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SHANGHAI'S MUNICIPAL SOLID WASTE AND WATER SECTORS, AND THEIR RESPECTIVE MANAGEMENT

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1. Introduction

The rapid economic growth, industrialisation and urbanisation of China have generated high pressures on the environment, with consequent damage to natural resources. Shanghai, with its spectacular development, is no exception to this trend. **The aim of this paper is to assess the global current situation of Shanghai's municipal solid waste and water sectors, and their respective management.** The sources to produce this paper are the public internet, relevant municipalities and foreign observers.

Main findings:

- *Shanghai is an exception in China and considers environmental issues as very important. This can be seen in projects such as the Chongming eco-island Project. On paper at least, it is a model for other cities in China.*
- *The Three-year Action Plan for Environmental Protection and Shanghai's 11th Five Year Plan are the main frameworks to improve the environmental situation.*
- *By 2010, Shanghai wants a waste water treatment rate of 80%. The actual rate is between 40 to 60%. The overall increase in quality of water can however be noticed.*
- *Domestic waste is increasing at a rate of about 8% per year in Shanghai.*
- *Shanghai's goal is to treat over 85% of urban sewage by 2010.*
- *In Shanghai, the water sector is under the administration of the Shanghai Water Bureau, and waste management under the Shanghai Sanitation Bureau.*
- *The funds for environmental protection should remain at an average of 3% of the city's GDP.*
- *The main challenges are the very minimal fees for sewage and the non-existent fee for municipal waste collection. Also, implementation of rules and regulations, and corruption are in need of amelioration. Overall, rapid urbanization means a fast-growing demand for safe and clean water in rapidly-modernizing cities and areas, as local populations continue to swell with an influx of new arrivals, and as industry increases consumption.*

Shanghai is one of the few cities in China that considers environmental issues as very important, and consequently, much attention is paid to setting up a comprehensive framework to improve the environmental situation. Due to this, Shanghai, on paper at least, is a model for other cities in China. However, enforcement is another issue.

Shanghai's main framework to an improvement of the situation is the implementation of a **Three-year Action Plan for Environmental Protection**, which covers all environmental fields. Currently, the third one is being carried out, and plans for the next one are being drafted (2009-2011). The 3rd round of Three-year Environmental Action Plan comprises of 256 projects with approximately 40 billion RMB investment. According to a report of June 2008, all of these projects are up until now successful. Furthermore in Shanghai's current **Five Year Plan**, making real progress in creating a conservation-oriented and environment-friendly city, and improving Shanghai's environment and ecology is emphasized in order to make Shanghai a **National Model City of Environmental Protection**. All these goals are definitely fuelled by the target of making the city's 2010 world expo an "**Ecological World Expo**". The city furthermore strictly abides to the national guidelines regarding these sectors.

In general, due to the high targets set in the above mentioned sectors, the potential market opportunities for foreign technology and equipment suppliers are many, as domestic

technologies are comparatively weak and still at the preliminary stage of development. Of course, this foreign technology is useless unless it is adapted to local conditions.

1.1. Facts and figures

Shanghai	
Type of City	Municipality under the Central Government
Population (2006)	18.15 million
GDP	US\$157.8 billion
Total domestic waste generation per year (million ton)	7
Total amount of water used per day (million ton)	7-8
Waste disposal service fee (RMB)	To be implemented soon, amount not yet decided upon.
Private water supply fee (RMB)	2/m ³

2. The Water Sector

2.1. Present situation of the water sector

Shanghai doesn't lack of water but lacks of drinkable water. The city has two heavily polluted rivers running across the city, the Huangpu River and the Baoshan segment of the Yangtze River. The water for urban residents is seriously polluted as it comes mainly from outlying sections of these two rivers – 80% from the upper stretch of the Huangpu River, and 20 % from the Yangtze River. These proportions are however intended to change, as plans are being drawn to mainly get water from the Yangtze River, as it's water is of better quality. With the size of Shanghai constantly increasing and the Chinese wealthy classes of society more and more adopting a western lifestyle, the amount of water used by the city is also in constant augmentation. Furthermore, **wastage is enormous and inefficiency rules.** In general, industries use 10 to 20% more water than their equivalent in developed countries, and up to 20% of the water used by the cities is lost due to leakage in the distribution networks.

