THE PROFESSIONAL ASSOCIATION FOR CHINA'S ENVIRONMENT

SINOSPHERE

Volume 1 Issue 2 September/October 1998

Contributing to a better environmental future for China and the world

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Welcome to the Issue

During the past two-decades, China has experienced dramatic economic growth. As one of the designated pillar industries, the Chinese auto industry has experienced even more explosive growth. But economic growth comes with price. The rapid increase in vehicle population has resulted in severe traffic congestion and unbreathable urban air quality in large cities such as Shanghai and Beijing. Considering the huge potential for further growth, it is critical for Chinese policy makers to reexamine its transportation policies and take measures to reduce vehicle emissions and improve transportation energy efficiency.

In this issue, we will feature several articles addressing transportation related energy and environment problems faced by today's China. In the Spotlight on China, Sandra Cornell tells us stories from Shanghai about urban environmental problems faced by the largest city in China. In the following featured essays, James Cannon discusses alternative transportation research and development programs in China, Feng An and Marc Ross offer their opinions about options to improve energy efficiency and reduce vehicle emissions from China's transportation sector, Michael Walsh addresses motor vehicle pollution control programs in China, and Mr. Jiang Dahe discusses the vehicle emissions and air pollution problems in Hong Kong. In the Marketplace column, Ford Motor Company presents an article: Ford Motor Company and Environmental Stewardship in China, to describe its involvement in various environmental programs in China. The China's Environmental Legal System Column continues to feature the second installment of a four-part series that discusses the state of environmental law in China by Zhang Hongjun and Richard Ferris.

In the next issue of SINOSPHERE, we will feature discussions of the energy efficiency industry in China. If you have done researches on energy efficiency related topics, we encourage you to send us essays or abstracts that you would like us to include in the next issue. I hope you will all enjoy this issue.

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SINOSPHERE is produced for the Professional Association for China's Environment, a non-profit, non-partisan education and research organization whose primary purpose is to increase awareness of environmental problems in China. PACE also sponsors seminars, workshops, and conferences in the United States and China.

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By Sandra Cornell

Pan Hongwei, a 27 year old swim coach, weaves his Xingfu motorbike through the maze of vehicles on Shanghai's crowded streets. Around him streams of blackness erupt from the exhaust pipes of engines coughing and belching their way through the city. "They are very dirty," he says frowning at a passing moped. Pan doesn't like what he breathes every day on Shanghai's roads.

The streets of Shanghai are no longer the carless domain of Flying Pigeon cyclists. Today the streets of the world's most populated city carry more than one million gasoline powered vehicles - and the number is growing rapidly as private vehicle ownership becomes a possibility for the city's many affluent, middle-class residents. While the dream of a "car for every family" continues to be promoted as a sign of China's development, authorities recognize that vehicle emissions are a major contributor to serious air pollution problems in large cities. According to the deputy director of the Shanghai Environmental Protection Bureau, exhaust emissions from motor vehicles and mopeds are one of the main factors detrimental to the city's air environment. In Shanghai, 70 percent of the carbon monoxide in the air is directly attributable to motor vehicles.

It is not just the growing density of vehicles that is of concern in Shanghai and other Chinese cities. Most vehicles in China have none of the emission control equipment that is standard on many Western cars. A recent World Bank study is reported to have found that low-tech Chinese made cars emit up to 40 times as much carbon monoxide, 15 times as much nitrogen oxide and 60 times as many hydrocarbons as U.S. cars. Although Beijing currently has only one tenth the number of vehicles as Los Angeles or Tokyo, the pollution created by motor vehicles in Beijing equals that in each of the other two cities, according to the World Bank. Moreover, China's petrol contains 0.78 grams of lead per liter compared with 0.15 grams of lead per liter in Hong Kong, Singapore and many Europeans countries.

The impact of poor air quality on human health is a major cause for concern. A number of studies reported in the 1998-99 World Resources report on Environmental Change and Human Health show significant links between air pollution and respiratory illness (asthma, bronchitis and respiratory infection), pulmonary heart disease, hospitalizations, lead poisoning, and premature death in cities throughout China. According to World Bank estimates 178,000, or 7 percent, of deaths in China's urban areas could be prevented each year by meeting class 2 air quality standards.

Here in Shanghai, Professor Shen Xiaoming, vice director of the Shanghai Children's Medical Center (SCMC) has taken a particular interest in lead poisoning in the city's children. Professor Shen and other researchers studied 1969 children between one and six years of age and found 37.8% had blood lead levels equal to or higher than the level defining lead poisoning (10 micrograms per deciliter) - a level at which IQ is known to deteriorate significantly. One factor that correlated highly with the children's lead levels with

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time spent on or near the city's traffic ways. Dr. Frieda Law, an Australian pediatrician with Project Hope, a non-profit organization that aims to improve health care in China, emphasizes the importance of long range blood lead level monitoring. "There are no overt signs to help us identify children with lead poisoning," she said.

Like many other cities in China, Shanghai authorities are addressing these problems aggressively.

Unleaded gasoline was introduced to Shanghai in October 1997, and a nationwide ban on the production of leaded gasoline will take effect at the end of next year. Taxes are being increased to keep the price of leaded fuel at least as high as that of unleaded gas. Stricter standards for controlling vehicle emissions have been announced by the National Environmental Protection Agency, and emissions control technology is being developed and gradually introduced. Air quality monitoring stations have been set up around the city and emissions testing-stations are being established. Last year a ban on marketing and licensing petrol-driven mopeds was announced with the intention of reducing their number from 470,000 to 100,000 by the year 2000. A number of taxis and buses have been converted to run on natural gas. The city has also set up a development center to promote research into battery powered vehicles, and is creating a network of battery recharging stations to provide cost effective and convenient electricity.

The city's bullish approach to vehicle emissions is bringing new business opportunities to Shanghai and foreign investors are lining up to aquaint the city's vehicle manufacturers with environmentally friendly technology.

The U.S. manufacturing company Corning is exploring the new market for catalytic converters. The introduction of lead-free petrol means that catalytic converters, which eliminate various pollutants from vehicle emissions but which can not operate effectively with leaded petrol, can be developed for China's vehicles. A Californian company, ZAP Power Systems, announced recently the opening of a retail/rental store here that will carry U.S. designed electric motor scooters and electric bicycles. Another international company, is developing modern battery technology that will enable the efficient operation of electric bikes and may eventually power electric mini buses. The city's commitment to developing battery powered transportation could make Shanghai the world leader in the use of electric vehicles. "When I see a bus coming around the corner and stepping on the gas," says an expat executive who bicycles around Shanghai, "I become a real believer [in electric vehicles]."

The Shanghai city authorities have made a commitment to address the serious and growing issue of exhaust emission pollution in the city. While there are many problems with implementation and enforcement, the new policies that promote cleaner technologies are essential to the city's sustainable development. But as the Chinese become wealthier and private vehicles become available to more and more of the country's 1.2 billion residents, other issues will raise ugly heads. Even zero pollution vehicles create accidents, take up space, and require roads, parking, repair stations and traffic management. Perhaps that will be the challenge of the next century.

Sandra Cornell is a freelance journalist who lives and works in Shanghai, China.

China's Environmental Legal System

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Shaping an Environmental Protection Regime for the New Century: China's Environmental Legal Framework*

By Zhang Hongjun and Richard Ferris, Jr.

* The second installment of a four-part series that discusses the state of environmental law in China.

National environmental statutes, regulations, rules, methods, standards, local legislation, and international treaties to which China has acceded, form the body of the Chinese environmental regulatory regime. In the period following the Cultural Revolution of 1966-76, China experienced a burgeoning of legislation and regulatory organs directed at environmental protection.1 Much of the fundamental environmental legislation includes broad terminology that is difficult for the regulated community to decipher, or follow in the way that environmental legislation guides regulated entities in, for example, many Western countries. Nevertheless, as a result of the legislative reforms that began with the establishment of specialized law drafting committees under the NPC in 1993, implementing regulations and standards tailored to the particular industrial pollution sources, pollutant loads and regulatory capacities of localities are being formulated at an unprecedented rate. Although more law does not necessarily mean more enforcement in these early stages of regulatory development, the increase in media attention focused on environmental legislation and the availability of the legislation in bookstores has had a profound effect on the Chinese populace. A two-fold increase in the amount of civil cases reaching the courts has occurred over the past decade.2 Environmental issues have been hot topics of debate in recent congressional meetings at both the national and local levels. Consequently, legislative proposals related to environmental protection are being reviewed with an exceptional level of attention by government authorities and citizens.

Even so, it is obvious that certain environmental media and protection issues have yet to receive sufficient attention from legislators and relevant drafting committees. This is in part a result of the complexity of issues that must be addressed, such as solid and hazardous waste management in a country with the waste-production capacity of one-fifth of the world's population. It is also a result of the weighty mandate of the drafting committees, which are charged with the creation or amendment of a comprehensive set of statutes, regulations, rules, methods, and standards to keep pace with China's breakneck economic development. Before legislative reform in 1993, it usually took several years to adequately draft one amendment to an environmental law. Moreover, even though the 1993 legislative reforms expedited the drafting process, a substantial amount of time is required to draft legislation for environmental issues that are entirely new to the body of existing national statutes, such as radioactive pollution prevention. These regulatory gaps frustrate comprehensive management of environmental pollution and until the missing links are forged, environmental law and policy goals will be undermined.

Law drafting is also made more difficult by the fact that most of China's early environmental laws and policies were drafted to accommodate a planned economy. Currently, however,

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Alternative Transportation Research and Development

Alternative Transportation Research and Development in China*

By James Cannon

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* Adopted from "China at the Crossroads - Energy, Transportation, and 21st Century," published by INFORM, June 1998.

Although China's fleet of motor vehicles is dwarfed by the estimated 600 million bicycles that ply its roads, the use of motor vehicles is growing much faster than any other ground-based transportation alternative. While the last twofold increase in the world's motor vehicle population took 20 years to occur, in China it took just three years.

Motor Vehicle Manufacturing

Despite this recent explosive growth, China's automotive market has barely been touched. There is still only one motor vehicle per 115 people in China, compared to one vehicle for every 1.3 people in the United States. China's motor vehicle population is only 6 percent that of the United States. If its vehicles per capita were the same as ours, there would be 920 million vehicles in China alone—47 percent more than the entire motor vehicle population of the world today.

