

Case Analysis of Maanshan City Xiangshan Refuse Landfill Gas (LFG) Recovery and Utilization Project

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Abstract

In China, methane gas produced by the disposed or simply landfilled refuse has a great effect on the warming of climate. The State General Bureau of Environment Protection paid extreme attention to it and submitted a project proposal of “China---Experiment Research of Recovering Methane from Municipal Mixed Household Refuse” to UN Global Environment Foundation(GEF) which was approved by GEF in 1997. The project included establishing a centre for landfill gas utilization technology and spreading and three demonstration sites and researching the national scheme for landfill gas recovery and utilization .

Maanshan City in Anhui, Anshan City in Liaoning and Nanjing City in Jiangsu were chosen as the demonstration cities. The paper describes the execution of the project , especially the repeated revisions on the gas utilization scheme and analyses the causes for the repeated, revisions and the problems and obstacles encountered. Economical analysis is made of the investment recovery period, operational cost and net present value of the finally determined scheme that will use the landfill gas as the fuel for incinerator to treat the city’s hospital refuse in a concentrated way of incineration. Analysis and assessment are also made of the environmental, social and economic benefits that may be obtained when the project is executed. At the end of the paper, it is hoped that encouraging policies be issued for its spreading .

1. Background of Project

The warming of global climate was attached great importance to at UN Environment and Development Conference of Heads of States held in June 1992, which called for the control of the discharge of man-made green house gas. In China, the gas produced by the refuse disposed in open-air place or simply landfilled greatly affected the warming of climate. The State General Bureau of Environment Protection paid extreme attention to it and submitted a project proposal of “China---Experiment Research of Recovering Methane from Municipal Mixed Household Refuse” to UN Global Environment Foundation(GEF) which was approved by GEF in 1997. The project included establishing a centre for landfill gas utilization technology and spreading

and three demonstration sites and researching the national scheme for landfill gas recovery and utilization .

In Oct, 1993, Maanshan Municipal Bureau of Environment Protection and Environment Sanitary Dept. submitted a project proposal of “ Maanshan Demonstration Project of Anaerobic treatment and Energy Recovery of Municipal Household Refuse Landfill Site” to the State General Bureau of Environment Protection and at the same time made application to both the provincial and municipal Planning Committee for this project . In Dec . 1993, the GEF experts accompanied by the official of the State bureau came to make a field investigation in Maanshan and made examination of the feasibility study report of the project. Full confirmation was given and as a result, Maanshan Xiangshan Refuse Landfill Site was listed as one of the three demonstration sites of the GEF project.

2. General Description of Project Execution

2.1 Background

Maanshan city lies in the east of Anhui Province and at the south bank of the Changjiang River. Under it is three districts and a county. It has a total area of 1686 Km² including 301 Km² urban area and 35.5 Km² built area and a population of 1.1814million People including non-agriculture population of 0.4978 million people.

It is an important industrial city in Jiangnan region that is characterised by coordinated development of various industries such as machinery, chemicals, electricity , electronics, building materials, light and textile and food, with iron and steel industry as the leading one.

Maanshan municipal household refuse includes resident household refuse and refuse of institutions, schools, trade and commercial units and that collected by cleaning the roads and public sites, but excludes medical waste, residue of construction, night soil and industrial solid waste. The historical household refuse cleaning and transportation amount and the refuse composition are show in Tables 1 and 2 .

Xiangshan Refuse Landfill Site is the only simple one for Maanshan household refuse. It is located in the discarded tailings reservoir of Xiangshan Pyrite Mine, 20Km distant to the urban area and 6Km east of Xiangshan County. The tailings reservoir has a total land area of 19.1 hect, 5.3 hect. of which was allocated for the landfill construction in 1985.Up to now, 637000t refuse has been landfilled in the original site since its operation in July 1985.

