

# **AN INTRODUCTION TO THE CHINA GEF PROJECT “PROMOTING METHANE RECOVERY AND UTILIZATION FROM MIXED MUNICIPAL REFUSE”**

Gang WEN  
China GEF Office  
Jibin CHEN      Hairan GAO  
Foreign Economic Cooperation Office, State Environment Protection Administration

## **Abstract**

This paper provides an overall introduction to the Global Environment Facility project “Promoting Methane Recovery and Utilization from Mixed Municipal Refuse” in China in aspects of project background, design and implementation, outcomes, and lessons learned. This paper also briefs some basics of The Global Environment Facility (GEF) and China GEF activities at the beginning.

## **1. GLOBAL ENVIRONMENT FACILITY**

The Global Environment Facility (GEF) is the designated financial mechanism for international agreements on biodiversity, climate change and persistent organic pollutants. Through its operational programs (OPs), it supports activities of the developing countries and economies in transition that create global benefits in the focal areas of biodiversity, climate change, international waters, ozone depletion, land degradation, and persistent organic pollutants.

Within GEF’s climate change focal area, there are four operational programs, i.e., Removal of Barriers to Energy Efficiency and Energy Conservation (OP5), Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs (OP6), Reducing the Long-Term Costs of Low Greenhouse Gas Emitting Energy Technologies (OP7), and Promoting Environmentally Sustainable Transport (OP11).

Since its launch in 1991, the GEF has allocated about \$4 billion in grants and mobilized an additional \$12 billion in co-financing from other sources to support more than 1000 projects in over 140 developing nations and countries in transition.

In August 2002, 32 donor nations pledged nearly \$3 billion to fund the work of the GEF for the next four years.

## **2. CHINA GEF ACTIVITIES**

As one of the sponsoring countries of the GEF, China is both a donor and a recipient of GEF funds.

The Ministry of Finance (MOF), which hosts the China GEF Political Focal Point and the China GEF Operational Focal Point, formulates policies for and oversees GEF activities in China. The MOF provides state endorsements for China GEF project applications, and supervises the implementation of those projects through regular and standardized management so as to ensure and enhance the overall performance and achievements of the projects.

China actively makes contributions to the relevant activities in implementing international environmental conventions on biological diversity, climate change persistent organic pollutants, desertification and etc. In order to implement the provisions of the conventions and fulfill her responsibilities, China cooperates closely with GEF.

The China GEF Office serves as a technical support body to assist the MOF in overseeing China activities at the national level.

### **3. CHINA GEF PROJECT “PROMOTING METHANE RECOVERY AND UTILIZATION FROM MIXED MUNICIPAL REFUSE”**

#### 3.1 Project background

In China, with the rapid development of economy and increasing level of urbanization and consumption in the urban areas, the volume of the refuse has been expanding steadily, and the municipal refuse problem has become the key factor to effect environment protection, urban construction, resident life and sustainable development. By the end of 2000, almost thousands of landfills have been established in the middle & large size cities in China, among them around 90 percent disposals the refuse in a simple pileup manner. The conventional method of landfill has not only caused common pollution, and also produced the landfill gas with the principal element of methane, which is an important greenhouse gas. The potential greenhouse effect of the equivalent volume of methane is 21 times of that of CO<sub>2</sub>.

#### 3.2 Project design and implementation

In January 1997, the State Environment Protection Administration (SEPA) of China started project “Promoting Methane Recovery and Utilization from Mixed Municipal Refuse” under GEF OP6. The United Nations Development Program (UNDP) is the international implementing agency of the project, and the United Nations Department of Economic and Social Affairs (UNDESA) is the executing agency. The project received GEF grants \$5.285 million and raised domestic co-financing \$14.28 million. The project consists of 5 parts, including three demonstration cities: Nanjing, Anshan and Ma’anshan, a Center for Landfill Technology Development and Training in Anshan and a Nation Action Plan.

The project is designed to have an implementation period of four year, was initiated. In the process of the project implementation, the closure date of the

project is postponed to the end of 2003.

The objectives of the project are to promote wide spread adoption of landfill gas recovery technology in China. In the long-term, the project contributes to the (a) significant reduction of methane emission; (b) reduction in air, water and land pollution associated with refuse dumping; and (c) promotion of indigenous enterprises that will build and operate recovery systems and utilize the energy. In the short-term, the project must (a) test several gas recovery designs on small sections of three existing landfills or dumps in order to maximize gas yield. (b) demonstrate several gas utilization systems at the three small-scale trials; (c) use field trial data to design, construct, and operate three full scale pilot landfill gas recovery plants at sanitary landfills in Anshan, Maanshan, and Nanjing; (d) develop an action plan to promote wide spread replication and adoption of landfill gas recovery technology in China. (e) strengthen Beijing Environmental Research Institute as a national center for methane recovery research and dissemination, that will disseminate the knowledge and techniques learned during this project. The Center will provide valuable information and assistance to municipalities and businesses in China.

