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*by Longmire Harrison**

Introduction

The world is becoming an increasingly urban place, creating problems that affect the environment, the poor, and the global economy. The urban population for developing countries by 2020 is forecasted to expand by 2.4 billion people.[1] In the People's Republic of China ("PRC" or "China") nearly all of the population growth over the last twenty years has occurred in urban settings.[2] The country's urban population was 72 million in 1952 and increased to 540 million in 2004.[3] It is predicted that an estimated 900 million will live in Chinese cities by 2020 if urbanization continues at the rate of one percent annually.[4]

China is not the only country experiencing rapid growth in urban settings. Over the next two decades, developing countries are projected to be home to 80 percent of urban dwellers.[5] Further, approximately 80 percent of East Asia's economic growth will occur in urban areas.[6] Thus, one of the challenges for this millennium is to develop an urban strategy for sustainable environmental and energy growth in current and emerging cities, with the goal of improving economic vitality and environmental livability for all.[7]

This article examines the relationship between urban population growth, municipal solid waste[8] ("MSW"), and energy sustainability challenges in the PRC. It also suggests that the United States could derive substantial benefits by assisting the PRC, and ultimately the world, in tackling these challenges.

The first section illustrates the challenges and relationships between urban growth, MSW, and sustainable development. It also provides a background of the current state of MSW in the PRC. The second section looks at the current methods of treatment for MSW, including promising waste-to-energy ("WTE") technologies as a means to achieving environmental and energy sustainability. The third section addresses the opportunities and benefits for the United States, and the U.S. environmental technology industry in the PRC. In conclusion, we find that the opportunities available in the PRC will simultaneously allow U.S. companies to reap economic benefits while providing solutions to critical environmental and energy problems that pose severe global consequences if not confronted today.

The Challenge: Urban Population Growth, Municipal Solid Waste, and Sustainable Development

Municipal Solid Waste in the PRC

The increased level of urban domestic wastes, occasioned by spectacular population explosion, has become a serious problem in the PRC. Due to China's rapid urban population and economic growth, MSW levels have increased approximately ten percent per year.[9] At present, the MSW treatment rate in the PRC is less than twenty percent, in comparison to over 90 percent in developed countries. Accumulated wastes in the PRC occupy 500 million square meters of space, weighing approximately six billion tons.[10] Currently, garbage surrounds two-thirds of the PRC's cities. For instance, Shanghai is surrounded by about 1,000 garbage dumping grounds[11] and Beijing has about 700 solid waste dumps surrounding the city in order to handle the 10,000 tons of urban solid waste generated every day.[12]

No country has ever experienced such a phenomenal increase in solid waste quantities that China is now facing. In 2004, China surpassed the United States as the world's largest waste generator and it is estimated that annual solid waste quantities will increase by 150 percent by 2030.[13] As a result, China's annual solid waste quantities will increase from 190,000,000 tons in 2004 to over 480,000,000 tons in 2030.[14]

The China Council for International Cooperation on Environment and Development, a nongovernmental advisory board working to strengthen environmental dialogue between China and the international community, recently released a report that summarized some of the land-use problems associated with MSW in China.[15] While currently a Chinese urban resident produces 740 pounds less waste per year than his/her American counterpart, Chinese waste production rates are rapidly rising. The report found that landfills of solid waste have clogged 50,000 hectares of land surrounding cities in China, rendering this land as useless.[16] Moreover, all urban landfills will reach capacity in another thirteen years.[17] Additionally, it is estimated the PRC's garbage pile-up will reach 400 million tons in 2020, which is equivalent to the volume generated by the entire world in 1997.[18] This report provides a dire glimpse into the future problems China will face while attempting to handle the increase in MSW that results from a soaring population.

According to the above statistics, China will be overflowing with MSW unless action occurs. China will need to develop systems to effectively handle two-and-a-half times more waste than current levels no later than 2030-and the sooner this technology

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is developed, the better.[19] China cannot ignore this problem due to the social, financial, and environmental impacts of its increasing waste production on domestic and international matters.[20]

The Role of Government Agencies in the PRC

China's State Environmental Protection Administration ("SEPA") began to promulgate regulations and legislation related to solid waste management in the 1990s.[21] In 1991, SEPA started a waste declaration and registration pilot project in seventeen cities.[22] Part of the goal of this program was to identify the type, characteristics, quantity, and danger of solid waste, including the hazardous types. Under this program, SEPA also conducted tests on waste exchange to evaluate how a comprehensive regional program could be adopted.[23] As a result of this experimental work, a solid foundation for waste exchange has been established in China.