The first thing to be done after the approval of the project was to select the location of the new landfill site. Through the comparison and proof, it was decided to acquire the rest capacity of the tailing reservoir on the basis of the existing landfill site , which will be designed according to the sanitary landfilling requirements specified by the Ministry of Construction , when the recovery , utilization and leachate treatment systems will be considered. The landfill site will have a total volume capacity of 29.3 million m³, designed daily throughput of 400t,

compared to the present 200t/d capacity , and a service life of 19 years. The landfill gas recovery and utilization project will also be located within Xiangshan Refuse Site.

Table 1 Maanshan Household Refuse Collected and Transported over the Years

| Year | Refuse Truck (unit) | Refuse collected and transported (t) |
|-------|---------------------|--------------------------------------|
| 1985 | 6400 | 16640 |
| 1986 | 7600 | 19760 |
| 1987 | 7210 | 18746 |
| 1988 | 7997 | 20792 |
| 1989 | 8200 | 21320 |
| 1990 | 10700 | 27820 |
| 1991 | 10791 | 28057 |
| 1992 | 12065 | 31369 |
| 1993 | 16304 | 42390 |
| 1994 | 16919 | 43989 |
| 1995 | 17405 | 45253 |
| 1996 | 19281 | 50131 |
| 1997 | 22957 | 59688 |
| 1998 | 24062 | 62561 |
| 1999 | | 73126 |
| 2000 | | 75043 |
| Total | 187891 | 63685 |

Table 2 Composition of Maanshan Municipal Household Refuse

| Refuse components | | Component percent |
|------------------------|--------------------|-------------------|
| Organic matter (%) | Animal | 0.74 |
| | Plants | 48.66 |
| | Total | 49.40 |
| Inorganic matter (%) | Dust and earth | 34.23 |
| | Bricks and ceramic | 1.94 |
| | Total | 36.17 |
| Recoverable matter (%) | Paper | 4.02 |
| | Rubber and Plastic | 5.09 |
| | Textiles | 1.64 |
| | Glass | 2.58 |
| | Metal | 0.31 |
| | Bamboo and wood | 0.79 |
| | Total | 14.43 |

2.2 Management Institutions of Project

When the project was approved, a leading group was immediately set up, with the related deputy mayor as the group leader and with the participation of various related organs , under the group is a GEF project office. The main member units are the Municipal Bureau of Environment

Protection (in charge of leading and coordination), the Municipal Environment Sanitary Dept. (in charge of construction) and Maanshan Institute of Mining Research (in charge of technical support). The three units assume concrete work, leaving the major issue to the decision of the leading group through Municipal GEF Project Office.

The management operation is kept through the whole process of the project execution.

2.3 Main Stages in the Project Execution

? Basic data collection, from 1994 to 1995

The research of the basic properties of the municipal household refuse over a year and of the methane production law of refuse mixed landfilling were carried out, obtaining preliminary detailed understanding of the composition, basic properties and methane production law of the city's household refuse.

? Industrial test of LFG recovery and utilization, from 1995 to 1996

An industrial test on 5kw electricity generation by landfill gas direct combustion was made in Xiangshan Household Refuse Site.

? Formal Start of the Project

"Project of Promoting China's LFG Collection and Utilization of Municipal Solid Refuse" was approved by GEF in April 1996. In May 1997, the project start meeting was held in Beijing, marking the project's coming on an all-round execution stage.

? Execution stage of the project

In 1998, technical preparation work of the early period of the project was completed, gas extraction test at Xiangshan site's 2 hect. landfill area made and the related technicians took part in the technical training in Anshan Training Centre for three times.

During 1999~2002, feasibility study was made on the utilization of Xiangshan Refuse Site's LFG. A period as long as four years was taken to determine the final scheme of Maanshan LFG utilization. In 2003, based on the final scheme, preliminary design and construction design are under way, marking the project's coming onto the engineering stage.

3 Selection of LFG Utilization Scheme

The most difficult stage in the whole process is that for deciding on the LFG utilization plan.