Motor vehicle manufacturing in China has nearly tripled this decade, to about 1.5 million vehicles per year, the great majority of which are trucks. (The United States manufactures 10 million vehicles annually.) An additional 100,000 vehicles are imported annually. Most automotive manufacturing in China is performed by joint ventures involving foreign companies. The first, and for a long time only, foreign automobile company licensed to build passenger sedans in China was Volkswagen. Working through a joint venture with the Chinese-owned Shanghai Automotive Industries Corporation, Volkswagen is by far the largest car manufacturer in China, producing 122,000 cars in 1994 (including the popular Santana, which is widely used as a taxicab). Daihatsu is the second largest automotive manufacturer in China, producing 58,000 cars per year. As of 1994, other automakers operating in China included Citroen and Peugeot, with total car production by all companies totaling 239,000 annually.

During the past few years, new joint ventures with foreign partners have led to a major expansion in automotive manufacturing in China. Arrangements for the first joint venture with an American company to produce a passenger sedan were completed in March 1997. This $1 billion deal between General Motors and Shanghai Automotive Industries will result in the manufacture of up to 100,000 Buick Regal and Century automobiles at a new assembly plant to be built in China around the end of the decade. These full-size cars, which have very low fuel efficiency (under 25 miles/gallon), will burn both leaded and unleaded gasoline and will not be equipped with catalytic converters.

In contrast to the US vehicle fleet, which is vastly dominated by passenger cars, China's fleet is mainly composed of trucks, buses, and other heavy vehicles used by government and industry. These include over 500,000 buses, compared to only 65,000 in the United States. Most of China's commercial trucks and buses are manufactured by companies that are wholly Chinese-owned. One US company, Chrysler, has been manufacturing the light-duty Cherokee truck for years in China, first for the military and more recently for purchase by private citizens. Unlike commercial vehicles, nearly all automobile production involves joint ventures with foreign partners. Joint-venture manufacturing agreements exist with Peugeot, Daihatsu, and Suzuki.

China's large motorcycle population accounts for about 10 percent of the motor vehicle fleet. Motorcycle manufacturing, like car production, occurs largely through joint ventures. It, too, is growing

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rapidly, despite steep registration fees and safety-related restrictions on the use of motorcycles in some cities, including Beijing and Shanghai.

Taken together, there were 123 motor vehicle manufacturing plants operating in China in 1997, the 13 largest of which are responsible for over 90 percent of the industry's output. Most motor vehicle manufacturing occurs near Shanghai and in the northeastern province of Liaoning, where Dalian, China's version of Detroit, is located.

Because the number of motor vehicles in China has only recently begun to expand, transportation accounts for less than 7 percent of the country's total energy use (compared to 27 percent in the United States). As in the United States, however, virtually every motor vehicle in China depends on an internal combustion engine powered by either gasoline (leaded and unleaded) or diesel fuel. Since most Chinese automobiles and trucks are small vehicles, their fuel economy tends to be good. Large trucks and buses, however, are equipped with older, more inefficient engines. Vehicles in China are equipped with virtually no pollution controls.

Alternative Vehicles and Fuels

The dependence of China's motor vehicles on oil-derived fuels and conventional internal combustion engine technology appears certain to continue into the foreseeable future, unless current trends are modified. Development of alternative transportation fuels and advanced propulsion systems that do not rely on oil has barely begun in China. Only a few encouraging signs of change have emerged. There is significant commercial use of natural gas, as well as considerable interest in developing electric-battery vehicle technology, especially for motorcycles. There are also several small-scale demonstrations under way involving other alternative fuels and propulsion systems.

Natural Gas Vehicles

The use of natural gas as a transportation fuel in China dates to the 1950s. According to the Institute of Natural Gas Vehicles in Beijing, there are approximately 2500 natural gas vehicles in China today, nearly all of which are buses, which must rely on only 35 refueling stations. In the United States, by contrast, there are over 60,000 natural gas vehicles in operation, including nearly 2000 buses, and 1200 refueling stations.

Most natural gas vehicles in China are found in the natural gas-rich Sichuan province. Fleets of hundreds of natural gas buses are operating in the provincial capital city of Chengdu and in Zigong. Smaller fleets are operating in other Sichuan cities as well. The design of these natural gas buses is not at all like that of natural gas buses in the United States and other countries. In conventional designs used elsewhere, natural gas is stored either in a highly compressed form in metal storage cylinders or in a super-cooled, cryogenic liquid state. In Chinese buses, on the other hand, the gas is typically stored in large rubber bags that sit atop the vehicles like balloons. The pressure in these bags is only 6 to 7 atmospheres, compared to 200 to 300 atmospheres of pressure in the storage cylinders. Because of the low pressure, the bags must be huge—typically the size of the bus frames on which they sit—in order to accommodate sufficient quantities of fuel. Even so, the range of these buses before refueling is typically less than 100 miles. As the gas is consumed, the bags gradually deflate, providing an obvious indicator of the need to refuel.

Although this fuel storage technology is primitive, it has been used successfully for decades. The bags are cheaper than tanks and the refueling equipment is simpler. One problem, however, is that the bags can snag and rip if they catch on overhead branches or power lines. They can also restrict access to tunnels and underpasses.

In addition to the bus fleets of Sichuan, a few vehicles in other regions are using natural gas produced as a by-product of oil production and traditionally vented or flared. One conventional high-pressure natural gas refueling station has been built near the Daqing oil fields in northeastern China to service a fleet of 200 natural gas trucks. In Beijing, the city's first fleet of 10 natural gas vehicles is planned as soon as a refueling station is connected to a recently completed natural gas pipeline. Entex Fuels, Inc., of Houston, Texas, is a leading US participant in this project. In Xi'an, 150 conversion packages that will allow conventional cars to burn natural gas have been sold by Clean Vehicle Systems, a New York-based company. The packages are to be installed by a joint-venture company in China. A small fleet of natural gas vehicles is also operating in Xinjiang province.

In September 1997, China's first commercial buses powered by liquefied natural gas (LNG) took to the streets of Haikou, capital of China's island province of Hainan in the South China Sea. The buses are the first stage of a much larger effort, valued at over $4 million, to convert 5300 cars and buses in Haikou to LNG. In early 1997, LNG storage and fuel handling equipment made by Denver, Colorado-based Cryenco Sciences, Inc., was licensed for sale in China for the first time, further signaling the country's growing interest. An earlier LNG demonstration project took place in 1990, when Kaifeng Cryogenic Devices Manufacturing Company converted a bus to LNG in the eastern interior province of Henan.

Numerous other natural gas initiatives have been reported over the past six months. In May of 1998, Volvo displayed various natural gas-powered vehicles to Beijing city officials seeking solutions to the city's traffic and pollution problems. Also in May, Beijing officials and automotive experts completed a six-month technical training program conducted by General Motors and IMPCO Technologies, Inc., in cooperation with the Beijing Science and Technology Commission. The officials are developing standards and infrastructure to facilitate conversion of Beijing's buses and taxis to natural gas. As part of the program at IMPCO's technology center in Irvine, California, Chinese engineers converted a five-passenger taxi designed by Beijing Automotive Industrial

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Corp. Group to natural gas.

Liquefied Petroleum Gas

Liquefied petroleum gas (commonly called LPG or propane, after its chief chemical constituent) is available in limited quantities as a by-product of natural gas production and oil refining in some regions of China. Like natural gas, LPG burns more cleanly and completely compared to gasoline or diesel fuel, and the air-tight storage system required to contain the gas eliminates emissions from evaporation.

In September 1997, a major project was announced by the Chinese news agency Xinhua that, if implemented, will result in the nation's largest LPG-powered transportation fleet: all 15,000 public transit vehicles in Shenzhen, near Hong Kong, are to be converted to run on LPG by the year 2000, beginning with 1000 taxis. This project, whose projected cost is over $19 million, is being undertaken as part of an effort to combat air pollution, to which motor vehicles contribute some 65 percent in Shenzhen.

Electric Battery Vehicles

In the past few years, the first serious research and development effort to build and test electric battery-powered vehicles was initiated in China. Only a few electric vehicles have been built to date. Most electric-battery vehicle development to date has been located at Tsinghua University in Beijing, which is directing a program with more than 10 other research agencies and industrial partners. So far since 1992, four electric-battery minivans and one electric bus have been built. The vehicles are equipped with lead-acid batteries.

A second electric-vehicle project began in late 1996 at the Beijing Institute of Technology. The first vehicle produced was a compact passenger car equipped with a nickel–metal-hydride battery developed by the General Research Institute for Nonferrous Metals, also in Beijing. The institute, one of the world's leading research centers for hydride material development, currently manufactures about 50 tons of the materials per year for use in hydrogen storage systems and nickel–metal-hydride batteries. The Beijing Institute's car has a range of approximately 75 miles and a top speed of 70 miles per hour. A second vehicle using nickel–metal-hydride batteries has also been built—a tricycle with a top speed of 14 miles per hour.

In late 1996, the State Science and Technology Commission announced the formation of a panel of experts to coordinate the nation's electric-battery vehicle R&D efforts. A total of $12 million has been approved by the commission to fund these programs over the next couple of years. The commission has also announced a goal of between 3000 and 5000 electric-battery vehicles for China by the year 2000.

Since then, the French auto company Peugeot has formed a joint venture with Dong Feng Motors in Hubei province to develop electric cars and vans, and American Electric Automobile Company of Bonita, California, has signed an agreement with the Guangdong Science and Technology Commission to convert several gasoline-powered cars to run on electricity. Accordingly, American Electric formed a joint venture with China Electric Automobile Company of Hong Kong in May 1997. Also, in August 1997, Wilmington, Massachusetts-based Solectria Corporation announced an agreement whereby GPE Industries Ltd. will be licensed to manufacture electric-vehicle components developed by Solectria. GPE is part of Gold Peak Industries Ltd., China's largest manufacturer of car radio and electrical wiring systems.

