2989	
	65	安徽芜湖经济技术开发区	Wuhu Economic Technological Development Zone Anhui Province	安徽芜湖经济技术产业开发区管委会 241000	Wuhu Economic and technology industry development zone management community, Anhui 241000	86553 584 6009	86553 584 1876
	66	六安经济技术开发区	Liuan Economic Technological Development Zone	安徽六安经济技术产业开发区 237161	Liuan Economic and technology industry development zone, Anhui Province 237161	86564 363 1800	86564 363 1277
	67	淮南经济技术开发区	Huainan Economic Technological Development Zone	安徽省淮南市田东建设路8号 232007	No.8 Tiandong Jianshe Road Huainan City, Anhui Province 232007	86554 331 2573	86554 331 0503
福建 Fujian	68	东山经济技术开发区	Dongshan Economic Technological Development Zone	东山经济技术开发区 363400	Dongshan Economic Technological Development Zone 363400	86596 585 6867	86596 585 2790
	69	福清融侨经济技术开发区	FuQingRongQiao Economic Technological Development Zone	福清融侨经济技术开发区 350300	FuQingRongQiao Economic Technological Development Zone 350300	86591 522 2237	86591 521 8034
	70	福州马尾经济技术开发区	Fuzhou Mawei Economic Technological Development Zone	福州市马尾区君竹路172号经济技术开发区办公室 350015	No.172 Junzhulu, Mawei District, Fuzhou City Fuzhou Economic and technology development zone office 350015	86591 368 1407	86591 368 2346
	71	厦门象屿保税区	Xiamen Xiangyu Free Trade Zone	厦门象屿保税区 361006	Xiamen Xiangyu Free Trade Zone 361006	86592 603 5831 86592 603 5830	86592 603 5830
	72	泉州清蒙科技工业区	Quanzhou Qingmeng Science & Technological Industrial Zone	泉州清蒙科技工业区 362005	Quanzhou Qingmeng Science & Technological Industrial Zone 362005	86595 248 0420	86595 248 8910
	73	厦门海沧台商投资区	Xiamen Haicang Investment Zone	中国厦门市海沧新市区 361026	New District Changhai Xiamen, 361026	86592 605 1027	86592 605 1048

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		Chinese	English	Chinese	English		
山东 Shandong	74	威海开发区	Weihai Development Zone	威海开发区 264205	Weihai Development Zone 264205	86631 598 0099	86631 592 2200
	75	德州市经济开发区	Dezhou Economic Development Zone	山东德州市经济技术开发区管委会办公室 253034	Dezhou City, Shandong Province Dezhou Economic and technology development zone management community office 253034	86534 256 1999	86534 256 1999
	76	济南市经济开发区	Jinan Economic Development Zone	济南市经济开发区管委会 250300	Economic development zone management community, Jinan City, 250300	86531 722 7668	86531 722 7666
	77	中国青岛经济技术开发区	Qingdao Economic Technological Development Zone	中国青岛经济技术开发区266 555	Qingdao Economic Technological Development Zone, 266555	86532 698 8503	
	78	青岛保税区	Qingdao Free Trade Zone	青岛保税区 266555	Qingdao Free Trade Zone 266555	86532 676 6665	86532 676 6622
	79	烟台经济技术开发区	Yantai Economic Technological Development Zone	烟台经济技术开发区 264006	Yantai Economic Technological Development Zone 264006	86535 6371 1113	86535 6371 1111
	80	济宁高新技术产业开发区	Jining Hi-Tech Technological Industrial Development Zone	吴泰闸路火炬城5楼 2722100	5th Floor, Huoju Cheng Wutaizha Road, Jining, 2722100	86537 236 3033	
	81	滋博高新技术产业开发区	Zibo Hi-Tech Technological Industrial Development Zone	中国山东省淄博市开发区 255000	Zibo Development Zone Shangdong Province 255000	86533 358 2653	86533 358 1098 86533 358 0997
	82	枣庄高新技术产业开发区	Zaozhuang Hi-Tech Technological Industrial Development Zone	枣庄高新技术产业开发区 277000	Zaozhuang Hi-Tech Technological Industrial Development Zone 277000	86632 441 3107	86632 441 3008