3.1 scheme of Generating Electricity by LFG for use in Electricity Network

Electricity generation by LFG direct combustion was the one selected first by Maanshan City with the following reasons:

? Utilization of LFG at abroad is mostly generating electricity for use through electricity network and the technology is ripe.

The problem of no power electricity for years in Xiangshan Refuse Site can be solved, with the plus electricity being salable, which may bring some economical benefit.

? Small range involved and convenient management

For this, the municipal leading group of GEF project organized the technical force to successfully carry out the industrial test of 5kw electricity generation by LFG direct combustion at Xiangshan Refuse Site during the period of 1995~1996, doing the exploratory work for LFG electricity generation project.

The Electricity thus generated should be incorporated into the electricity net. At the municipal coordination meeting, the electricity department explicitly expressed its objection to it with the arguments of too small amount of generated electricity, not high utilization value and effect of

its incorporation on the electricity net. It was only suggested to use it for the refuse site itself or to try other ways .

As there was no definite policy support, the resistance from the electricity department, led directly to the abortion of this scheme.

3.2 Comprehensive Utilization Scheme of Partial LFG for Electricity Generation and Partial LFG for Use as Fuel

The reasons are:

? To meet the electricity demand of the refuse site itself .

? LFG is a good clean fuel and will have the highest utilization rate when used as fuel.

? The technology is ripe and there are professional personnel in this city , showing little risk .

? LFG except for electricity generation shall all be used as fuel so as to avoid the loss of LFG that may occur when all LFG is used for electricity generation ,where sometimes surplus LFG has to be burned due to unproprieate electricity generating set ,leading to a low LFG utilization rate.

Selection of fuel clients

1) Industrial Clients

No suitable industrial Clients have been found.

2) Building incinerator for hospital refuse in the refuse site to burn the medical refuse of various hospitals in a concentrated way.

As there was no policy requiring a concentrated burning of hospital refuse, it can not be executed.

3) To use the LFG as civil fuel

As there are several administrative cuns, 1km apart from the refuse site, and Xiangshan County having a population of 40000~50000 people, 6km distant to the refuse site they may become the long-term clients of LFG.

In view of the above, the Municipal Project Office basically approved this scheme. Maanshan Institute of Mining Research accomplished the feasibility study report in March 1999, which was submitted to US CH2M HILL Company for examination. CH2M HILL Company suggested to change the partial electricity generation to sell all the LFG as fuel while the needed electricity can be obtained through public electricity net so as to get better economic benefit. According to the analysis of their economists, this change could shorten the investment recovery period and increase the internal return rate. The Municipal GEF Project Office accepted their suggestion and the scheme was thus modified.

3.3 LFG being directly used as civil fuel for Xiangshan County

The reasons are :

? Direct use of LFG as civil fuel can have the highest utilization rate

? Ripe technology

? Xiangshan County is 6km distant from the refuse site, suggesting a medium distance of LFG transportation . As the county is at the edge of the city, municipal gas pipe hasn't led here. The introduction of LFG may solve the problem of inconvenience brought by the lack of pipe gas to the resident life.

Its distinct defects are :

? Since LFG is the only gas source here , there will be low guarantee rate of gas supply.

? As LFG will be used as civil fuel , the management ought to be executed by Maanshan

General Co. of Fuels from the department duty . If the Municipal Environment Sanitary Dept, assumes the responsibility of management, it means that the department has to directly face the clients .This will bring great difficulty in management for the following reasons:

1. Cross-industry operation ; 2. incapable of assuming the maintenance of the gas pipe due to few professional personnel and risk of unable to collect the fuel gas cost , which will directly affect the economical benefit of the dept.

? To lay a gas piping net in Xiangshan County will need a great sum of investment and it is difficult for the local government to allocate the needed fund.

In view of the above conditions , there is serious problem in the operationability of this scheme.