In the meantime, a major effort has been under way to sell electric bicycles in China. In February 1997, ZAP Power Systems of Sebastopol, California, which sells electric bicycles in the United States, established a joint venture between its ZAP China division and Shanghai Forever Company Ltd., which manufactures three million bicycles in China per year. The partners will manufacture bicycles in China and sell them at the 1500 sales outlets currently operated by Shanghai Forever. ZAP will provide the first 50,000 motors from its manufacturing plant in the United States. Future plans call for the production of a variety of small electric vehicles, including three-wheel bicycles, scooters, and motorcycles. In March 1997, the project received a $20,000 grant from the US Environmental Protection Agency.

Hydrogen Vehicles

INFORM's visit to China in September 1997 was part of a "hydrogen energy delegation" (organized by the Spokane, Washington-based People to People Ambassador Program) to institutions specifically involved in hydrogen projects. The welcoming meeting provided the first hint of what the delegation would learn about the state of hydrogen development in China.

The agenda called for the group to be greeted by the chairman of the "China Hydrogen Association," but no such official was present. Repeated calls to the China Energy Association and other organizations found no evidence that a specific organization dedicated to hydrogen energy issues even exists in China. Instead of a focused discussion, the opening meeting served as a forum for officials from the Energy Research Institute to provide a broad overview of energy in China. When asked specifically about hydrogen, Deputy Director Zhou Da Di responded, "There is no practical plan to develop hydrogen over the next 20 years."

Two weeks of meetings confirmed that hydrogen energy development in China is only now beginning. The delegation did uncover several recently initiated hydrogen vehicle projects involving fuel cells, an important early step toward a more comprehensive national effort. Additional hydrogen R&D projects were also found to be under way at several research and academic institutions.

A joint hydrogen fuel cell bus project was inaugurated in 1995 between the Institute of Nuclear Energy Research at

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Tsinghua University in Beijing and the Karlsruhe Research Center (formerly the Karlsruhe Nuclear Research Center) in Germany. The project is an outgrowth of previous collaboration on nuclear energy development and exemplifies a broadening of energy research activities at both institutions. The goal of the project is to develop a fuel cell-powered bus similar to Tsinghua University's electric-battery bus. Although the collaboration is three years old, it only began to receive serious attention late in 1997. Decisions about what fuel cell technology and hydrogen storage system the bus will employ are likely to be made in 1998.

The Shanghai Institute of Organic Chemistry is the lead agency in a second fuel cell vehicle project. According to Deputy Director Dr. Jiang Biao, this is a "big project" that aims to incorporate a membrane developed over the past 10 years at the institute into a commercial fuel cell. So far, a 1.2 kilowatt proton-exchange membrane fuel cell has been built and the institute is working with four other partners (including Shanghai Automotive Industries Corporation and the Chemical Physical Sciences Institute in Dalian) to design a fuel cell-powered automobile using the technology. The national government is investing $2 million per year in this project, which may produce a prototype as early as the end of 1998.

In October 1997, the W. Alton Jones Foundation announced a grant of $127,000 to support the development of hydrogen fuel cell bus projects in three Chinese cities: Changchun, in the northeastern province of Jilin; Shanghai; and Ningbao, in the province of Zhejiang south of Shanghai. The first phase of this project, in the first half of 1998, includes workshops for preliminary discussion and data collection. Phase II will involve site visits to fuel cell manufacturers, followed in August 1998 by the development of specific fuel cell bus designs. The project is coordinated by the Unirule Institute of Economics in Beijing.

Several other hydrogen research projects are being conducted at Shanghai Jiao Tong University's Department of Electrochemistry. One of these involves collaboration with the Japan Central Institute for Electricity to develop a molten carbonate fuel cell for stationary-source electrical generation. A second effort involves development of a proton-exchange membrane fuel cell. These two projects are supported by $625,000 in funding from the national government.

A hydrogen research project at the China Petroleum University near Beijing has as its goal a process for removing hydrogen from the large quantities of waste hydrogen-sulfide gas generated during oil production and refining. A two-step, indirect electrolysis process is under development that would convert this highly poisonous and corrosive gas into pure hydrogen and sulfur. (The sulfur, extracted as a solid, could then be sold or disposed of as a solid waste.) Finally, the General Research Institute for Nonferrous Metals is developing hydride materials for hydrogen storage (see the section on electric-battery vehicles).

While hydrogen R&D in China is only beginning, there are signs that hydrogen is capturing the attention of energy policymakers and that its role in future energy development may increase. In May 1997, the United Nations Development Program sponsored a two-week trip by seven leading Chinese hydrogen experts to the United States, Germany, and Canada. The leading government agency involved in setting energy research and development policies—the Science and Technology Commission—is currently preparing a national hydrogen energy development plan. Finally, having won a competition held in 1996, China will host the 13th World Hydrogen Energy Conference in Beijing in 2000. By then, it is possible that hydrogen vehicle programs in China will have increased far beyond the level of today's activities.

China's Transportation System: The Opportunities Ahead

China's reliance on fossil fuels to meet its energy needs has already created terrible risks for its environment, its security, and its people's health. Yet the opportunity exists for China to make a transition in one area of energy use that could be a model for the world: a transportation system based on cleaner alternative fuels and vehicle technologies. China can also take advantage of the lessons learned from the United States and other industrialized nations by planning mass transit and rail systems that will move its people rapidly, comfortably, and conveniently across and between cities.

Time to Change Course

Up until now, China's transportation sector has relied increasingly on oil and on the technology of the internal combustion engine to build the nation's growing motor vehicle fleet. This pattern of energy development raises troubling issues for both China and the United States.

World oil consumption in 1994 stood at 66.8 million barrels per day. Assuming a modest 2 percent annual growth rate, more oil will be consumed globally just during the next 20 years than throughout all of previous history. Were current trends to continue and China's per capita oil consumption to ultimately equal the current US rate, Chinese demand alone would exceed total oil production in the world today by 18 percent. Clearly, the emergence of a major new market for oil in China would greatly accelerate the existing drain on this already dwindling resource.

Reliance on oil-fueled vehicles in the twenty-first century makes no more sense for China (or for any other country) than continued reliance on the horse would have been for the United States 100 years ago. A significant motor vehicle transportation system in China will require huge capital investments, and it will be decades before that system even begins to match its counterpart in the United States. If oil and the internal combustion engine are China's chosen fuel and propulsion technology, global oil supplies will likely be constrained by the time the nation's transportation infrastructure

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is established.

Although China is not completely ignoring transportation strategies based on alternative fuels and technologies, its overall approach to date has been to increase deployment of conventional technologies and expand its use of oil. When faced with lagging domestic oil production, China, like the United States, has chosen to increase oil imports rather than seek diversification to other fuels. With oil imports inching steadily upward toward 60 percent of total demand in the United States and 20 percent of total demand in China by 2010, the stage is set for competition of an intensity that could threaten the security of both countries.

Similarly, the fate of China's environment is inexorably linked to the transportation system it provides for its people. Automotive emissions are the most rapidly growing source of urban air pollution in most Chinese cities. Programs requiring the installation of catalytic converters and the use of cleaner-burning reformulated gasoline would be costly and difficult to implement, and even if successful, would do nothing to reduce emissions of carbon dioxide. In the United States, oil burning—mainly in vehicles—is already the largest source of carbon dioxide emissions, accounting for more than 40 percent of the total. If China continues on its current energy path, its own environment will undoubtedly meet with the same fate.

Clean Fuels and Other Options

China has only limited time to analyze its options and set the nation's course—one that hopefully will serve its people's needs while also promoting energy security and environmental well being for the rest of the world.

The good news is that China is still very near the starting point in its efforts to establish a nationwide transportation system. Unlike the United States, the choice it makes is not heavily encumbered by economic investments in a preexisting infrastructure. This means it can build a system from the ground up, using the latest propulsion technologies and fuels, rather than attempting to replicate the oil-based model of the nineteenth century. Among the most promising options are natural gas vehicles and a variety of electric and hydrogen vehicle technologies.

To get the job done, China will have to make a much greater commitment to developing these new technologies. A good first step would be a national program aimed at marketing electric-vehicle technologies and establishing the necessary fuel infrastructure. Some impressive work is already under way, but there is a risk that progressive transportation strategies will be subsumed by the proliferation of gasoline-powered vehicles.

Programs to diversify transportation fuels to include non-oil alternatives are only beginning in China. The only significant historical use of alternative fuels in motor vehicles is natural gas, long used in buses in Sichuan province. Several programs are now expanding the use of natural gas and liquefied petroleum gas in a variety of vehicle types, including passenger vehicles and trucks as well as buses. Such efforts will have to be greatly expanded if China is to combat its increasing dependence on oil through alternative fuels.

A Market for US Industry

Development of a transportation system in China based on alternative fuels and propulsion technologies would provide the United States with enormous market opportunities. Alternative fuels and vehicles have established a presence in the US market, but it is minuscule compared to the conventional automotive and oil industries. The ultimate success of the alternative fuel industry in the United States may well hinge on its ability to sell its products, technologies, and skills on the international market.

China represents by far the largest potential transportation market for this fledging industry, especially the urban bus market. There are more buses in China than in any other country in the world—at over 500,000, more than eight times the number in the United States. Shanghai alone has 6000 buses and Beijing has 5000. Buses offer China the opportunity to expand access to transportation to the largest number of people in the shortest time and at the least cost, while making most efficient use of the country's limited existing roadways.

Urban buses are also the strongest sector in the US alternative transportation fuel industry today, so there is an excellent fit between the transportation needs of China and the products and services available from US companies. More than 20 percent of all buses now under construction in the United States will be equipped to burn natural gas. A large industry of natural gas bus equipment suppliers and installers has sprung up to serve this market. Moreover, bus chassis and engine manufacturers have modified their products to accommodate natural gas fueling technology.

China's Crossroads

China's economic polarities and its enormous social, political, and cultural contrasts with the United States confound attempts to predict with any confidence the country's future direction. This is particularly true in the area of energy development. In a Shanghai shantytown, an electric light bulb burning over a coal-fired cooking stove may well be powered by a nuclear generating station. In Beijing, luxury cars weave cautiously through traffic snarled by thousands of bicycles and hand-pulled carts. Throughout China, the incessant clash of such disparate elements threatens at any moment to rip apart the already frayed social fabric of this nation in transition.

Will China commit itself to developing the fuels, vehicle technologies, and infrastructure that will define the transportation systems of the twenty-first century? The advantages of doing so are enormous, for China's population, security, and environment and those of the rest of the world.