In October of 1995, China passed the "Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste."[24] As China's first comprehensive law on solid waste, it authorizes the government to inflict solid waste discharge fees on entities that do not comply with certain environmental laws.[25] The Cleaner Production Law was passed in 2002 and put in force in 2003; the goal of this law is to provide incentives to industries to reduce, recycle, and reuse wastes.[26] Some local governments also have enacted regulations and standards for the prevention and control of pollution by solid waste.[27]

The PRC's New MSW Approach

In China, the municipal environmental sanitation administrative bureaus are responsible for daily garbage collection, transportation, and centralized garbage treatment, including landfills and incineration plants.[28] Based on the volume, it has become clear that the Chinese waste industry alone cannot meet the demand for waste management technology.[29]

China's waste management system is undergoing wholesale changes as the government tries to respond to the increase in production of waste.[30] Partly inspired by Japanese and German recycling economy laws, the Chinese Government is increasingly viewing the concept of a circular economy ("CE"), also known as a life cycle economy, as a means of balancing rapid economic development in China.[31] A basic definition of CE is the joining of manufacturing and service businesses seeking to improve economic and environmental performance by collaborating in the management of environmental and resource issues. One of the Chinese CE objectives is to diminish the growing waste problem by increasing the efficiency of resource utilization by a factor of ten by the year 2020.[32]

The conversion of municipal solid waste to energy can conserve valuable fuels and improve the environment by lessening the amount of waste in landfills.

Factors, such as hosting the 2008 Olympic Games and the 2010 International Expo, mounting health hazards such as Severe Acute Respiratory Syndrome ("SARS"), and trying to manage growing stockpiles of solid waste are increasing external pressures on the Chinese Government to safely manage its solid waste. As a result, the government has begun encouraging the development of a solid waste management industry. Unfortunately, the local industry lacks the experience and technology to satisfy the rapidly growing demand.[33] As a result, China designated environmental protection as a key investment area, making it a new, market-oriented point of economic growth in the country and directing more foreign capital into this sector. This has resulted in China's environmental industry quickly becoming one of the most dynamic segments of its economy. Increasingly, international partnership projects, cleaner production, energy efficiency, and carbon dioxide emissions reduction are opening the market in China to highly diversified environmental technologies and services.

The Sustainability Solution: Municipal Solid Waste and Waste to Energy Conversion Technology

China needs an integrated sustainable waste management approach with the long-term objective of waste segregation. This approach requires involving key stakeholders, such as the 82,000 rural migrants making their living as garbage pickers in Beijing,[34] in the planning and decision-making process. China must also take a holistic view of the complete waste management system, including waste minimization, collection, transfer, treatment, recycling, resource recovery, and disposal.[35] Some MSW management techniques include source reduction, recycling, composting, landfills, and incineration. Source reduction involves altering the design, manufacture, or use of products and materials to reduce the amount of toxic materials that become waste. Recycling diverts items, such as paper, glass, plastic, and metals from the waste stream.

China currently uses the following three principal treatment methods for managing MSW: (1) landfills (70 percent); (2) high-heat composting (twenty percent); and (3) incineration (ten percent).[36]

Landfill: Turning Municipal Waste Methane into Energy

Most cities use centralized stacking and simple landfill treating methods to dispose of waste. The majority of these treatment facilities are not able to meet international standards and pose significant environmental hazards, particularly associated with leachate from the site.[37] Water percolating through landfills produces

leachate, which often contains toxic chemicals. Very few landfill sites in China are equipped with leachate collection and treatment systems, which are required in the developed world.

The biodegradation of organic matter creates landfill gas, which is about fifty percent methane.[38] The abundance of landfills has given China the distinction of producing more methane than any other developing country. This dubious distinction, since methane is a greenhouse gas, can be turned into a positive in that methane can be used as fuel for industry and vehicles.[39] Along this line of thought, China implemented several landfill gas capture projects. For example, one project included three technology demonstrations on how to use landfill gas for electric power generation, incineration of medical wastes, and vehicle fuels.[40] In addition, besides helping energy-starved cities in China, according to a World Bank report, "carbon credits from turning methane into energy could generate as much as [U.S.] $1 billion per year for Chinese cities."[41]

After the United States, China is the world's greatest energy consumer and largest emitter of greenhouse gases that contribute to global climate change.

High-Heat Compost

Composting decomposes organic waste, such as food scraps and yard trimmings, with microorganisms (mainly bacteria and fungi).[42] Composting may increase in importance due to the possible sale of carbon emission reductions under the Clean Development Mechanism of the Kyoto Protocol; however, this would entail establishing a marketing program and a review and testing of compost quality.[43] Currently, high-heat compost is not the focus of the Chinese Government.