3.4 Scheme of using LFG as the complementary source of municipal fuel gas

The reasons are :

? Eliminating the unfavourable factors such as low supply guarantee rate of single gas resource and unstable gas flowrate due to season change;

? With the Environment Sanitary Dept. as the seller and the General Co. of Fuel Gas as the buyer , there will be clear responsibility division ,facilitating the management;

? Theoretical calculation and mixing test show that it is feasible to mix LFG with the presently used coal gas of coke oven .

Difficiencies:

? At the beginning ,the small amount of LFG will have no attraction to the Fuel Gas company ,only to increase its work load;

? Due to long transportation distance (about 14km), there will be great investment in the pipe line, wide involvement and great difficulty in construction.

The successful execution of the scheme needs the support of the Fuel Gas Company .

The General Company of Fuel Gas objected to this scheme at first.

The main concerns included the high content of oxygen in LFG, which might lead to hidden safety danger and the too small LFG amount which would not mitigate the gas supply shortage. Therefore, the scheme was discarded due to the objection of the Fuel Gas Co. in 1998 when the LFG clients were being selected .To solve the fuel gas supply shortage , the Fuel Gas Company mixed liquefied petroleum gas with coke oven gas. Over one year practice showed that the existence of a little amount of oxygen in the fuel gas will not affect its safety .This eliminated the worry of the General Company about the safety of the mix of LFG with coke oven gas .For the sake of safety, Fuel Gas Testing Centre was entrusted by the Municipal GEF Project Office to make the test on the mixing of LFG with coke oven gas .The test proved its feasibility ,with the highest mixing ratio of 30%(coke oven gas: LFG =7:3) The gas mixed with this ratio can meet the various index requirements of burning .The feasibility report concluded that “using LFG as the supplementary gas source to mix with coke oven gas has the advantages of simple production technology , small investment and low production cost which is lower than any other gas source. Therefore, it is technologically and economically feasible .” But, meanwhile, it was pointed out that “ As LFG has a high oxygen content ,strict monitoring should be made in the gas mixing process”. It should be said that this scheme, comparatively, accords with the practical conditions of Maanshan City. However , this scheme was abandoned due to the following reasons:

? The project of east transportation of western gas requires that Maanshan City should all use natural gas in 2003, not later than 1994. Then ,the LFG gas pipeline shall be left unused ,

leading to an investment waste .

- ? Great one-time investment ,unsettled fund and setbacks in getting bank loan;
- ? The General Co. of Fuel Gas has been holding an unactive attitude toward the LFG utilization;
- ? The construction of the LFG pipeline will involve many things (such as occupying farm land, compensation for young crops and road breakage for laying the pipeline), need great efforts in coordination and have great difficulties ,which the Environment Sanitary Dept. cann't assume by itself . It is worried about that the construction shall have a too long period and cann't be completed within the required period .

3.5 Scheme of using LFG for cooling and heating greenhouse

The reasons are:

- ? Small investment , reducing the difficulty in fund raising;
- ? The whole scheme from land acquisition to construction is within the control of the Environment Sanitary Dept., convenient for operation and management.
- ? Short construction time, making it possible to complete the project on time .

Distinct shortcomings:

- ? The utilization of LFG is limited to only Winter and Summer .It cannot be used in Spring and Autumn when the temperature is agreeable and has to be burned ,leading to a low LFG usage rate, which doesn't accord with the objective of GEF demonstration project.
- ? The construction unit is in shortage of the professional personnel majoring in special flowers and counter-season vegetables. At the early period, there will be support from Nanjing Agricultural University. But the operation and management after the construction could present a great problem .
- ? Shortage of professional sales personnel

In this case , Maanshan LFG utilization scheme was difficult to advance or retreat .

