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Hebei Rural Renewable Energy Development Demonstration Project

Environmental Management Plan

Hebei Rural New Energy Development Project Management Office

Hebei Jingmiao Environmental Consulting Co., Ltd.

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ABBREVIATIONS

EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
WB	World Bank
PMO	Hebei Rural New Energy Development Project Management Office
CSTR	Continuous Stirred Tank Reactor
VPF	Vertical Plug Flow Anaerobic Digestion Process
UASB	Upflow Anaerobic Sludge Blanket Reactor
USR	Upflow Solid Reactor
IC	Internal Circulation Anaerobic Reactor
PFR	Plug Flow Reactor
MCT	Dry Anaerobic Fermentation by Membrane Covered Through
SAPS	Solid Producing Acid and Liquid Producing Methane Fermentation Process in Series
PDO	Project Development Objective
EP	Environmental Protection
EPD	Environmental Protection Department
EPA	Environmental Protection Agency
TPC	the Third Party Certification
ECOP	Environmental Codes of Practice
TS	Total Solids
PRC	The People's Republic of China
EHS	Environment, Health and Safety

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1. Overview

1.1 Brief description of the project

1.1.1 Project background

There is a great amount of rural waste in Hebei Province every year, mainly including straw and manure of intensive breeding farm. They severely contaminate water, atmosphere, soil and etc. Hebei Province is a major agricultural province, and agriculture take an important position in the provincial economy. However, huge amount of livestock manures and crop straws are generated in agriculture. In recent years, with the rapid population increase and rural economy development, the waste pollution situation is really serious. Due to lack of proper guidance, a large number of livestock manures and flushing mixtures are discharged directly into the natural environment, and livestock waste has become a huge source of pollutants. For the lack of scientific disposal technology, most farmers basically do not burn straw for cooking, and can not find the approach of "turning waste into wealth ". Most of straws are burnt directly in the field, which affect the environmental quality of soil, water and atmosphere straightly, severely restrict the agricultural efficiency and farmers' incomes, and threat food safety and human health.

In Hebei Province, the annual amount of livestock manure is up to 120 million tons, and crop straw volume is also very large. Exploring resource utilization of agricultural waste not only can improve rural ecological environment, but also meet part of the energy demand in farmers' lives and agricultural production. Meanwhile, resource utilization of agricultural waste play an exemplary and leading role in building a resource-saving and environment-friendly new village and ecological civilization.

From the environmental point of view, the People's Republic of China (PRC) faces enormous energy and environmental pressures at present. Domestic oil and coal resources become depleted and annual oil imports have reached more than 91 million tons. Meanwhile, the uncontrolled use of mineral energy causes increasingly serious environmental pollution problems. Chinese natural gas gap is big, and the per capita domestic gas is just 1/5 of Korea, especially rural gas supply gap is bigger. To achieve the goal of quadrupling national economy in 2020, the guarantee of reliable gas supply is essential condition. Adjusting measures to local conditions using local biomass resources to produce a variety of renewable energy has become the urgent matter.

From the point of view of recycling economy, development of biogas, its residue and liquid utilization industry is an important way of comprehensive, harmonious and sustainable

development, and is one of the important basis and key links to develop agricultural recycling economy. Utilization of biogas and its residue and liquid has three aspects. First is using straw and manure to produce biogas for supplying surrounding farmers and meeting the living and production energy demand of the plant. Second is biogas residue to produce solid organic fertilizer. The third aspect is biogas liquid to apply directly to farmland, vegetable greenhouses and fruit trees as liquid fertilizer. Project will achieve pollution reduction and resource utilization of livestock manure. The project will achieve the minimization of livestock wastes and recycling of the nutrients, as well as cleaner production of the livestock farms, and industrialization operation to shape into a cycle of ecological agriculture system.

Biogas classified as green energy is a kind of high grade fuels. Meanwhile electricity generation using the biogas is suitable for large, medium and small-scale biogas projects and large-scale production, and will form an emerging industry with broad prospects to produce good economic benefits and social benefits. Biogas liquid and residue generated in the production process is also the high quality organic fertilizers, which are necessary for ecological agriculture planting. Therefore, under the background of sustainable development, vigorous promoting construction of biogas project is very necessary.