However, much attention has been given to the situation and according to its **11th Five-Year Plan** (2006-10) Shanghai will have established by 2010 a sewerage network covering both the downtown area and suburban townships, with a wastewater treatment rate of 80%. It also is planned that the chemical oxygen demand (COD)¹ amount of the city's total discharged water will be cut by 15%. Interestingly enough, the Shanghai Environmental Protection Bureau (SEPB) states that Shanghai is already treating 80% of its wastewater and that sustainability is now the next step. However, some non-governmental sources say that the wastewater treatment rate is currently only between 40-60%.

Up until now, progress has been noted. For example, the quality of water environment in Shanghai in 2007 stayed the same as in 2006. The water quality of the Huangpu River, Yangtze river (including the Suzhou creek), and other main relative waterways was improved or stayed the same. The **Ministry of Environmental Protection of the People's Republic of China**, formerly **State Environmental Protection Administration** (SEPA) also confirmed that as in 2007, the COD in Shanghai was 2.52% lower than in 2006, the goal of reducing pollutants discharge thus being reached. Also, the surface water quality within the municipality kept unchanged, and an improvement of the situation of black and stinky sections of water body in sources around the city has been noticed.

¹ The COD is an index for measuring water quality of the discharged water.

One key local player within the water sector which collaboration with, from the part of foreign companies, is of great interest is **Shanghai Urban Construction Investment Development Corporation** (Shanghai Chengtou). It is a professional holding company engaged in raising, utilizing and managing funds for urban construction. Shanghai Chengtou is authorized and backed by Shanghai Municipal Government, and as such is responsible for the main projects around the city. At present, Chengtou Water Division consists of 14 subsidiaries, including 5 water supply companies, 4 sewage companies, 1 raw water supply company, 2 construction companies and 2 pipeline engineering companies. So far, the total daily capacity of raw water supply is 6.3 million m³ /d, capacity of water supply is 7.74 million m³ /d, the capacity of waste water treatment is 3.6 million m³ /d, which has become the major company in the related field.

The main areas of improvements within this sector outlined by the SEPB are upgrading the existing water plants, upgrading the waste water collection system (pipes) and finding a better way to dispose of the sludge, which currently just goes to landfills.

The areas of demand within the water sector in Shanghai are the same as in all cities across China: to increase capacity to meet growing needs, and to bring improvements in standards of service in order to deliver a high quality of water services to consumers, in terms of water quality (a reliable service and water safe to drink) and associated customer services.

2.2. Present development status of the municipal sewage treatment sector

The general trend in this sector is that investment has been increased year by year. Furthermore, the construction of sewage treatment plants and water drainage networks has been accelerated. Along with the accelerated construction of municipal sewage treatment plants and municipal sewage drainage networks, the municipal sewage treatment ability has been stably upgrading. As such, Shanghai has 20 to 30 small to medium sewage treatment plants, and also two big ones, the **Bailonggang** one, that can process up to 1.7 million tons a day of sewage and the **Zhuyuan Sewage plant**. Furthermore, to improve sewage gathering and disposal, 659km of pipeline has been newly laid. However although the structures are existent, the running of the treatment plants is not always successful. It seems that some treatment plants are without a connection to the sewage system. Others are switched off because no provision has been made to pay for their operation. Others lack the qualified personnel to operate properly. This once again supports the argument that implementation is one of the key problems in this sector.

3. The Municipal Solid Waste Sector

3.1. Present situation of the municipal solid waste sector

No country has ever experienced such a phenomenal increase in solid waste quantities that China is now facing. In many places in China, waste management is the “underdog” of Chinese environmental policies: an ad hoc legislation exists only since a dozen years and the resources allocated to it are considerably less than the ones provided for the managements of problem related to water and air. Although the environmental question has definitely gained in importance, it nevertheless remains subordinate to the economic imperatives. This obviously contributes to a certain failure in waste management.