3.6 Reselecting the Scheme of Generating Electricity by Direct Combustion of LFG

In such a difficult situation, the LFG project aroused the great interest of UR CPL Energy Company. Various kinds of information indicated that electricity generation by LFG could have good benefit and the key to it was how to operate. For this, the Municipal GEF Project Office organized an investigation of Hongzhou Tianziling Refuse Site , where the project of using LFG to generate electricity for electricity net was successfully realized in a BOT mode . In addition, Nanjing Shuige Refuse Site, also one of the demonstration unit of this GEF project, cooperated with a foreign company to jointly develop the LFG electricity generation project ,making a real breakthrough for the slowly progressing project . In view of this, the GEF Project Office once again considered the scheme of using LFG to generate electricity for the public net. The favourable factors are:

- ? The State has explicit policy supporting clean and regenerated energy source being used to generate electricity for the net and the electricity departments at both provincial and municipal levels expressed that there would be no problem if the capacity of electricity generation was small:
- ? Joint development of LFG utilization with the city's Electricity Development Co. might be favourable for getting a favourable price of electricity .
- ? To establish a joint electricity company between the Municipal Environment Sanitary Dept. and Electricity Development Co. by which the operation of electricity generation by LFG for the net would be done. The required fund would be put in by both units and the shortage would be

met by getting a loan by the new company.

The difficulties in its execution are:

? Due to small refuse amount , LFG amount and small scale electricity generation capacity ,the cost would be comparatively high. If there was no favourable electricity price, the scheme would lack attraction to investors, so to the Electricity Co.

? There existed certain technical risk as it would be the first time to undertake such project for both construction unit and the Electricity Development Co. and they had no operation and management experience.

This scheme once again fell into difficult situation as there was a great gap between the electricity price asked and that the Electricity Supply Bureau could afford. The Electricity company considered it to have too great risk and finally retreated from the project.

3.7 Case Analysis of the Frequent Change of Utilization Scheme

The main causes are:

Small refuse site scale and LFG production directly affect the economy of LFG utilization project and lack the attraction to investors. This may be problem commonly existing in the refuse treatment in most China's small and medium-sized cities.

4 Brief Introduction to the Final Scheme of LFG utilization

4.1 Reasons for the Selection

As Maanshan is a small and medium-sized city, the amount of refuse landfilled is small and therefore the LFG production is small. Especially at the early period of LFG recovery , limited by its small production, LFG utilization cannot be done in a large-scale way. In addition ,the existing landfilling mode cannot be fully changed ,which will affect the production of LFG . Therefore , the scheme of directly using LFG as the fuel , which is the ripest one, of the incinerator for medical refuse is adopted. LFG will be used to burn all the medical refuse of the city in a concentrated way and the surplus will be used for the industrial boiler of Nanshan Mine, 2km distant to the refuse site.

The reasons are:

? Suitable to the early period of recovery when the LFG production is low;

? The government has published the policy relating to concentrate burning of medical refuse , making it possible to erect the incinerator for it in the refuse site;

? LFG collection and utilization will be controlled by the Environment Sanitary Dept. itself , facilitating the operation management.

? Less investment , easier for the government to get supplementary fund.

? The Municipal Government has published the policy relating to the fee collection for the concentrate burning of hospital refuse.

4.2 Investment Scale and Benefit Analysis

4.2.1 The total investment will be 5.781 million RMB yuan at a medical refuse treatment capacity of 600kg/h.

By the year of 2005, 65000m³ LFG will be sold per annum.

4.2.2 Analysis of Economical Benefit

If the fee for medical refuse burning is collected according to the number of sickbeds and LFG is sold, the project will have an internal return of 10.2% and an investment recovery period of eight years. If calculated only according to the investment on LFG without considering the

infrastructure construction cost of the refuse site, the project can have certain economic benefit.

In the analysis of the project sensitivity, the selected factors are: an increase of investment by 10%, a reduction of sales income of 10% and an increase of operation cost by 10%. The analysis results show that the key factor affecting the benefit is sales income, next to it is investment increase. Therefore, the key to ensure the economical benefit of the project is to ensure the collection of the medical refuse disposal fee and to sell as much LFG as possible.