SINOSPHERE

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Ford Motor Company and Environmental Stewardship in China

By Dennis Schuetzle, Weiping Zhu, Weijian Han and Michelle Marcoux
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Introduction

Scientific cooperation between Ford Motor Company and China was established in 1978 when Henry Ford II met with Premier Deng Xiaoping in Beijing. The Ford China Visiting Scientist/Engineer Program was initiated shortly after this visit. The first two Visiting Scientists worked in Ford's Scientific Research Laboratory on the development of instrumentation for the measurement of environmental pollutants. In 1986, Ford provided technical assistance to the Chinese State Education Commission, the World Bank and the United Nations Development Program to help plan the establishment of environmental testing and analysis laboratories in 57 provincial universities and institutes throughout China. These laboratories, completed during 1989-90, were equipped with the latest scientific instrumentation and staffed with qualified personnel.

In the early 1990's, Ford established a policy of "Environmental Stewardship" as a proactive approach to preserve the global environment, promote the development of fuel efficient vehicles, encourage the efficient use of materials, and advocate environmental awareness through education and conservation. Ford has currently over $1.0 billion invested in research, development and testing facilities, and spends about $750 million/year to support these environmental efforts. As a result, Ford is recognized as a global industry leader in environmental quality and energy conservation programs.

In 1993, Ford initiated cooperative research and development efforts to support China's rapidly developing transportation industry. Nearly half of Ford's presently active 28 cooperative R&D projects in China support environmental and energy initiatives. These projects are carried out in 23 universities and institutes in 17 cities and in cooperation with 13 governmental organizations.

Environmental Conferences and Workshops

Ford has sponsored several automotive conferences and workshops to help develop policy and technical recommendations in support of issues related to energy and the environment in China's transportation industry. In 1995, Ford sponsored the China Automotive Technology Workshop in which approximately 100 experts participated from more than 40 government, industry and academic organizations in China and the United States. These experts drafted 44 key policy and technical recommendations in the areas of fuels and energy, environmental sciences and technology, emission control technologies, life cycle assessments and harmonization of global standards. Several of these recommendations were included in China's Ninth Five-Year Plan.

Since the Workshop, follow-up meetings, conferences and workshops have been held and

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research projects initiated to implement these key recommendations. During 1998, Ford sponsored follow-up workshops in Beijing and Shanghai to help develop strategies and regulations for the control of vehicle emissions in China during the next decade. Some key recommendations included the elimination of leaded fuel in major urban areas in 1999 and throughout China by May 2000, the addition of catalytic converters on all new vehicles by 2002-2003 to meet the European #83-01 standards for light and medium duty vehicles; and European #R89 standards for heavy duty vehicles. In addition, it was recommended that policies should be developed to encourage the establishment of CNG and LPG fueled vehicles and the development of an urban infrastructure for these fuels. The recommended applications include fleet vehicles such as medium-duty (8-22 passenger) and heavy-duty buses, and commercial trucks.

Using the China Workshop as an example of how to effectively help emerging market governments with long-term planning for their transportation industry, Ford sponsored (in cooperation with GM) a similar Workshop in Thailand during April 1998.

Ford China Research and Development Fund

The Ford China Research and Development Fund was established in 1993 to promote ties in science, technology, and business between Ford and China. This was the first research fund of its kind established between the Chinese government and a foreign company. This significant grant program is managed by Ford, the National Natural Science Foundation of China (NSFC), the State Economic and Trade Commission, the Chinese Academy of Sciences, and the Ministry of Science and Technology.

This Fund currently supports projects related to the environment and energy including the development of 1) comprehensive models to determine the current and long-term effect of vehicle emissions on ambient air quality in major Chinese cities, 2) emission control systems for gasoline and diesel engines and 3) high energy density, long-life batteries for electric vehicles.

Rare-Earth Oxide Catalyst Program

A three year cooperative program was established in 1996 between Ford, China's Ministry of Science and Technology and the State Economic and Trade Commission to cooperatively develop low-cost and durable catalysts for the control of vehicle emissions in China and other emerging markets.

Since China has about 80% of the world's recoverable deposits of rare-earth oxide (REO) mineral deposits, the use of these abundant REO materials was emphasized for this development work.

R&D programs were established with the Kunming Institute of Precious Metals and the Dalian Institute of Physical Chemistry to develop the REO-based catalysts. This program has been very successful. The first effective REO catalyst was shown to meet China's emission standards for 2002-2003. This technology was displayed at the China Automotive Technology and Emission Control Exhibition held in Beijing during 1997.

Resource Use Efficiency Program

In anticipation of the future depletion of petroleum supplies, China has recognized the need to implement long-term policies for the efficient use of energy. Ford assisted in this effort with the establishment, in 1994, of a "Resource Use Efficiency Program," in cooperation with the Massachusetts Institute of Technology and China's Ministry of Science and Technology. The general objective of this program is to help support research and develop policies that will lead to the more efficient use of materials and energy resources used by the transportation industry. This program has made it possible for scientists, engineers and policy experts from China and the U.S. to travel and work together on sustainable development programs.

A collaborative study was sponsored by Ford and China's Ministry of Science and Technology, and carried out by more than forty technical experts from eight government, industry, and academic organizations in the U.S. and China. This study developed and utilized life-cycle assessment (LCA) models to compare the environmental, energy and economic impacts of utilizing coal as an automotive fuel that 1) provides the lowest total cost to the customer (**E**conomics), 2) minimizes the total effect on the local and global **E**nvironments and 3) maximizes energy **E**fficiency. This program is referred to as the Triple "E" study.

This study was very successful - it was the first life cycle study every carried out to determine the most viable options for the use of a countries major energy resource. These studies have helped China and Ford identify which types of alternative fuel vehicles (AFV's) will best suit China's long term needs.

Alternative Fuel Vehicle (AFV) Program

In 1998, China imported about 13% of its total domestic needs. China's dependence on imported oil is projected to increase to about 60% by the year 2010 to about 3.0 billion barrels/day. However, China has abundant sources of coal and natural gas which can be used as an alternative energy source for transportation.

A cooperative AFV program was initiated in 1995 between Ford, the Ministry of Science and Technology and the Chinese Academy of Sciences. This three-year study has helped to identify which types of AFV's will best suit China's long-term needs.

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Ford's advanced flexible fuel vehicle (FFV) technology was tested in Beijing over a period of three years to help understand the factors that effect vehicle performance under China's environmental conditions, using domestically produced gasoline and methanol fuels. This FFV technology allows blends of methanol and gasoline (0-85%) to be used in the vehicle without any changes in engine performance. This study identified fuel contaminants that can affect engine performance. Follow-up work with China's oil industry helped to identify the key contaminants that caused poor engine performance. Solutions were successfully provided, including the development of a new fuel additive.

The first prototype Ford Escort flexible-fuel vehicle was developed as a result of the cooperative efforts between Ford and China. A joint program was established with the Shanxi Provincial government to develop prototype FFV's and evaluate the feasibility of economically producing methanol from coal. The first FFV vehicle (20 passenger bus) developed in China resulted from this effort. These vehicles were displayed at the Electric and Alternative Fueled Vehicle Exhibition and Conference in Beijing during December, 1996.

In September, 1998, Phase II of this program was initiated, with particular emphasis on the cooperative development and commercialization of CNG and liquefied petroleum gas (LPG) vehicles. It is predicted that natural gas will become a significant source of transportation fuel since it is abundant, flexible, economical and environmental friendly. We believe alternative fuels would be sensible for China, given the abundance in China of potential fuels, and we assume that an attractive market eventually will emerge for AFV's in China.

Visiting Engineer/Scientist Program

Since 1982, Ford's Visiting Engineer/Scientist program has made it possible for over 100 Chinese engineers and scientists to work in Ford's scientific and engineering laboratories on a variety of automotive R/D programs. Visiting engineers and scientists have worked in the area of vehicle emissions control, environmental measurements, life-cycle assessments and emissions standards.

Environmental Standards and Regulations

An integral part of Ford's future environmental stewardship in China is to establish ISO 14000 environmental standards in Ford's manufacturing plants in China. Several of the environmental and energy programs described above support the "Energy and Environmental Cooperation Initiatives" established between China and the United States in October, 1997.

Conclusion

Although there are many environmental obstacles facing the emerging markets at this time, several countries appear to be paying more attention to those obstacles. China has promulgated some environmental regulations and they have established regional environmental protection offices throughout the country.

Even though these regulations are not strictly enforced at this time, China's State Environmental Protection Administration (SEPA) will gradually tighten laws in the coming years. A key imperative of the Chinese government has been to raise the awareness of policy makers and the public. This will ensure that local economic and development policies are friendlier to the environment.

Other emerging countries are adopting similar approaches and policies. Mr. Xie Zhenhua, Minister of the China SEPA, believes that "there are no national boundaries in handling environmental issues. The Earth is big, yet it is only a global village whose residents should cooperate closely to preserve the surroundings."

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China is promoting a series of reforms aimed at introducing market-based mechanisms into these statutes. While these changes may be welcomed by foreign investors, the fundamental reforms and substantial political and financial commitments that will accompany these changes are being met with dread or apprehensive acceptance by China's new class of entrepreneurs. Indeed, the Chinese business response to many of these changes, is that the Chinese are "amputating their limbs for the good of all."[3]

The early stages of the legislative reform process have made critically evident the awesome task that lies before the law drafters. For example, many of the concepts that are to be introduced into the new generation of legislation, such as the "Polluter-Pays-Principle,"4 cannot be readily adapted to government work units or dan wei. Applying such concepts to a state-owned entity has a dubious deterrent effect. In a sense, it is the functional equivalent of "slapping the right hand with the left hand."