河南 Henan	83	洛阳经济技术开发区	Luoyang Economic Technological Development Zone	洛阳经济技术开发区 471002	Luoyang Economic Technological Development Zone 471002	86379 490 2652	86379 490 2651
	84	郑州经济技术开发区	Zhengzhou Economic Technological Development Zone	郑州经济技术开发区 航海路东端 450047	Zhengzhou Economic & Technological Development Area (Hanghai East Road) 450047	86371 678 1252	86371 678 1252
	85	安阳高新技术产业开发区	Anyang New & High Technological Development Zone	安阳高新技术产业开发区 455000	Anyang New & High Technological Development Zone 455000	86372 296 9893 86372 299 7518 86372 298 0533	86372 296 1067
	86	漯河高新技术产业开发区	Luohe New & High Technological Industrial Development Zone	人民东路漯河高新技术产业开发区, 462000	Huohe New & High Technological Industrial Development Zone, 462000	86395 262 2608	86395 262 6146

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Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
河南 Henan	87	郑州高新技术产业开发区	Zhengzhou New & High Technological Industrial Development Zone	郑州高新技术产业开发区 450001	Zhengzhou New & High Technological Industrial Development Zone, 450001	86371 798 1577	
	88	郑州国家高新技术产业开发区	Zhengzhou National Hi-Tech Technological Industrial Development Zone	郑州市国槐街 450001	Guohuai Street Zhengzhou City, Henan Province 450001	86371 798 1577 86371 798 1706	86371 798 1800
	89	长沙市经济开发区	Changsha Economic Development	长沙市经济开发区, 410100	Changsha Economic Development,410100	86731 401 1101	
	90	岳阳经济技术开发区	Yueyang Economic Technological Development Zone	岳阳经济技术开发区, 414000	Yueyang Economic Technological Development Zone, 414000	86730 821 7194	
	91	长沙国家高新技术产业开发区	Changsha National New & High Technological Industrial Development Zone	长沙国家高新技术产业开发区, 410013	Changsha National New & High Technological Industrial Development Zone, 410013	86731 880 6513	
	92	株州高新技术产业开发区	Zhuzhou New & High Technological Industrial Development Zone	株州高新技术产业开发区 412007	Zhuzhou New & High Technological Industrial Development Zone, 412007	86733 882 7230	
	93	嘉兴经济开发区	Jiaxing Nanhu comprehensive Development Zone	浙江省嘉兴市城南路四号桥嘉兴科技创业中心507室，314000	No.4 Bridge Cheng Nan Road Jiaxing Science and Technology Development Center, Room 507, 314000	86571 261 5687	86571 261 5686
	94	马坡岭农业高科技园	Mapoling Agricultural High-tech Park	湖南长沙市芙蓉区马坡岭 410125	Mapoling Furong District Changsha City, Hunan Province 410125	86731 469 0189	
广东 Guangdong	95	广州经济技术开发区	Guangzhou Economic Technological Development Zone	广州经济技术开发区, 510430	Guangzhou Economic Technological Development Zone 510430	8620 8221 8126	
	96	广州南沙经济技术开发区	Guangzhou Nansha Economic Technological Development Zone	广州南沙经济技术开发区 511458	Guangzhou Nansha Economic Technological Development Zone 511458	8620 8468 0504	
	97	广东花都市西城经济技术开发区	Guangdong Huadu City Xi Cheng Economic Technological Development Zone	花都市建设北路73号之九, 510800	Zhi 9, No.73 North Jianshe Road Huadu, 510800	8620 8689 0088	
	98	惠州大亚湾经济技术开发区	Huizhou Dayawan Economic Technological Development Zone	澳头进港西路, 516000	Western Road, Aotoujingang, 516000	86752 557 4481	
	99	湛江经济技术开发区	Zhanjiang Economic Technological Development Zone	人民大道中2号桥, 524022	No.2 Bridge, Renmin Dadao, 524022	86759 338 0654	