4.2.3 Analysis of Environmental Benefit

Practical measurement show that the burning of the medical refuse of the city needs 1.26t standard coal and the industrial boiler of Maanshan Iron Mine consumes 1.27t standard coal. According to the theoretical calculation, the burned 2.53t coal can produce 2820m³ CO₂ that is emitted into the atmosphere and other pollution factors such as SO₂ and dust. Except CO₂, LFG contains methane gas which is directly emitted into the atmosphere and has a value of contribution to greenhouse gas that is 21 times that of CO₂. If LFG is used as a direct burning fuel, 2.53t standard coal can be saved and 2820 m³ CO₂ and 4000 m³ LFG be reduced which are discharged into the atmosphere per day. Therefore, the environment benefit will be remarkable.

5 Problems and Obstacles Encountered in the Execution of Demonstration Project

5.1 Insufficient Importance Attached to the Project

Due to insufficient importance attached to the project by high level government, the execution of the project lacks continuity and little technology and fund have been put in to the household refuse treatment. Though in recent years, governments and responsible departments have realized the danger of refuse, the attention paid to it and the fund for it are always arranged behind other municipal infrastructure projects. In the project execution, the government lacked continuity. Every change of responsible leader can affect the support degree. The main leaders of some responsible departments even considered the project construction as a little too early.

5.2 Fund Shortage

Since a long time ago, environment sanitary has been an undertaking of public welfare. The government allocates fund for refuse treatment and the environment sanitary department has been an institution living on financial budget. Taking the construction of Xiangshan Refuse Site as example, at the early period, the fund was mainly put in the land acquisition and infrastructure construction including office building. The routine treatment fund arranged by the financial dept. includes the cost for refuse collection, transportation, landfilling and roller compaction machine repair and wages, leaving very little for reconstruction. To build a refuse site demonstrating the sanitary landfilling and LFG recovery and utilization needs the fund far greater than that of the financial allocation. Applying for a bank loan by a unit as such will be suspected of its repayment ability. With the guarantee of the municipal government and the repayment plan of the municipal financial dept. The bank will still refuse to give the loan, making it very difficult to get a bank loan.

5.3 Lack of Cooperation Between Departments and Limited Government Coordination Capability

Refuse treatment is a comprehensive basic work and LFG utilization is even more a system engineering, needing the cooperation between various departments and related enterprises. It is difficult to seek for a partner in joint utilization of LFG. The causes includes: 1. small gas

amount ,lacking a attraction ; 2. no preferential policy for the cooperative unit ,which get little benefit while needing greater efforts in the management ; 3. cooperation consciousness between departments is lacked due to the long-time cultivated habit of each doing things in his own way. In such case , government coordination is generally needed for cooperation . With the deepening of market economy and the expansion of enterprise right to act on its own , the government coordination effect is evidently reduced especially to some monopoly industries or enterprises belong to the management of the industry ,increasing the difficulty in smooth execution of the project .The Environment Sanitary Dept. had no choice but to finally select the scheme of greenhouse shed , which could be executed within its own right range as it couldn't coordinate the cooperation with other departments .

5.4 Technical Obstacles

The technology of LFG collection and utilization is not a ripe one in China . Though there are successful cases of Hongzhou Tianziling and Guangzhou Datianshan Refuse Sites ,both was constructed in a BOT mode, technically relying mainly on the foreign side .There are few professional contingent and personnel that have rich experience in both refuse landfilling and LFG collection and utilization .The technically supporting units of the three cities have to study while working .It may be said to help in capability training ,but the technical guidance will relatively lag behind in the project execution.

Prediction of LFG production is an utmost basic parameter in LFG utilization project .As there was no domestic prediction model, the technical support units had to use the model provided by CH2M HILL Company for it. But for the reliability of the predicted results, it is difficult to judge due to the lack of proof of practice, directly affecting the scale of LFG utilization .