According to the international experiences and the experiences and lessons from three demonstration sub-projects, the problems and barriers of landfill gas recovery and utilization in China are technical barriers, mechanism barriers, policy barriers, and organization and implementation barriers. The project tried to removed the barriers by (a) gaining experience in identifying, designing, constructing and operating landfill gas recovery and utilization plants in China by constructing and operating three pilot plants in three different sites at Anshan, Maanshan, and Nanjing. (b) training national staff to undertake the above functions over time. (c) building capacity through experiences gained, and bringing in conditions that will promote indigenous enterprises that will build and operate recovery systems and utilize energy. Domestic manufacturing of equipments will aim at lowering the costs of technology. (d) promoting its acceptance among local decision makers and demonstrate it as a viable measure that produces energy as well as reduces air, water and land pollution. This will create essential incentives to develop further institutional and legal framework related to landfill gas recovery technologies. (e) by developing an action plan based on the experience from pilot plant, to promote wide spread replication and adoption of landfill gas recovery technology in China. (f) strengthening existing national institutes to enable them to disseminate the knowledge and techniques learned during this project

A number of national, local, and foreign entities will be responsible for developing, managing, and implementing the project. Their roles are summarized below:

- (a) UNDP. The UNDP will provide overall leadership and management from its in-country office in Beijing.
- (b) SEPA. The SEPA has formulated and coordinated this project from its inception, and it continues to play that role. The SEPA reviews all activities for technical quality, economic efficiency, organizational performance, and adherence to national environmental laws and policies.
- (c) City Governments (of Anshan, Ma'anshan, and Nanjing). The

demonstration plant host cities organize task forces for the project. A task force, under the leadership of a deputy mayor of each of the cities, includes the representatives from the local Environmental Protection Administrations, and from the sector administrations of sanitation, and construction and etc. The latter organizations plan and implement the field trials and the pilot plants. The cities perform the demonstration plants under the guide from the SEPA.

- (d) Non-government organizations (NGOs). Both the SEPA and the cities relied heavily on a variety of institutes, universities, and private consultants to perform much of the study, research design, and engineering work involved in every phase of the project. The work was let out on a competitive basis.
- (e) Private manufacturers and capital providers. At each of the three pilot sites, private manufacturers and capital providers collaborated with the SEPA, city governments and NGOs to help decide the best equipment and financing schemes that could be set up so as to be able to replicate the pilot projects elsewhere in China.
- (f) The owners and operators of the landfill. They participated in the negotiation of a power purchase agreement with the electricity bureau and/or neighboring enterprise(s) interested in purchasing power from the landfill plant.

### 3.3 Project outcomes

The project, following a market-orientated approach, collects experiences of technique application and of management, and provides demonstration cases for the cities in China. The outcomes of the project are:

- (1) Establishment and on-trial operation of three demonstration pilot facilities for landfill gases collection and utilization in Anshan, Ma'anshan, and Nanjing.

The different technologies on methane recovery and utilization have been adopted respectively in three demonstration cities: to generate electricity onto the wire netting from recovered methane in Nanjing (see appendix), to use the purified methane as the vehicle fuel in Anshan, to burn the poisonous and harmful refuse produced in hospitals by methane in Ma'anhang.

- (2) Establishment of an institution with functions of education, training, research, promotion and information dissemination for landfill treatment and utilization.

Anshan Center for Landfill Technology Development and Training was established in the end of 1998. The center has wide cooperation with many training and research institutions. Since its establishment, the center has organized training activities and workshops for over 20 times on methane recovery and utilization from municipal refuse all around the nation, yielding nearly 1500 trainees.

- (3) Establishment of the infrastructure, for meeting the market economic requirements, to support both technical and commercial management and operation for landfill gases collection and utilization

The successful implementation of the demonstration cases includes the beneficial exploration on the coordination between speeding up the municipal development and protecting environment. The project is a test to some means by adopting a market-orientated approaches to formulate new models for landfill management in cities., and collected experiences of processing and utilization refuses, and hence show good examples. Therefore, the success of the project will exert positive impacts on not only the three demonstration cities but also those similar cities in China.

A number of things in the project were carried out based on almost zero. For example, The owners and operators of the landfill. The participated in the negotiation of a power purchase agreement with the electricity bureau and/or neighboring enterprise(s) interested in purchasing power from the landfill plant. China has little or no experience for the stakeholders to reference for the negotiation of a power purchase agreement. The project serves as a model for the purchase of electricity.

(4) Establishment of a national action plan to promote wide spread replication and adoption of landfill gas recovery technology in China.

In April 1998, the Energy Research Institute of the State Development and Reform Commission (SDRC) (former State Development and Planning Commission) began to work out the National Action Plan. During the research and formulation process, some Holland experts provided their suggestions and comments. With the great support of the related government ministries such as the SDRC and the Ministry of Construction, the National Action Plan was finalized.