The Chinese law drafters' goal of creating workable environmental law and further thwarted by the enormity of the geographical area to be regulated. China is slightly larger than the United States but only has a fraction of the regulatory staff. For example, NEPA (now SEPA) had 250 full-time staff in 1997.5 By comparison, the United States Environmental Protection Agency (US EPA) Headquarters currently has a staff of 6,098 permanent and temporary employees.6 Moreover, the concept of an advanced legal system that can work independently of central government directives is of relatively recent origin in China and enforcement of legislation is still sporadic in many areas. Traditional aversions to the use of law to contest authority will not be easily overcome. Enforcement power is also fragmented among many administrative entities with often conflicting environmental protec-

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Improve Energy Efficiency & Reduce Vehicle Emissions

Options to Improve Energy Efficiency and Reduce Vehicle Emissions from China's Transportation Sector

By Feng An and Marc Ross

During the past two-decades, China has experienced dramatic economic growth, which has resulted in severe energy shortages and deteriorated urban environments. As one of the designated pillar industries, the Chinese auto industry has experienced even more explosive growth, which has resulted in traffic jams and severe air pollution in large cities such as Shanghai and Beijing. Considering the huge potential for further growth, it is critical for Chinese policy makers to reexamine its transportation policies and take measures to reduce vehicle emissions and improve vehicle energy efficiency.

At stake are two categories of emissions: One is greenhouse gas (GHG) emission (primarily CO_2 emissions) which directly contributes to global warming. The other category is often called criteria pollutants such as CO, HC and NO_x, which directly threaten people's health. The GHG emission is directly related to vehicle fuel consumption and thus can be reduced by promoting the overall transportation energy efficiency. The criteria pollutants may or may not related to fuel use, thus need to be dealt with separately.

Many technical and policy measures to reduce energy consumption and environmental damage by urban transportation have been introduced in different parts of the world. While the technology options are similar in different cities, the priorities for improving urban air quality and traffic congestion varies. In the following, we will examine short-term, medium-term and long-term strategies for dealing with motor vehicle emissions in China.

Short-Term Measures

The short-term strategies include measures with implementation time frame up to 5 years. They are mostly low cost measures with immediate benefits. The following programs have been proven effective around the world and some are already being implemented in China.

Continuously improve fuel quality

Fuel quality has great impacts on air pollution and, to a lesser extent, has indirect impacts on energy consumption as well. A strategy for China future fuel use has to apply specifically to China's vehicle fleet. One of the important recent findings in Europe, Japan and US is that the fuel cannot be considered in isolation of the vehicle and visa versa. One must consider the vehicle and fuel as a system, because the combination affects: emissions, performance and derivability, fuel system, engine and emission control system, fuel economy; and customer satisfaction. China should support a continuous effort to improve fuel quality and reduce lead and sulfur content in diesel and gasoline fuels.

Strengthen pollution inspection of the existing vehicle fleet

Numerous studies in the United States demonstrated that only small fraction of on-road vehicles (e.g., 10-20%) contribute most pollution (e.g. over 60%). These statistics may apply to China as well. Thus how to capture and eliminate these "high-emitting" vehicles become critical measures to clean-up urban air. Effective measures and regulations should be developed to remove these high-emitting vehicles from road. Experiments in the US have proven that to clean-up dirty vehicles through maintenance service is very difficult, and usually ineffective. A better way to achieve this may be to provide economic incentives to retire or scrap the old, dirty vehicles.

The US experience illustrates that, the tailpipe emission levels of on-road real-world gasoline vehicles can be several times higher than that of their certified levels. This means that the durability of emission control systems of gasoline vehicles has been poor, and it requires sophisticated technologies to maintain gasoline vehicle's emission control system in good condition. In developing countries such as China, it is even more difficult to provide good maintenance service to keep gasoline vehicles running clean. In this sense, China should focus on developing low-cost emission control system with high degree of durability, instead of pursuing high-cost system requiring extensive maintenance service.

Traffic management to reduce congestion in large cities.

Effective traffic management can reduce traffic congestion, optimize the efficiency of the transportation system, and thus reduce the fuel use and air pollution. Some effective and low cost measures:

- Synchronize traffic signals and create the "signal green

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wave". These have to be accompanied by the implementation of appropriate one-way roads.

- Create dedicated bus lanes. This will significantly increase person-moving capacity, reduce vehicle mile travel and travel time.
- Turn prohibitions, especially the left-turn prohibitions.
- Add lanes without widening. This can significantly increase the traffic capacity of road.
- Create auto-restricted zones. This can have major favorable impact on an area's economic activities and reduce congestion.
- Improve parking management and promote Park & Ride programs. Among traffic management concepts tried in the US (HOV lanes, ride share, parking program,...), only parking charge and restrictions have proven to be successful. Thus enforced parking prohibition combined with remote parking and bus service has often been successful.
- Encourage alternative work hours.

The above measures only involve in low financial cost, but can have significant impacts on reducing traffic congestion. For a city as mature and old as Shanghai, these measures provide the best way to reduce the traffic congestion and travel demand. Other measures such as building new highways, expressways, and local/distributor roads also have significant impact, but may be too costly and may not reduce congestion.

Introduce driver-training program to reduce fuel consumption.

A driver-training program could be also very effective. In the highly congested cities like Beijing and Shanghai, driving cars and buses fuel-efficiently can make a large difference. Fuel-efficient driving techniques include: driving smoothly, less aggressive acceleration and deceleration, driving at optimal vehicle cruise speed, shifting gear earlier, using more coastdown driving, turning off the engine during long waiting and predicting the change of traffic light from green to red in advance so that vehicle approaches the intersection slowly. Numerous studies have shown that improved driving behavior could save fuel consumption 10-15%.

Medium-Term Measures

In the medium-term, China should encourage the introduction and development of "green" vehicles, which include "green buses" and "green cars". The key is development of technologies appropriate for China, since the direction being followed in OECD countries is costly and requires an extensive regulatory infrastructure if it is to be successful. "Green" vehicles for China should involve low incremental cost and their emission performance should be sustained over a long vehicle life. For this purpose better designed vehicle/fuel systems rather than clean-up technology (catalytic converters and diesel soot traps) may be the best first step. Furthermore the design goal must be based of average system emission over typical vehicle life, rather than new vehicle emissions under laboratory test conditions. Several automakers have begun to design specific vehicles that suit the driving conditions to the developing countries. For example, the idle-off technology would have much larger impact in Beijing or Shanghai than in most cities of OECD countries.

Encourage the development of simple fuel-efficient technologies.

To identify and introduce some simple fuel efficient technologies for domestic auto-industry can be very effective. These techniques are simple and cheap to implement. They include: 1) adding another gear in transmission gear box (acting like an overdrive gear, this could improve fuel economy dramatically), 2) reducing engine displacement or number of cylinders, 3) building lighter and smaller cars, and 4) introducing idle-off engine technology. This will be extremely beneficial for a city as congested as Beijing, where the average travel speed is so low that a large percentage of fuel is wasted during engine idling, and 5) developing low-mass low-cost plastic body technology. Plastic auto body technology has been slow to develop in OECD countries because very high surface finish quality is considered essential. The potential advantages of lower cost and lighter weight (and thus higher fuel economy) are important enough for China that this technology should be developed. It is likely that with experience the surface finish would moreover be improved.

Establish fuel economy certification program for cars and motorcycles

Most developing countries have very little knowledge about the fuel economy of their vehicles, and for this reason, are unable to establish fuel economy standards. It is important for Chinese government to establish a vehicle fuel economy certification program for new passenger cars and motorcycles. This program will require every new passenger car or motorcycle model, both foreign and domestic, to label its fuel economy. This program serves five benefit areas regarding fuel economy: 1) providing information on vehicle energy efficiency, 2) creating public awareness, 3) making international comparisons, 4) evaluating technical and economical potentials for improvement and eventually 5) establishing a fuel economy standard.

Integration of trucking (short haul) with railroads (container and/or road-rail traveler)

At present, China’s trucks are almost all of small and medium

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size. Increasing truck size and containerization of trucking and railroad transport will greatly improve energy efficiency and usage of railroads. To consolidate many small truck companies into several large ones will make it possible to establish national-wide dispatch centers to optimize the operation of trucks, avoiding empty or part-load running, and greatly improving energy efficiency.

Introduce the new two-stroke engine

The two-stroke engine has long been a favorite for inexpensive vehicles; but it is a high polluter, partly because the fuel is mixed with lubricant in the cylinder. The technology has now been revolutionized with direct injection of the fuel into the cylinder and direct metered lubrication. The advantages of the new two-stroke, compared to the four-stroke engine standard in cars and light trucks in industrialized countries, are

- much lower manufacturing cost,
- smaller size enabling lower weight and flexibility in body design, and
- simpler and, perhaps, more-robust emissions control.

With the new two stroke, in particular: 1) Manufacture and maintenance are simpler because there are ports exposed by the moving piston instead of valves. The complex valve and valve control mechanisms in four-stroke engines are avoided. 2) The size of the engine is much smaller for a given power capability, because there is a power stroke every cycle instead of every other cycle and because valve mechanisms above the cylinders are eliminated. 3) Lean-burn characterizes most driving, leading to much lower engine-out emissions of CO, hydrocarbons and nitrogen oxides than with the four stroke. This means that emissions performance may be adequate without a catalyst, or with only a modest catalyst to reduce hydrocarbon emissions. Thus, sophisticated control systems are unnecessary.

While emissions controls are successful in modern high-cost vehicles, they add cost. Moreover, they deteriorate with driving and poor maintenance. One must not focus only on the emissions performance of a vehicle when it is new. At high mileage even very sophisticated emissions control systems become inadequate. This is a challenge for the two-stroke as well; and this durability question hasn't as yet been fully evaluated. It is likely that fuel quality is important to injector performance over engine life. Fuel quality is an important part of any program to improve the Chinese transportation system.

Two-stroke engines can be designed for very small to large vehicles, from motorcycles to large trucks. For the quality car market they have the advantage of running more smoothly than a four stroke with the same number of cylinders, because they fire twice as frequently. Two strokes are also somewhat more fuel efficient. The new two strokes have not yet been adopted by automotive manufacturers, but motorboat

Promote alternative fuel trucks and buses

Trucks and buses in use in China are almost completely gasoline powered. This has resulted in wasteful and inefficient use of fuel and excessive pollution. Small-scale development of various alternative fuel powered engines for use in heavy-duty trucks and buses has occurred in US and other countries in the last several years. These vehicles use natural gas and alcohol, instead of gasoline or diesel, as the fuel, and they offer substantial benefits in emission reduction. The major drawbacks are that the range is limited (150 miles) and that infrastructure is lacking to support these alternative fuels. Hence, these vehicles are particularly well suited for centrally fueled urban fleets that are parked at night.