WTE Technology

In many Chinese cities, WTE has been selected as a primary treatment method for MSW volume reduction and as a source of energy.[44] The conversion of MSW to energy can conserve valuable fuels and improve the environment by lessening the amount of waste in landfills.[45] The importance of utilizing WTE was recognized in the 1991 U.S. National Energy Strategy, which sought to support the conversion of MSW to energy.[46]

One way to utilize the energy value of MSW is to burn it in a steam power plant to generate electricity. In addition, the co-combustion of coal and MSW is an option. Coal has long been the predominant source of energy for electricity production in China and around the world. The same combustion principles apply to both energy sources, and the technologies for controlling emissions are similar in both the combustion of coal and WTE.[47] More than half of the electricity generated in China is produced in coal-fueled power plants. Thus, the co-combustion of coal and MSW as an energy resource can help mitigate the MSW disposal problem, conserve valuable fuels, and reduce emissions of CO_2.[48] This type of combustion reduces waste volume by 90 percent, resulting in sizable landfill capacity savings, even when the resulting ash is landfilled. Land filled ash weighs about one-fourth to one-third as much as processed trash and can be used as aggregate material for road building and other construction.[49]

In China, MSW incineration technology was initially used at the end of the 1980's, and was rapidly developed in the 1990's. Incinerators are growing in popularity but their "growth is often driven by artificial and non-sustainable subsidies and non-transparent financing structures, as well as lack of understanding and experience about incineration facilities."[50] It is encouraged that all new incinerators should meet Japanese-EU emission standards for dioxin and mercury, and that all operators should receive a significant level of training.[51]

China currently operates nineteen municipal waste incinerators with a total daily capacity of approximately 7,000 tons (December 2002 status).[52] This is about two percent of all the municipal solid waste produced in China.[53] More than 30 enterprises, research institutes, and universities are now concentrating on the research and development of incineration technology and its integrated equipments, and more than 30 large- and middle-scale cities have constructed or are constructing MSW incineration plants. Many new constructions are in conjunction with Japanese, German, French, and Canadian companies.[54]

The Opportunity: Benefits for the U.S. Environmental Technology Industry and U.S. Companies

China, with a current population of over 1.3 billion people, is one of the fastest growing economies of the world. This rapid growth will propel a dramatic increase in the demand for energy and other resources, with increasing demand over the next 40 years. In order to meet the increasing needs for proper MSW management, the Chinese Government is working with foreign partners to import technology. This creates great business opportunities for countries like the United States. The United States is a major exporter of MSW management technology, permitting it to provide guidance and gain financially from exchanging development technology with countries like China.

For example, effective alternatives to the MSW disposal and conversion technologies currently available in the PRC have been developed by the global environmental technology industry. Some of these technologies have still not been commercially exploited. However, each of these technologies will be able to convert MSW into usable raw material for other industries, and, at best, will completely eliminate contaminants in the air waste stream. The use of such technologies will create true sustainability in places like the PRC. Thus, the market for environmental goods and technology is rapidly increasing.

Despite the obvious opportunities for U.S. companies to continue to develop and deploy new technology in markets like the PRC, many companies allege that more stringent emission reductions standards cannot be achieved or that doing so would be devastating to the national economy. While these claims are met with sympathy in some circles, it is instructive to note that similar arguments were made by the U.S. automobile industry in the 1970s when they insisted that greater gas mileage or fuel economy could not be achieved. While the U.S. automobile industry, their lobbyists, and politicians were playing bipartisan politics and a game of "chicken," the Japanese simply developed and tested the technology, and built fuel efficient automobiles. The U.S. automobile industry has never recovered and has never been the same. Thus, this lesson should caution those who claim new MSW technology could not conform to stringent environmental standards.

Conclusion

Sustainable economic growth and development is critical in every part of the world. As urban populations increase and mega-cities become the norm, political leaders will increasingly be called upon to develop policies and procedures that promote economic viability while enhancing the environment. Such growth also provides opportunities for foreign companies to reap economic benefits while providing solutions to critical environmental and energy problems, such as the possible role of U.S. MSW management technology in the PRC.

Current MSW treatment and disposal methods in the PRC lag far behind international standards. This lag, if unchecked, will lead to dire consequences for the global community. After the United States, China is the world's greatest energy consumer and largest emitter of greenhouse gases that contribute to global climate change. New and existing MSW and WTE technologies have the ability to revolutionize the WTE industry in the PRC. The merger of new technology and existing experience-based practices could create a powerful partnership between respective organizations in the PRC and global environmental technology companies as the two work together to deliver the benefits of strong sustainable environmental and economic development to the citizens of the PRC and the world.

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