5.5 Defficiencies in Construction and Management of Refuse Site

Unstandard landfilling operation and lack of efficient management are common problems .It's far from the coverage required by LFG collection ,very unfavourable to LFG production and collection. The causes are: 1. Getting used to the present operation mode, simple and power saving ; 2. limited operation cost. The repeated roller compaction as required by strict coverage will in crease oil consumption and work hour. The purchasing and transportation cost for additional clay as needed will be uncoverable. Besides, the low level of overall management of the site is far behind the internationally advanced level , which is also one of the causes leading to the difficulty to practice standard operation.

5.6 Electricity price may become the biggest obstacle of project execution

As the income of electricity selling is the only source of income for the investors of LFG electricity generation, it is the issue of prime importance for both domestic or foreign partner. In the “Proposal of Electricity Generation by LFG of Manahan Landfill Site” of UK CPL Company, it is suggested, the local electricity price should be 0.41 yuan/Kw/h for a two megawatt generator set requiring a total investment of 12.84 million yuan ,and 0.46 yuan/Kw/h for a total investment of 15.26 million yuan to make the investment balanced . It is found out that the electricity sell price on the net is not exceed 0.20 yuan/KW/h. In a situation of competition , the cost of LFG electricity generation can't compete with that of thermal power at all. Too low a electricity sell price on the net has no attraction to investors , resulting in abortion of the related scheme though there is policy of support.

5.7 Worries about the Policy of Collecting Refuse Disposal Fee

On June 7, 2002, the State Planning Commission, Ministry of Finance, Ministry of Construction and State General Bureau of Environment Protection jointly issued "Circular of Practicing the Policy of Collecting Municipal Household Refuse Disposal Fee to Promote the Industrialization of Refuse Treatment" ([2002]No.872), an explicit national policy relating to the refuse fee collection.

In the cities around Maanshan (such as Nanjing and Hefei) test point work on refuse fee collection has been carried out. However, the city's environment sanitary system showed an unwarm attitude to it. Once the refuse disposal fee is collected formally, it means the refuse disposal will become a paid service from a original public welfare. The environment sanitary department will become one having economical resource, making it possible to loose the financial allocation. In addition, the refuse fee policy may not be well accepted by the urban residents. It will be difficult to collect the fee from units having poor benefit and from laid-aside workers, which may directly affect the income of the environment sanitary department. Therefore, the department has doubt how the department will develop after the fee collecting policy is put into effect and whether it can survive by only collecting the refuse fee. It is reluctant to be thrown onto the market.

6 It is hoped that encouraging policies be issued for the popularization of projects of this kind

6.1 It is hoped that encouraging policies be issued as early as possible to buy clean energy resource or regenerated energy resource and products of electricity generation by such resources or other ways.

The experience of the scheme of electricity generation for the net by LFG during the various periods of 1996~2001 shows the effect of policies and regulations. It is suggested the related supplementary policies be published including reward and penalty to activate the market of regenerated energy source.

6.2 Doing well the propagation and guiding work when the refuse fee collection policy is practiced.

Insufficient fund for the capital construction of the refuse sites has led to a slow construction of China's municipal refuse disposal sites, making it difficult to meet the increasingly stricter requirements on refuse treatment and the refuse pollution being increasingly serious. Therefore, the State has issued the policy of refuse fee collection. But propagation and guiding work should be made after the policy issuing to make public and enterprise recognize that the issue of refuse has close relation to every one. Good disposal of refuse can improve the environment and is a good thing and practical thing for the people. Efforts should be made to help the public and enterprise to accept the fee collection policy, further to actively help and take part in the work.

6.3 Correspondent preferential policy should be given to encourage non-state enterprises to participate in such projects.

The refuse treatment market should be gradually developed, fund resource be widened by multiple channels and non-state enterprise or private investment be encouraged to construct the refuse treatment site. The policy should make the investment enterprises get more profit. The local government should protect the interests of the investors in formulating laws, regulations or rules, making them boldly take part in the competition of municipal infrastructure construction market.