Drawing on the practices of the refuse management in developed countries and combining the experiences derived from the demonstration cases implemented in the project, the National Action Plan analyzes the following aspects on municipal refuse in China: the basic framework of the managerial mechanism, the technical prospect for the resource treatment and resource assessment, and the status quo of the municipal refuse and methane recovery and utilization technology at the current stage. Besides, it also provides the in-depth analyses on the barriers in terms of mindset, policy, finance and technology on promoting methane recovery and utilization from municipal refuse and brings forward the comments and suggestions on how remove these barriers and how to promote the resource treatment of the municipal refuse to reduce the greenhouse gas emission.

Aiming at providing useful references to the development and improvement of policies and regulation of the nation, the National Action Plan supplies the municipal managerial departments with the practice reference and new assessment system of methane recovery and utilization at the designing stage of the landfill plants and references on how to promote the industrialization and resource treatment of the municipal refuse to make the relevant regulations and policies better meet the requirements of market economy development in China.

Providing the status quo of the managerial system and policy-making status of municipal refuse in an objective manner, the National Action Plan gives guidance to the measures and activities to be taken on the resource treatment of refuse in the future. Owing to the joint efforts of related government departments and experts from China and abroad in the development of the Plan, it bears the great academic value as well as the authority on the policy making direction, which makes it an important guidance to both policy maker, urban planner at all levels of the government and engineers and scientists of the enterprises and organizations concerned.

The National Action Plan focuses on the following components, aiming at the problems and barriers of Chinese landfill gas recovery and utilization:

(a) Legislation and regulation development

- To issue a national standard system for the landfill system design, construction and maintenance.
- To develop a government regulation, which request all of the new landfill system should be designed, constructed and maintenance based on the national standards.
- To develop a national regulation, requiring the utility should purchase the electricity, gas, thermal or other energy products, which produced by the landfill system.
- To set up legislation, which allows private sector to own the landfill system or landfill gas recovery and utilization system.

(b) Enforcement the implementation of legislation and regulations

(c) Economic incentives

Economic incentives are the major driving force for inducement of enterprises to adopt the landfill gas recovery and utilization. The major incentives should cover prices, taxation, duty for relevant necessary imported high-tech equipment, investment, equipment production

(d) Education and public awareness

As soon as the legislation and regulations to be developed, a training program for the education of government staff, design institutions and maintenance entities should be developed.

(e) Information dissemination and technical training

(f) Establishment of flexible and efficient coordination mechanism

(g) Demonstration and promotion activities

It is suggested to encourage commercial approaches of landfill gas recovery and utilization.

(h) Financial arrangement

The sufficient financial arrangement can ensure the successful of the national

action plan. The financial flows in consideration for the action plan can be governmental financial budget, bilateral concessional or ODA financial support, GEF grant financing, national development bank, commercial banks, and private investment.

### 3.4 Problems found and lessons learned

In the project implementation, especially from the build-up and operation of demonstration plants, the problems found and lessons learned are:

- Power purchase agreement of landfill gas for power generation and the power price
- The determination of power capacity and the arrangement of time of facilities installed
- Purification of landfill gas for residential fuel and vehicle fuel

Furthermore, there are also some problems for the three demonstration projects in the aspects of institutional building and economic incentive policy, especially for the project operation mechanism and finance aspects. General speaking, local governmental departments are in charge of the clean and disposal of municipal refuse, and the capital is from local finance. However, for the landfill gas recovery and utilization, it is necessary that local government set up the special fund to ensure the capital for investment and O&M cost of landfill gas recovery and utilization projects. Regarding the three demonstration project, it is easy to be implemented because they are financed by the international cooperative projects. But generally, it is difficult for central government and/or local government to arrange special fund for landfill gas recovery and utilization.

## Appendix

### Case of Nanjing

With a population of 2.47 million, Nanjing city produces 2000 tons of refuse every day. Shuige Landfill, located 20 kilometers in southern suburb with an occupation area of 540 mu (equivalent to 88.8 acre), has a daily capacity of 1000 tons of refuse. The project has a total investment of the project in Nanjing 34 million Yuan in RMB. Nanjing City Appearance Administration is the implementation unit of the demonstration sub-project.

In May 2002, Shuige Landfill has finished the engineering construction of the electricity-generation project that was started in 1997, and entered into operation in July 2002. With the total generation volume of 1250 kw. so far, the plant handles 400 m<sup>3</sup> of methane per hour with a utilization rate of 0.37 kg/kwh. With the continues development of the plant, the total generation volume is expected to reach 5000 kw/h in the future.

Nanjing is the first demonstration city that generated electricity from recovered methane with GEF grant in China. It made the fruitful exploration development in the marketing management and resource treatment of municipal refuse, providing a lot of experiences to other cities of the nation.