Evaluate clean-diesel technology for cars and trucks

The diesel engine has long been the most energy efficient power plant for transportation. Moreover, diesels emit extremely low levels of hydrocarbons and carbon monoxide that do not require aftertreatment to comply with current and projected standards. However, it is admittedly difficult for this power plant to simultaneously meet projected NO_x and particular matter projected standards.

Two opposite trends with significant implications for the future growth of diesel vehicles and engines are taking place around the world. On one hand, all major auto manufacturers have committed to promote diesel engine technology to improve fuel efficiency and cut GHG emissions. On the other hand, environmental officials are increasingly focusing on small particles and ozone levels in the air as serious causes of adverse effects on health and the environment. As a result, they are focusing their regulatory efforts on reducing emissions of the fine particles and oxides of nitrogen from all sources including diesel vehicles.

The Chinese government should closely monitor these two trends and evaluate whether the diesel technology should be promoted in China. Beyond the energy efficiency benefit of diesel technology, the other major advantage of diesel vehicles is that they are durable and their emission levels manage not deteriorate as fast as their gasoline counterparts. In the other words, they may not require extensive and expensive maintenance service to maintain their certified emission levels.

Promote electric scooter

While a battery-electric car with good characteristics is difficult to realize in practice, because the range is short, the needed large battery is very expensive and charging may be difficult, an electric scooter would be fully satisfactory with lower range and speed capability. Combined with its light weight this means that a scooter needs a battery with only three or four percent the energy capacity of that for an electric car. For example, 10 kg of lithium-based batteries now coming into use would be more than sufficient.

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Whether this is the proper direction for development of very light transportation vehicles, in contrast for example with scooters using the gasoline-based modern two-stroke engine needs study and, probably, trial.

Long-Term Measures

Over the long term, at stake are two fundamental elements: 1) the shortage of worldwide oil reserves; and 2) the increasing awareness of global warming. It is widely believed that the world oil reserves can only serve the earth for another 25-50 years. In other words, the earth will face energy crises by the year 2020 – 2050. These crises may come sooner if the international pressure of fighting against global warming intensified. China should position itself to address these two problems in the new millennium and come up with a long-term sustainable development plan for transportation sector.

Integrated transportation planning

An important area to improve urban transportation system is to integrate the transportation, land use and environmental planning. The key is to shift emphasis from improving "mobility" to "accessibility." Improved access corresponds to reduced travel time and costs to access work education, health care, shopping, government offices, recreation, family and friends, etc. Access involves non-vehicular mode as well as vehicular travel. Mobility is measured by number of passenger-kilometers. Although access may be hard to measure, making it an objective insures that reducing the need for vehicular travel is considered in addition to mobility.

A major challenge is to plan land use and development of alternative modes so flexibility is maintained, such that other modes compete effectively with private motorized vehicles. Recent research suggests that higher density, mixed commercial and residential use, and good public transportation strongly reduces travel requirements (passenger-km) and, especially, the need for motorized vehicle travel. Moreover, urban transportation planning should include provision for growth in demand for access from outside the presently built-up area.

Hybrid electric vehicle evaluation

The type of hybrid to be considered independently of electric vehicles is liquid-fueled (no grid electricity being used). The vehicle uses a small high-power battery of a kind now becoming available (rather than the high-energy battery needed for an electric car). Analysis shows that this configuration enables more than a 50% improvement in fuel economy, with the greatest advantage in slow stop and go driving. The improvement is due to regeneration of braking energy, a smaller engine and turning off the engine whenever little power is required. (If some of these steps were already taken in improved "standard" vehicles, the advantage of hybridization would be less.)

Electric car evaluation

In the long term, electric cars could become important in dense urban areas because they are clean at the point of use and they are particularly efficient in stop and go driving. It will be useful for China to become aware of the technologies so that, if the costs come down and the electric generating capacity is available, electric cars could be seriously considered.

Fuel cell vehicle evaluation

The bid for a fuel-cell-powered car is growing intense, most recently illustrated by Royal Dutch/Shell Group's alliance with Daimler-Benz to advance the technology. The fuel cell, invented in the 19th century and used in the US space program of the 1960s, is an attractive alternative for automobile propulsion. The technology offers high efficiency, nearly exhaust-free operation as well as no moving parts and quiet operation; however, unlike a battery, it need not be recharged as long as there is fuel. Many carmakers, including Daimler-Benz, are moving forward at a rapid pace with tentative timetables for production. After reaching a final decision next year, Daimler-Benz has announced they will produce 40,000 fuel cell cars by 2004. Ford, Toyota, and General Motors, meanwhile, hope to have commercial models available at around the same time. Other manufacturers are producing prototypes--fueled by methanol or stored hydrogen gas. But one obstacle that must be overcome if commercialization is to be achieved is price. Although the cost of fuel-cells has dropped dramatically in the past decade, there is still a long way to go toward making these cars affordable to the average customer. China should closely monitor the development of fuel-cell technology vehicles and evaluate the feasibility of promoting such vehicles into Chinese market in foreseeable future.

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Motor Vehicle Pollution Control in China - A Strategy For Progress

By Michael Walsh

I. Background

In recent years, the vehicle population in China has been increasing sharply, with much of the growth taking place in cities. As a result, serious air pollution problems are beginning to emerge. To address these concerns, China has put together a project with the World Bank to develop an National Action Plan to address motor vehicle pollution.

The objective of the project is to assure that by 2010 the air quality levels in China?s major cities meet the second class of national standards according to the ninth-five year plan.

II. The Current Situation In China

a. Vehicles

The total number of motorized vehicles in China, although very low by Western standards, is growing rapidly and has already risen to about 1 million in Beijing and almost 700,00 in Guangzhou. For the country as a whole, the number of vehicles in 1995 climbed to about 28 million.

With regard to driving patterns and average speeds, many existing roads have already reached their maximum capacity and are saturated during long periods of each day.

Further, the vehicle technology being produced tends to be primarily carburetor equipped with mechanical rather than electronic controls. Recently collected emissions data in China shows that current vehicles are typical of late 1960/early 1970's US cars.

Vehicle maintenance also seems to be poor as reflected in the high failure rate in the existing, relatively lenient I/M program. Many vehicles seem to be operating with a rich air fuel mixture which produces relatively good driveability, high fuel consumption, excess CO and HC but relatively low NO_X emissions.

b. Air quality

Air quality monitoring data in Chinese cities are limited especially in high traffic areas. Based on the available data, however, it is clear that national NO_x air quality standards are currently exceeded across large areas, including but not limited to high traffic areas.

National air quality standards for CO and particulate are also frequently exceeded and recent data indicates that standards for ozone, formed by the photochemical reaction of NO_x and HC, have been exceeded during the last decade.

c. Contribution From Mobile Sources

On average, mobile sources contribute approximately 45-50% of the NOx emissions and about 85% of the CO emissions in typical cities at present.

Although not yet studied in detail, the available data indicate that mobile sources also are the main source of hydrocarbons.

III. The Likely Future Situation With No Additional Controls

Since the vehicle population is increasing at a much faster rate than roads are being constructed, the number of roads approaching saturation will likely increase and the period of time when these roads will be overloaded will increase. This will result in more frequent and severe air quality peaks in localized areas.

National air quality standards for NO_x and CO will increasingly be exceeded in many cities.

The ozone problem will become more widespread and exceedances of the national standards will be much more frequent.

Roadside particulate problems will likely increase, leading to serious health problems.

Based on data collected in this project the following observations concerning the role of mobile sources can be made:

- Due to more diesel vehicles the contribution from mobile sources to PM and NOx will increase. Since diesel particulate has been identified as a likely human carcinogen, this risk will increase as well.
- Due to rapid growth of the vehicle population the contribution to ozone precursors will increase.
- Based on the vehicle growth projections, it can be concluded that a successful program to reduce air pollution and its local and regional effects will depend on the success in controlling mobile emissions sources.

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IV. Technical Plan To Address These Problems

a. Emissions Standards For New Vehicles

In determining the appropriate emissions standards to adopt, estimates were made regarding the potential emissions reductions which they could achieve, the cost to achieve these reductions and the overall cost effectiveness. Listed below are these values for the various alternatives considered for NO_x control even though in most cases, substantial CO and/or HC reductions would also occur.

Vehicle Type	Strategy	Tons Reduced	Cost ($/Ton)	Cost Effectiveness
HDDV	EU2	2.2487	$946	$421
Jeep	96/69	0.8602	$42	$49
LDDV	94/12	0.7694	$396	$515
LDGV	94/12	0.704	$382	$543
Jeep	93/59	0.6993	$139	$199
LDDV	91/441	0.6239	$100	$160
LDGT2	96/69	0.5859	$370	$632
LDGV	91/441	0.5714	$394	$690
LDDT	96/69	0.5037	$370	$734
HDDV	EU1	0.4814	$721	$1,498
Mini Vehicle	96/69	0.4468	$316	$706
LDGT2	93/59	0.4449	$385	$866
LDDT	93/59	0.4061	$100	$246
Mini Vehicle	93/59	0.347	$344	$992
MC	Japan	0.1893	$216	$1,142
MC	Taiwan 91	0.1884	$224	$1,190
HDGV	EU2	0.1183	$322	$2,726
MC	Taiwan 94	0.0658	$309	$4,699
HDGV	EU1	0.0219	$416	$18,995
HDGV	EU1	0.0219	$416	$18,995

It can be seen that all but the last four measures considered would cost less than $2000 per ton of NOx reduced, a very cost effective level based on international experience.

Several potential scenarios were developed to represent packages of measures for all categories of new vehicles. In selecting strategies to be adopted, several factors were taken into account, including the following:

- air quality need
- potential effectiveness of the measure
- cost of the measure, including hardware, maintenance and fuel economy
- overall cost effectiveness
- technical feasibility

Considering each of the above factors, the choice came down to two scenarios as summarized below.

Scenario	Vehicle Type	2000	2002	2005
2	Passenger Cars	91/441		94/12
	Light Duty Vehicles	93/59		96/69
	Heavy Duty Vehicles	Euro 1		Euro 2
	Motorcycles	ECE 40.01		Japan
4	Passenger Cars		94/12	
	Light Duty Vehicles		96/69	
	Heavy Duty Vehicles		Euro 2	
	Motorcycles		Japan	

In comparing the two scenarios, it was determined that both Scenarios are very cost effective.