However, **Shanghai breaks this trend, and is the city that probably adopts the best waste management practices of any city in China**, receiving national recognition for its environmental leadership. With some foreign help, Shanghai municipality has been able to build landfills sites with modern technology and also has modern municipal solid waste (MSW) incineration facilities. The World Expo hosted by the city in 2010 is also a major

incentive to concentrate on environmental issues, following in the lines of the expo's theme "Better City, Better Life", and thus conforming to the idea of an "Ecological World Expo". Furthermore, in the most recent Shanghai Environmental Bulletin, it is stated that "We [SEPB] would rather let GDP fall by one or two percentage points than failing to achieve this goal [of reducing pollutants discharge]", thus emphasizing that environmental imperatives are slowly becoming as important as economic ones.

Despite Shanghai's efforts, there is still a lot of room for improvement. This can be seen in the increasing amount of rubbish surrounding the city; about 1,000 garbage dumping grounds surround Shanghai. Furthermore, the volumes of solid waste produced are rising 8% a year, according to the Ministry of Construction. Therefore continuous efforts to improve the situation are needed.

3.2. Main means of dealing with domestic solid waste

In Shanghai the 3 main treatment methods are:

3.2.1. Landfills

One of Asia's biggest landfill is in Shanghai, the Laogang landfill. The Shanghai Laogang Municipal Solid Waste Landfill is situated at Laogang town, Nanhui District, southeast of Shanghai, some 60 km from the city centre. The landfill is located adjacent to the coast and occupies 360 hectares with an anticipated total capacity of more than 34 million tonnes of waste over a 20-year concession contract.

However, although Shanghai possesses sanitary landfills, the effectiveness of some is nonetheless debated, due to lack of enforcement of regulations, meaning for example that not all wastes are sorted and treated before being buried.

Municipal landfills are, at the moment, the least environmental solution for the treatment of wastes. They are a hazard to the landscape, they take up a lot of arable land, they provide high risk of contamination to surrounding land and water, and also, the methane produced by the fermentation of the wastes threatens the quality of the air.

3.2.2. Incineration

Shanghai currently already has several household incineration factories, including the one of Minhang, which is supposedly the largest one in China. The facility is designed to have a daily garbage handling capacity of 3,000 tons and generate around 270 million kilowatt-hours of power every year.

Incineration reduces the volume of waste by 90%, and 80% of its weight. Furthermore, it reduces the toxicity of the wastes that will then be put in landfills, and offer the opportunity to use the energy contained in the waste. Waste-to-energy facilities produce clean, renewable energy through the combustion of municipal solid waste in specially designed power plants. One of the largest waste-to-energy power plant is in Jiangqiao, Shanghai. It is actually a Sino-French Joint venture between Shanghai Huancheng Waste-To-Energy Co. Ltd and the French giant Veolia. Established in 2004, it burns 1,000 metric tons of waste each day.

4.2.3 Recycling

Although the State does sponsor some kind of recycling industry, the private and informal activities constitute the most important mode of recycling. That is because the informal waste picker relies on this recycling to resell the materials and make a living. As such, every thinkable material is collected, from papers to plastic, electric appliances to metals, and everything else in between.

Informal recycling goes in four steps, 1) individuals separate the wastes to their smallest unit 2) it is brought to community based waste collection centres (there are around 200 to 300 of them in Shanghai), 3) it is then brought to centralized garbage centres, 4) it is sent to a plant.

One of the main factors affecting the recycling industry though is that the buying price of recycled goods by industries isn't very high, which therefore does not provide an incentive for individuals to recycle. Without a market for reused materials, recycling is pointless. Furthermore, finding a recycling bin in Shanghai is extremely hard, which explains the tendency of the inhabitants to dump all the waste together. All of this contributes to the fact that sorting at source is not yet a habit in people's lives. However recent policies, such as shops making the customers pay for plastic bags, are helping ameliorate the situation.

However, when wastes are recycled, different kinds of use are found for them. In general, household wastes are reused as fertilizer or incinerated to produce electricity. Industrial wastes are turned into construction materials, and hazardous wastes are turned into raw materials again.