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		Chinese	English	Chinese	English		
广东 Guangdong	100	江门市高新技术产业开发区	Jiangmen City New & High Technological Development Zone	江门市高新技术产业开发区	Jiangmen City New & High Technological Development Zone	86750 386 1503	
	101	广东省东莞高新科技产业开发区	Dongwan New & High Technological Science and Technological Development Zone Guangdong Province	黄村白马宏图工业区，宏图大楼3层, 523080	3rd Floor, Hongtu Building Huangcun Baima Hongtu Industrial Zone, 523080	86769 240 0296	
	102	山高新技术产业开发区	Shangao New Technological Industrial Development Zone	佛山市大幅路市政府大院10号楼, 528000	No.10 Building City Government Dafu Road Fuo Shan City, 528000	86757 338 6093 86757 335 5158	86757 335 5686
	103	惠州仲恺高新技术产业开发区	Huizhou Zhongkai New & High Technological Industrial Development Zone	惠环镇仲恺开发区75号, 516006	No.75 Zhongkai Development Zone, Huihuan Town, Huizhou, Guangdong province, 516006	86752 260 5480	
	104	汕头高新技术产业开发区	Shantou New & High Technological Industrial Development Zone	汕头高新技术产业开发区 515041	Shantou New & High Technological Industrial Development Zone 515041	86754 846 3433	86754 836 5429
	105	中山火炬高技术产业开发区	Zhongshan Touch Hi-Tech Industrial Development Zone	中山火炬高技术产业开发区 528431	Zhongshan Touch Hi-Tech Industrial Development Zone 528431	86760 559 6050	86760 559 7917
广西 Guangxi	106	南宁经济技术开发区	Nanning Economic Technological Development Zone	南宁经济技术开发区 530031	Nanning Economic Technological Development Zone 530031	86771 451 6160	86771 451 6160
	107	南宁高新技术产业开发区	Nanning New & High Technological Industrial Development Zone	南宁高新技术产业开发区 530003	Nanning New & High Technological Industrial Development Zone 530003	86771 383 6393	86771 382 7201
	108	柳州高新区	Liuzhou New & High Technological Industrial Development Zone	柳州高新区 545006	Liuzhou New & High Technological Industrial Development Zone 545006	86772 261 2217 86772 261 2209	86772 261 7644
四川 Sichuan	109	成都经济技术开发区	Chengdu Economic Technological Development Zone	成都市龙泉区政府101楼, 610100	101 Building, Longquan District Government, Chengdu, 610100	8628 485 2829	
	110	成都高新技术产业开发区	Chengdu Hi-Tech Industrial Development Zone	成都高新技术产业开发区 610041	Chengdu Hi-Tech Industrial Development Zone 610041	8628 518 4155	8628 518 4066
	111	绵阳高新技术产业开发区	Mianyang Hi-Tech Industrial Development Zone	绵阳高新技术产业开发区 621000	Mianyang Hi-Tech Industrial Development Zone 621000	86816 253 2610	86816 253 2016

China Development Zone List

Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
	112	绵阳国家高新技术产业开发区	Mianyang National Hi-Tech Industrial Development Zone	绵阳市棉兴路西段40号 621000	No.40 East Part Mianxing Road Mianyang City, Sichuan 621000	86816 253 2016 86816 253 2020 86816 253 2937	
贵州 Guizhou	113	贵阳经济技术开发区	Guiyang Economic Technological Development Zone	贵阳市黄河路贵阳经济技术开发区，550009	Huanghe Lu, Guiyang Economic and Technology Development Zone, 550009	86851 383 0769	
	114	贵阳高新技术产业开发区	Guiyang Hi-Tech Industrial Development Zone	贵州市贵阳新天大道火炬大厦 550018	Torch Tower Xintian Ave. Guiyang Guizhou Province 550018	86851 684 6059 86851 684 6672 86851 684 6673	86851 6846 6448

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Area	No.	Development Zone Name		Address		Telephone No.	Fax No.