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Scenario	Cumulative NOx Reduction	Cumulative Costs	Cost-Effectiveness
	(10^4 tons)	(10^6 $)	($/Ton)
2	97	441	450
4	120	389	320

(Continued from page 19)

The conclusion of the team after considering all these factors as well as the **technological capability** of the domestic vehicle industry was to recommend Scenario 2 as the minimum requirement but to allow option 4 as an alternative and to provide fiscal incentives to encourage Scenario 4 vehicles and engines.

b. Programs For Existing Vehicles

Similarly, it was decided that NEPA should issue regulations specifying the national policy regarding the following in use vehicle directed programs:

i. *Inspection and Maintenance (I/M)*

Analysis indicated that the I/M program is one of the most cost effective options considered and one which could have a rapid impact. After 2002, a loaded mode test procedure, the ASM test will be adopted for catalyst equipped vehicles and 100% of the vehicles will be required to be tested and 100% will need to pass the test in order to be driven. In combination with new vehicle standards, this will enable the NOX targets to be approximately achieved.

ii. *Retrofit*

It had been proposed that national retrofit regulations should be issued for two primary reasons:

- to assure that retrofit programs being introduced around the country are adequately considering important factors such as fuel quality and vehicle maintenance.
- to assure that retrofits actually achieve the claims made by retrofit companies.

The final report recommends that a performance standard be used as a basis for approving systems.

c. Fuels

NEPA should issue regulations regarding the quality of fuels and fuels additives and enforce these standards and specifications in the fuel distribution system.

d. Non Technical Measures

In addition to technical measures, cost-effective non technical measures should be developed. These types of measures should normally be implemented locally. However, national support through technical investigations, financing and necessary legislation are also needed.

V. Management Plan to Address These Problems

The project group has concluded that the technical measures will be most effective if NEPA is authorized to supervise enforcing the vehicle and fuels emissions regulations and standards which they adopt; this includes the imposition of sanctions and the withdrawal of certificates which allow vehicles to be sold. EPA should also participate with Security, Transportation and the Trade Ministries as well as Ministry of Machine Industry (MMI) and the Petrochemical industry in a Management Team to coordinate with all other relevant Government Ministries in developing and implementing its regulations. A parallel organizational structure should also exist at the municipal level in the major cities.

If NEPA is given the full responsibilities recommended above, the project team further recommends that a new Mobile Sources Management Office (MSMO) be created within NEPA to develop and implement the motor vehicle pollution control regulations. After considering other programs in other countries, it appears that the **minimum** staffing for this office should include the following:

Mobile Source Management Office

Function	Staff Persons
Certification of Vehicles & Laboratories	3
Regulations	2
Fuels	2
Environmental quality	2
Overall Management and Supervision	2
Minimum Total	**11**

With regard to new vehicles, NEPA will be responsible for drafting the national regulations, setting standards and defining the enforcement criteria; local EPA's will have the option, acting as the agent of NEPA, of carrying out some periodic or random testing or oversight to assure that locally produced vehicles are meeting the nationally set standards.

The agency responsible for China's border, Customs, should be responsible for assuring that **all** vehicles imported into the country - new or used - comply with the **new** vehicle standards and regulations in effect in China at the time the vehicle is imported.

Recognizing that other organizations have certain responsibilities for approval of new vehicles - e.g., MMI for Safety - it was recommended that in granting these approvals, a valid certificate from NEPA is sufficient to assure compliance with emissions requirements; there should be no redundant responsibilities in this regard.

With regard to in use vehicles, it was recommended that the local police and environment departments jointly develop and implement the annual and roadside inspection programs.

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NEPA should define the national I/M requirements to be then implemented jointly at the local level by the Police/EPA authorities. Local officials could impose more stringent management of in use vehicles - e.g., more frequent or intense random roadside inspections, retrofit requirements, etc. - which are applied to local vehicle users but have no direct impact on vehicle manufacturers.

VI. Impact on Air Quality and Remaining Problems

Even after adoption of the management and technical measures noted above, the air pollution problems in China's major cities will not be completely solved. While much lower than would be the case without controls, ambient NO_x levels are projected to remain higher than the targets. While area wide CO problems should be eliminated, it is expected that levels near roadways will still be unhealthy. Further, ozone and PM levels will likely worsen from today's levels without focused efforts to address their emissions and precursors. In future work to address these remaining problems it is important to focus on those vehicle categories for which additional control measures appear feasible and potentially effective. In this regard it is useful to understand the relative importance of the various vehicle categories to overall vehicle emissions in 2010 as summarized below.

Vehicle Category	HC	CO	NOx
LDGV	36.80%	52.10%	47.10%
LDGT1	13.50%	17.20%	15.30%
LDGT2	10.70%	13.50%	13.40%
HDGV	2.90%	3.30%	6.60%
HDDV	1.80%	1.00%	11.90%
MC	30.40%	7.90%	0.80%
JEEP	3.80%	5.00%	4.80%

Based on this data, it seems obvious that light duty gasoline fueled cars and trucks will need to remain a primary focus of control efforts in the future. In this regard, it is important to remain abreast of technological and other developments around the world. Therefore, after the standards contained in the Action Plan are implemented, it will be valuable for NEPA to analyze the potential feasibility and cost effectiveness of the so called Euro 3 requirements for China.

VII. Progress To Date

China has moved rapidly to implement the strategy. In March of 1997, the decision was made to phase out leaded gasoline. By July of that year, Beijing had already stopped sales of leaded fuel in the city center and by October the ban had spread to Shanghai and Guangzhou. Similarly, Beijing has just recently announced its decision to phase in the European auto standards next year, requiring all new cars to be equipped with catalysts. Shanghai is in the late stages of a process which will almost certainly result in a similar decision for 2000. Numerous cities are aggressively pursuing retrofit strategies as well.

VIII. Conclusions

With funding provided by the World Bank, China has developed a national strategy for reducing motor vehicle pollution. Key components of the strategy include unleaded gasoline, tight standards on all categories of new vehicles and a substantially upgraded I/M program. Institutional improvements to enable the strategy to be implemented have also been developed. A great deal of additional work will be needed but it is believed that the work carried out to date under this project provides a good basis upon which to build in the future.

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tion and development goals. Much of China's recent legislative activity has been directed toward these serious issues so that plans for comprehensive management of environmental pollution and natural resources degradation can be acted on and realized.

Notes

1The general timing of this phenomenon was shared by many other dynamic countries and territories in the Asia region. See generally, Richard J. Ferris Jr., Aspiration and Reality in Taiwan, Hong Kong, South Korea, and Singapore: An Introduction to the Environmental Regulatory Systems of Asia's Four New Dragons, 4 DUKE J. COMP. & INT'L L. 125 (1993).

2Including, but not restricted to, environmental cases.

3This remark was voiced during many conversations held by the authors with the domestic Chinese business community. The remark was also captured during a recent interview conducted in China by National Public Radio (United States) reporters. See All Things Considered: Cleaning Up the Huai (National Public Radio Broadcast Transcript, Apr. 7, 1998).

4The Polluter-Pays-Principle requires that the costs of pollution prevention be borne by the polluter.

5The total number of SEPA staff (per orders of the State Council formerly applied to NEPA) is limited to 261. This number will likely be reduced in order to fully implement personnel reductions and related administrative changes required of all ministries at the national level. Reportedly, SEPA may face personnel reductions of roughly 30 percent.

6Telephone Interview with Paulette Everson, Information Management Specialist, US EPA, Office of Administration and Resources Management (Apr. 28, 1998). The comparison with the number US EPA headquarters staff is provided merely as a general reference to underscore the serious issue of SEPA resource limitations. Naturally, US EPA is responsible for managing a comparatively more comprehensive and detailed environmental legal regime within an enforcement-oriented legal culture.

Vehicle Emissions and Air Pollution in Hong Kong

By Jiang Dahe

In the past decade, Hong Kong has enjoyed splendid economic growth and urbanization. Like other megacities in the world, urban development has spawned a host of environmental problems. After economic reforms were initiated in mainland China, many Hong Kong industries moved north, helping to alleviate industrial pollution in the territory. However, in congested urban areas, numerous high rise buildings enveloped busy and narrow streets, causing the pollution from motorized traffic to accumulate and stagnate. For these reasons, Hong Kong's air pollution problem is best characterized as coming from a limited number of large point emissions sources and a huge fleet of automobiles.

In general, the air quality in Hong Kong is much better than in many South Asian cities and most cities in China. However, a walk down the streets of Causeway Bay or Nathan Road, the territory's two busiest commercial areas, can lead to an unexpected bout of suffocation <because the street canyon effect is extremely strong.> <The major part of mobile oil is diesel.> Consequently, RSP (respirable suspended particulate matter) levels in Hong Kong are particularly high, and fine particle PM2.5 pollution is also a serious problem, <although not yet in regulation.> In addition, there is a alarming rise in the incidence of photochemical smog pollution. In August 1997, Hong Kong set a dubious record when its air pollution index exceeded 100 for two consecutive days -- the first time in recorded history. This phenomenon was attributed to abnormally high concentrations of ozone and NOx.

Hong Kong's territorial government has made a series of efforts to combat air pollution problems. It established a set of Air Quality Objectives in 1989 to limit the emissions of seven air pollutants. The Air Pollution Control Ordinance (APCO) and its subsidiary regulations were passed in 1989 and became effective in 1990. Afterwards, emissions from large industrial sources seemed to be under control, and there appeared to be significant improvements in the ambient levels of air pollutants, especially SO2. Certain industrial processes such as those used by power stations, gas refineries, cement works and mineral plants required licensing from the EPD. The government strengthened provisions for this part of the ordinance in 1993 when it increased the number of industrial processes that fell within EPD licensing requirements.