4. Policy and Regulation

4.1. Shanghai's general objectives and tasks for the Next Five Years

At the first session of the **Thirteenth Shanghai Municipal People's Congress** in January 2008, environmental protection, and more specifically waste management and municipal waste water management, was highlighted many times. Among the general objectives for the Next Five Years, **making real progress in creating a conservation-oriented and environment-friendly** city, and improving Shanghai's environment and ecology was emphasized.

The government affirms that it will not hesitate in using all economic, legislative and administrative means to phase out heavy pollution and low productivity capacity that devours energy and land resources. Furthermore, it vies to create a conservation-oriented and environmental-friendly city through more economical resource use and environmental protection. Concerning water management, water sources will be better planned, developed and protected as **Shanghai strives to weave water conservation into the fabric of its society**. It was furthermore stated that the government of Shanghai is committed to environmental protection and ecosystem management, and vies to become a "National Model City of Environmental Protection". It will intensify environmental monitoring and law enforcement, with improved environmental impact assessment (EIA) and a cap on the total amount of discharged pollutants. It will step up its efforts in pollution control and reduction through better treatment of the Suzhou creek and other small and medium-sized rivers city-wide. Its goal is to treat over 85% of urban sewage by means of an urban sewage system connecting treatment facilities with feeder pipeline networks by 2010. Concerning solid waste management, the objective is to substantially complete the installation of waste recycling and treatment facilities enabling 85% of household waste hazard-free for the environment.

The representatives of the government also recognize that it is crucial to build up public awareness and responsibility for resource conservation and environmental protection. This goal can be seen in action for example with the website "Shanghai Environment Online"², set up by the SEPB, which provides information and encourages citizen participation. The overall motto is to make for a better and cleaner Shanghai.

² <http://www.envir.gov.cn/eng/>

4.1.1. Chongming Eco-island Project

Measuring over 1000 square meters, Chongming is the largest alluvial island in the world and the third largest islands in China. It is also one of Shanghai's five municipal districts. With Dongping National Forest Park occupying almost 100 square meters at the center of the island, it is the last relatively untouched part of the greater Shanghai municipality. Chongming has remained relatively unaffected by contemporary ecological problems, and that should remain that way: The government of Shanghai has developed a comprehensive master plan to transform the island into an ecologically-oriented recreational zone and laboratory for sustainable urban, agricultural, and ecological technologies by the year 2020. The master plan addresses five distinct zones:

1. Dongtan wetlands to the east will be preserved in their entirety as a sanctuary for migrating birds. Dongping National Forest Park will be expanded and developed as Shanghai's largest recreational area.
2. In the northern part of the island, there will be stadiums and theme parks, with some land reserved for ecological agriculture.
3. To the south (today the most densely populated part of the island), residential districts will be developed and clean industries established.
4. Dongtan, the island's economic center, will be developed as a green city that depends on renewable energy, rainwater, and fuel generated from kitchen waste.
5. To the west, a large lake and an international exhibition and convention center are in development.

By end 2008, the 25.5-kilometer Shanghai-Chongming expressway will be completed, including a 9-kilometer tunnel and a 10-kilometer bridge. There is no plan for an environmentally-sound transportation system, and this has been the subject of criticism. Nevertheless, the strategy for Chongming is progressive for China. The project is distinguished not only by the wide range of ecological measures, but by its international partners. The master plan was developed by the American firm of Skidmore Owings & Merrill (SOM), and universities throughout the world are working on its various aspects. The eco-city of Dongtan is being designed by Arup UK.

4.2. Legislative structure – Roles and Responsibilities

Within the actual system several organizations play a key role in the protection of the environment.

The **Shanghai Environment Protection Bureau** ("SEPB") is the regional organisation of the national **Ministry of Environmental Protection of the People's Republic of China**, formerly **State Environmental Protection Administration** ("SEPA"), which is the highest level government organisation in charge of environment protection. Its main task is the implementation of policies and laws specified by the Ministry of Environment and supervision of the work of the local Environmental Monitoring Stations.

Ministry/EPBs are additionally in charge of standards and enforcement of law, in particular for supervision, standards and administration. However, laws themselves are the responsibility of the National's People Congress, and besides laws, regulations are emitted by various ministries. The role of these bodies is also to raise awareness of environmental protection.