		Chinese	English	Chinese	English		
云南 Yunnan	115	昆明经济技术开发区	Kunming Economic Technological Development Zone	昆明经济技术开发区昆经路1号, 650217	No.1 Kunjing Road Kunming Economic Technological Development Zone, 650217	86871 727 4962	86871 727 5003
	116	云南民办科技园	Yunnan Local Science & Technological Park	护国路22号, 650000	No.22 Huguolu, 650000	86871 318 6641	
	117	昆明国家高新技术开发区	Kunming National New & High Technological Development Zone	昆明市二环西路中段一号 650118	No.1 Middle Part of Second Ring West Road, Kunming Yunnan Province 650118	86871 831 1306 86871 818 8750	86871 818 8795 86871 818 8794
陕西 Shannxi	118	汉中经济开发区	Hanzhong Economic Development Zone	汉中经济开发区北区管委会 723000	North Management Committee Hanzhong Economic Development Zone 723000	86916 231 1475	86916 231 0219
	119	西安经济技术开发区	Xi'an Economic Technological Development Zone	西安经济技术开发区 710016	Xi'an Economic Technological Development Zone 710016	8629 652 0244	8629 652 1102
	120	宝鸡高新技术产业开发区	Baoji Hi-Tech Industrial Development Zone	宝鸡高新技术产业开发区 721006	Baoji Hi-Tech Industrial Development Zone 721006	86917 367 4086	86917 367 4818
	121	西安国家高新技术产业开发区	Xi'an National Hi-Tech Industrial Development Zone	西安高新路火炬大厦 710075	Torch Building Gaoxin Road Xi'an China 710075	8629 821 0486	8629 821 0481
	122	杨凌农业高新技术产业示范区	Yangling Agriculture Hi-Tech Industrial Demonstration Area	杨凌示范区西农路6号 712100	No.6 Xinong Road Yang Ling Demonstration Area 712100	8629 701 1355 8629 701 1353	8629 701 1353
	123	陕西渭南高新技术产业开发试验区	Weinan Hi-Tech Industrial Development Test Zone	陕西渭南高新技术产业开发试验区 714000	Weinan Hi-Tech Industrial Development Test Zone Post Code: 714000	86913 211 5928	
	124	西安高新技术产业开发区长安科技产业园	Xi'an Hi-Tech Technological Industrial Development Zone-Chang'an Science & Technological Industrial Park	西安市长安县郭杜镇 长安园基地西沣一级公路3公里处 710061	3kilometres of Xifeng First Level Road, Chang'an Park Base Guodu Village, Chang'an County Xi'an City, Shannxi Province 710061	8629 584 4955 8629 584 4966	8629 854 4980
宁夏 Ningxia	125	宁夏石嘴山河滨工业园区	Shizuishan Hebin Industrial Park Ningxia Province	宁夏石嘴山河滨工业园区 753202	Shizuishan Hebin Industrial Park Ningxia Province 753202	86952 368 1121	86952 368 8667
	126	银川高新技术产业开发区	Yinchuang Hi-Tech Industrial Development Zone	银川高新技术产业开发区	Yinchuang Hi-Tech Industrial Development Zone	86951 503 6144	
新疆 Xinjiang	127	乌鲁木齐经济技术开发区	Urumqi Economic Technological Development Zone	中国新疆乌鲁木齐经济技术开发区中亚大道68号 830026	No.68 Zhongya Dadao Urumqi Economic Technological Development Zone Xinjiang 830026, China	86991 371 3834	86991 371 3116