The government also included measures to control vehicle emissions in the APCO Amendment of 1991 by requiring that unleaded petrol be made available at all filling stations beginning in April of that year. By the end of 1995, nearly 80% of the petrol sold in Hong Kong was unleaded. The availability of unleaded petrol paved the way for the introduction of stringent controls on emissions from petrol-powered vehicles in January 1992 and tighter emission standards for light duty, diesel vehicles. After April 1995, diesel vehicles were required to use <cleaner diesel fuel.>

Another measure aimed at reducing vehicle emissions is a scheme involving the use of "spotters" to identify vehicles emitting excessive amounts of smoke. Vehicles that have been singled out for inspection must be examined and tested at one of the territory's twenty private vehicle emission testing centres or at an EPD vehicle emission testing centre. In 1995, 44,000 vehicles were tested under this program. Hong Kong also takes part in the movement to combat ozone layer depletion. The Ozone Layer Protection (Amendment) Ordinance took effect in 1993.

Despite these efforts, Hong Kong continues to suffer from air quality degradation. As described, it is mainly due to urban development and vehicular emissions. The government has tried to determine the feasibility of diesel-petrol switching for diesel engined taxis and light duty vehicles, and a program to use LPG fueled taxis has already been conducted for an entire year. However, Hong Kong still has a long way to go if it ever hopes to control its air pollution problem.

Field Notes – Power Industry to Support EV Development

Opportunities for the Electric Power Industry to Support Electric Vehicle Development

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Abstract:

The Chinese government has made a commitment to incorporate electric vehicles in its growing automotive industry in order to achieve environmental protection and energy conservation. Although progress has been made, there is need for further electric vehicle research and development, and more work is required to develop an infrastructure to support an electric vehicle market.

The governments of the People's Republic of China (PRC) and the United States of America (U.S.) have entered into an agreement for cooperatave activities to further the development of electric vehicles. As part of this program, the U.S. Department of Energy (DOE) is providing information to the State Science and Technology Commission (SSTC) of the PRC related to experience in the U.S. in promoting an electric vehicle industry.

An essential ingredient in promoting electric vehicles in the U. S. is a close working relationship between the electric power industry and the automotive industry. The electric vehicle industry will benefit greatly from this relationship because of the expertise on electric power utilization that can be provided by the power industry.

Electric utilities will benefit substantially from widespread use of electric vehicles because they would make greater use of the excess power generating capacity during off-peak hours. The demand for electricity fluctuates during each day, with the peak usage occuring in daylight hours and the minimum usage occuring at night. Since EV battery charging will occur mostly at night, power generation capacity would be used more effectively because the daily fluctuations in demand would be less severe.

This paper describes the roles that electric utility companies are playing in the U.S. to promote the use of electric vehicles. Many electric utilities have procurred electric vehicles in order to understand the impact of electric vehicle charging on the electric transmission and distribution grid. Utilities have conducted tests on electric vehicles, batteries, and battery chargers, and have contributed to developing industry codes and standards.

The paper also addresses the differences between the electric power industries in China and the U.S. Although the power industry in China does not have excess generating capacity comparable to that in the U.S., there are still many benefits to be gained by a synergistic relationship between the Chinese automotive and electric power industries. The paper concludes with recommendations for achieving this synergism.

PACE Workshop

The following is an announcement of China environmental policy workshop "China's Environmental Perspectives in the 21st Century," co-sponsored by China State Environmental Protection Administration (SEPA)'s Policy Research Center (PRC) and Professional Association for China's Environment (PACE). In responding to the calls from Mr. Xie Zhenhua, Administrator of SEPA, and other SEPA's senior officials, the workshop has been designed to bring together a small group of environmental policy experts (about 20, among which about 10 may be PACE overseas' members) to have face-to-face discussions on various environmental policy issues with Mr. Xie Zhenhua, Mr. Wang Yuqing and other SEPA senior officials. After considering various constraints, the workshop has been scheduled in Beijing on November 16-17, 1998.

"China Environmental Perspectives in the 21st Century"

Time: November 10-11, 1998

Location: China State Environmental Protection Administration's Policy
Research Center, No. 1, South Yuhui Road, Caoyang District, Beijing 100029, China

Sponsors:

China State Environmental Protection Administration's Policy Research Center (SEPA-PRC)
Professional Association for China's Environment (PACE)

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Participants: SEPA Administrators and other senior officials, and
environmental policy experts.

Working Language: Chinese

Schedule:

November 10: Keynote speech by Mr. Xie Zhenhua, Administrator of SEPA, followed by presentations and discussions;

November 11: Concluding remarks by Mr. Wang Yuqing, Deputy
Administrator of SEPA after scheduled presentations and discussions.

Costs: No registration fee is required; participants pay their own costs.

Conference Corner

Renewable Energy Asia Pacific (REAP) '98 (Incorporating Energy Efficiency)
Date: 14-16 October 1998
Location: Shanghai World Field Convention Hotel
See the Alternative Development Asia Limited site (http://www.adal.com) for
more information.

Sixth Roundtable with the Government of the People's Republic of China
Date: 11-13 October 1998
Location: Beijing, China
See The Economist Conferences web page (http://www.economistconferences.com) for
more information.

International Expo on Energy & Power
Date: 5-18 November 1998
Location: Beijing
Tel: (852) 2811-8897, Fax: (852) 2516-5024

EP China '98
Date: 11-14 November 1998
Location: China International Exhibition Center, Beijing
Tel: (852) 2811-8897, Fax: (852) 2516-5024

Call for Contributions

To ensure the quality of SINOSPHERE, the editorial staff needs contributions from you, our members. We hope to establish a backlog of pertinent articles that we can draw on from time to time over the next few months, but our success ultimately depends on your willingness to provide us with information. In general, we need three types of contributions:

Abstracts

If you have written, published, or presented any articles that are relevant to the study of China's environment, please send us an abstract of the article and information on how we can obtain a copy (Publication date and location, or personal address). We would like to include these abstracts in our upcoming issues to inform our readers of the type of research that is being carried out by PACE members and to stimulate discussion about environmental issues.

Articles

For those of you interested in specific issues, we would like you to express your views in short scholarly essays devoted to a single topic. We welcome articles on any subject, including technological developments, business trends, and policy issues. These articles should be approximately 2000 words in length, although quality is more important than quantity.

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Autobiographical Sketches

Please send us brief descriptions of your educational background, current occupation, research interests, and any specialized information regarding your involvement in issues related to China's environment. You should also include a current address and a contact number. (100-200 words)

Remember that SINOSPHERE will be read by almost 500 people worldwide, many of whom occupy influential positions in the public and private sectors, academia, and NGOs. This is your chance to communicate with like-minded individuals who share your interest in China's environment and to tell them of your research and concerns.

Please send all submissions to the editors at jpsnyder@umich.edu or ctsao@umich.edu

Call for Donation

Dear PACE members,

On behalf of PACE Board of Directors and Management Team, I am sending a call for donations to all of you, the owner of PACE.

From the day PACE was established, members' dedication, genuine concern and generous contribution in numerous forms have nurtured the healthy growth of PACE. We have come a long way and to a critical point.

Since its establishment in December 1996, PACE has received monetary donations from members, including Board members and officers totaled $678.00. The fund has been spent on unavoidable costs that keep the organization legally alive. Please see the Statement of Cash Receipts and Disbursements that itemized the uses of the fund attached at the end of this message.

As of June 30, 1998, we have a balance of $32.50 in the bank account. However, several imminent items are pending to be paid, including but not limited to: Filing fee to the District of Columbia in the amount of $55.00; estimated fee for application of tax-exempt status in the District of Columbia $50; re-application fee for tax-exemption status to IRS $465. Delaying these payment may affect the very existence of the organization. In addition, the Management team has some excellent programs in planning, such as organization of seminars and meetings in the US and China. We are also looking into every possible way to better serve our members.

On such grounds, we call on all concerned members of PACE to extend your willing hands again to keep PACE alive and grow. The Management is in the process of designing a mechanism for charging membership fees. Once the plan gets approved by the Board and put into implementation, donations made by the members before the effective date of such plan will be treated as membership fee paid. For now, an amount of $25-50 or above is suggested for the donation.

Please send your donation via check, payable to "PACE", and mail to Ms. Song Li, one of the former Board member, to the following address:

Ms. Song Li
2001 North Adams St. #539, Arlington, VA 22201, USA.

Upon receiving the checks, Ms. Li will log the checks and pass them to
PACE Treasurer for deposit and recording. An electronic receipt will then
be sent to you. Kindly let us know your EM address with your payment to
facilitate this process.

Thank you for all your contribution and support.

Regards
Jing Chen

PACE Treasurer

Special Announcement

A Special Issue of the China Quarterly will be published in December 1998. The issue is entitled "China's Environment" and is the result of a conference held at the School of Oriental and African Studies, University of London, in January 1998. Below is a list of participants and their papers which will appear in the issue.

China's Environment - to be published December 1998

The China Quarterly

22-23 January 1998
The School of Oriental and African Studies
University of London

Introduction

The Environmental Legacy of Imperial China
Professor Mark Elvin, Australian National University

Law and Policy

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The Organization of Environmental Protection in China
Professor Abigail R. Jahiel, Illinois Wesleyan University

Domestic Environment Law
Mr. Michael Palmer, SOAS

China and International Environmental Law and Treaties
Mr. Lester Ross, Paul, Weiss Rifkind, Wharton & Garrison

The Resource Base and Implications for the Environment

China's Land Resources, Environment and Implications for Agriculture
Dr. Robert F. Ash & Dr. Richard L. Edmonds, SOAS

Environmental Issues of South-to-North Water Transfer Schemes in China
Professor Liu Changming, Chinese Academy of Sciences

Forests and Conservation of Biodiversity in China: Threats and Prospects
Dr. Jim Harkness, The Ford Foundation

China's Energy Resources and Uses: Continuity and Change
Professor Vaclav Smil, University of Manitoba

Problems and Prospects

Industrial Pollution in China and Remedial Policies
Dr. Eduard B. Vermeer, Leiden University

Population, Public Health and the Environment
Dr. Judith Banister, Hong Kong University of Science and Technology

Business Opportunities for Foreign Firms Related to China's Environment
Mr. Bruce Tremayne and Ms. Penny de Waal, London & Beijing

In Our Next Issue

In the November/December issue of SINOSPHERE, we will feature a discussion of the energy efficiency industry in China. If you have done research on energy efficiency related topics, we encourage you to send us essays or abstracts that you would like us to include in the next issue. Any submissions should conform to the specifications outlined above.

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