A number of **ministries and agencies** are also involved in environment management (Ministry of Water Resources, Ministry of Finance, Ministry of Agriculture, Ministry of Communications, Ministry of Railways, State Administration for Civil Aviation...).

A variety of **sub-national administrative units** also play a very important role (Mayor's offices, planning commissions, industrial bureaus, finance bureaus, urban construction bureaus): they cooperate with the SEPB for the implementation of the regulations. They can

also be proactive in carrying out new projects: in fact, some regions and cities are at the forefront at national level. In Shanghai, the water sector, concerning water treatment and infrastructures, is under the administration of the **Shanghai Water Bureau**, and waste management is under the administration of the **Shanghai Sanitation Bureau**.

Environmental NGOs have a role to play as well. There are approximately 2,000 environmental groups officially registered as NGOs in China, among which are some well-known international groups like Greenpeace. The government has generally adopted a positive attitude toward environmental NGOs, but continues to control them through a range of regulations and restrictions, remaining wary of the potential of environmental activism to transform into a force for much broader political change. SEPA is a strong supporter of NGOs activities.

All these organizations and the different role they play means that in the case of waste management, it lacks transparency regarding data, responsibilities, coordination of policies and such. This leads to confusion and contradictions. As a fact, **China in general seems to be suffering from “over- institutionalisation” of its management of wastes.**

4.3. Environmental laws and regulations

Altogether, **China has a comprehensive and modern set of laws** (see annex 1) **to address environmental issues, along with regulatory and economic instruments to implement them.** However the volume and complexity of China's laws and regulations makes it difficult to provide clear signals to the regulated community. In fact, inadequate enforcement is one of the key factors in the country's deteriorating environmental situation, and the government of Shanghai is aware of this issue and is planning to take further action against this problem.

4.4. Funding

The funds for environmental protection are under constant increase, with an investment in 2008 that should remain around 3% of the city's GDP. This follows the global trend in China as under the National 10th five-year plan, around 700 billion RMB were invested in environmental protection, whereas it is now estimated that the objectives for the 11th five-year plan are set at over 1200 billion RMB. Furthermore, in the field of environmental protection investment and financing market, the Chinese Government has generally opened the water supply and wastewater treatment infrastructure market to international competition since its WTO accession.

The financing of policies of waste management is often very vaguely defined. No specific budget is allocated to any specific domain. Therefore, it is extremely hard to get any precise facts and figures about current budgets, funding, and such data. However, efforts are being made by the government of Shanghai to improve transparency in government information, which might lead to positive results.

Overall, 36.612 billion RMB was allocated in 2007 to environmental protection in Shanghai, which amounted to 3.05% of the local GDP during the same period of time. An amount of roughly 3% GDP yearly is the target the city wants to keep to.

Unlike other cities in China where there is a collection fee, usually 3RMB per month/ per household, Shanghai's private households do not have to pay any waste disposal services fee. However, this is about to change, as promulgated in "Shanghai Urban Household Garbage Collection and Disposal Management Measures", in August 2008. In the provision 17, it says that residents should be submitted to solid waste disposal fee. The regulation will

take effect from November 1 this year. However the concrete date at which these measures will be carried have not yet been determined. The amount is also still unclear.

As for water, Shanghai's average urban water price is about RMB 2/m³ compared with a world average of RMB 9.08/m³. This is one of the cheapest water tariffs among the Chinese mega cities.

The minimal fees for sewage and the non-existent fee for municipal waste collection have resulted in a lack of investment in urban infrastructure. There is therefore the need to raise sewage and waste management fees in order to recover costs and raise funds for investment in new facilities. One of the only feasible options seen is the division of tasks between local authorities and external help. In addition, specifically for water, the prices and fees are so low that there is little economic incentive to conserve water and thoroughly treat waste water.

In 2005, the planned total investment of fixed assets in the water sector was 82.74 billion RMB. For a breakdown of this budget, see annex 2.

5. Challenges faced by Shanghai

The representatives of Shanghai are aware of the gravity of the environmental situation and are trying to take counter-measures. However, the challenges Shanghai has to face are numerous, and involve several social and political aspects.

The main challenge is rapid urbanization, which means a fast-growing demand for safe and clean water in rapidly-modernizing cities and areas, as local populations continue to swell with an influx of new arrivals, and as industry increases consumption. This also involves upgrading the piping network.

In addition, some parts of the administration in Shanghai still regard economic growth more important than the protection of the environment. The effectiveness of governmental decisions is consequently seriously compromised. Although there is a plan to fight **corruption**, it is still much present, and the support of local leaders can sometimes still be bought by businesses threatened of being shut because of lack of authorization or inadequacy in applying to new laws. Furthermore, although at the thirteenth Shanghai Municipal People's Congress it was said that the government of Shanghai planned to make government information more accessible, there is a big tendency to hide the actual numbers concerning pollution, and official statistics are not always true. Moreover, the incitation to better protect the environment is not sufficient as the fines allocated to businesses who ignore the new rules are much less than the necessary investment needed to conform to them. For example, the maximum fine for water pollution is of US140,000 per instance.

In general, **the minimal fees for sewage and municipal waste collection, and water are a major problem** creating a total lack of incentive from the Shanghainese to improve the situation in these respective fields.

6. Foreign involvement

Shanghai is open to foreign investment. The city seeks to attract international services outsourcing contracts. At the same time, high energy- and land-consuming or high-polluting projects with low economic returns are firmly rejected.

In Shanghai, the market of water and solid waste management is still tightly in the grip of municipal and local companies. Although foreign technologies have widely made an

appearance in the market, the sector itself is still very hard to enter. As such, foreign companies' main involvement is in the provision of technology, equipment, and services.

Some foreign giants of the environment have managed to implant themselves within the sector of waste management, and play key roles, such as providing full water services including management, but these are not many. Opportunities for small to medium size foreign companies are also existent, but their involvement is however often less direct, such as only supplying technology and equipment.

Annex 1 - Overview of National Chinese Laws and Regulations regarding solid waste and water sectors

Laws and Regulations	Brief Description	Issuer	Effective Time
Environmental Protection Law of the PRC	First comprehensive law regarding environmental protection	The Standing Committee of the National People's Congress	1989 (amended since)
Law of the PRC on Water and Soil Conservation	Formulates for the purpose of the prevention and control of soil erosion, the protection and rational utilization of water and soil resources, the mitigation of disasters of flood, drought and sandstorm, the improvement of ecological environment and the development of production.	The Standing Committee of the National People's Congress	1991
Regulations Regarding Municipal Residential Solid Waste	Regulations regarding the management of collecting, transferring and treating residential solid waste.	The Ministry of Construction of PRC	1993
Law on Prevention and Control of Environmental Pollution Caused by Solid Waste of PRC	First law to regulate the management of MSW.	The Standing Committee of the National People's Congress	1995 (amended in 2005)
Law of the PRC on Prevention and control of water pollution	Enacts the purposes of preventing and controlling water pollution, protecting and improving the environment, safeguarding human health, and ensuring effective utilization of water resources.	The Standing Committee of the National People's Congress	1996
Water Law of the PRC	Formulates the rational development and utilization of water resources and the protection of such resources, for the prevention and control of water disasters, and for the full derivation of comprehensive benefits from water resources in order to meet the needs in national economic development and in the livelihood of the people.	The Standing Committee of the National People's Congress	1998 (amended in 2002)
Technical Policies on the Disposal of Domestic Waste and the Prevention of Pollution	Guidance and standards of the technologies applied in the MSW treatment.	The Ministry of Construction of PRC	2000
Comments on Promoting the Industrialization of Municipal Waste Water Treatment and Municipal Solid Waste Treatment	An important signal for attracting private and foreign investment into municipal wastewater and solid waste industry.	State Development & Planning Committee, The Ministry of Construction, and State Environmental Protection Administration	2002
Law for Promotion of Cleaner Production of PRC	From each step of the production, the manufacturers should take measurements to reduce pollution.	The Standing Committee of the National People's Congress	2003
Law for Environment Impact Assessment of PRC	Emphasize the importance of preventing environmental pollution from source; any new construction must obtain EIA approval before breaking ground.	The Standing Committee of the National People's Congress	2003

Annex 2 – **Breakdown of water sector budget (billion RMB)**