National Twelfth Five-Year Plan pointed out to accelerate new energy development, promote clean and efficient use of traditional energy sources, adjust the structure of energy consumption and increase the proportion of non-fossil energy. At the meeting of "highlighting ten key works and promotion ten practical technologies", Chinese Ministry of Agriculture has vigorously advocated the production and application of biological organic fertilizer to improve environment and ensure food safety. *Hebei Provincial 12th Five-year Plan* has planned to develop recycling agriculture, promote recycling and reuse technology of livestock manure and other wastes actively, and form a recycling agricultural development pattern. It is proposed to strengthen the construction of agricultural standardization and marketization, enable sound agricultural criteria system. It is also proposed to carry out a unified industry operation procedures and technical specifications, in order to accelerate the development of pollution-free, green, organic agricultural products with signs of production origin.

Therefore, Hebei Provincial Department of Agriculture, Hebei Development and Reform Commission, and Hebei Provincial Department of Finance have proposed to carry out Hebei Rural Renewable Energy Development Demonstration Project in Tangshan City, Hengshui City, Chengde City, and Handan City. The project intends to focus on supporting large-scale straw and farm waste jointly producing biogas for central gas supply engineering, and makes an application to the Hebei Provincial People's Government ("*Application of Loan from the*

World Bank" Applying for Foreign Capital from Hebei Development and Reform Commission [2013] No. 473).

The aims of *Environmental Management Plan* are to fully consider and prevent variety of possible environmental impacts in the project implementation, as far as possible to minimize or relieve the negative environmental effects of the project design, construction and operation. According to the relevant requirements of "*The Environmental Impact Assessment Law of the People's Republic of China*" and "*Notice on Strengthening Management of Environmental Impact Assessment of Construction Project from International Financial Organizations Loans*", Hebei Jingmiao Environmental Consulting Co., Ltd. was authorized to undertake the compiling work of Environmental Management Plan (EMP) for Hebei Rural Renewable Energy Development Demonstration Project. After the preliminary date collection and investigation, the *EMP* of the project was compiled.

1.1.2 Project objectives

The proposed Project Development Objective (PDO) is to demonstrate innovative sustainable renewable energy management models to promote environmental improvement and clean energy provision in rural areas.

1.1.3 Project contents

After the first batch of subprojects is implemented, the six biogas engineering will annually produce 72829.7 thousands cubic meters biogas with consumption of 19.14×10^4 tons straw (straw silage) and 13.31×10^4 tons livestock manure, and produce 7.91×10^4 tons solid organic fertilizer and 4.79×10^4 tons liquid organic fertilizer. In addition to meet subprojects' own heating demand in the operation process of biogas engineering, biogas is supplied to 9.61×10^4 households for cooking and purified to gain 778×10^4 m ^{3}fuel gas for automobile.

The second batch of biogas works will be screened and appraised according to the operation manual. The second batch will include 4-9 biogas works, with the effective volume $4.93\times10^4 m^3$, producing biogas $5.46\times10^4 m^3$/d, ($1685.85\times10^4 m^3$/y, annual operating 8000hours), consumption of 9.93×10^4 tons straw (straw silage) and 9.64×10^4 tons livestock manure, and produce 3.15×10^4 tons solid organic fertilizer, supplying to 4.79×10^4 households for cooking. The requirement and guidance for the preparation of the EA and the approval of the EA for the second batch is provided in the EMF of the EMP.

The construction scale of first batch subproject is shown in Table 1.1-1.

Figure 1.1-1 The geographical location of Hebei Province

Figure 1.1-2 Subproject Distribution

Table 1.1-1 Construction contents and scales of Hebei Rural Renewable Energy Development Demonstration Project (the first batch of subprojects)

No.	Subprojects name	Implementation agencies	Construction sites	Construction scales and contents (including gas pipelines)
1	Anping Subproject	Hebei Yufengjingan Farm Co., Ltd.	Main part of Hebei Yufengjingan Farm Co., Ltd, where is in the south of Dongzhaizi Village, Anping County	Construct 6 biogas digesters, a total volume of $2.82\times10^4 m^3$, a daily biogas production of 31689.35 m^3, and annual production of the bio-gas is 1052.56 $X10^4 m^3$, and annual production of the CNG is 5.2112 million $m^{3,,}$ and annual production of solid fertilizer of 12,954 t, and liquid fertilizer of 33,215 t.1.46×10^4 tons of straws and 8.69×10^4 tons of livestock manure are used every year to produce biogas supplying for 2×10^4 households and 1 CNG filling station.
2	Yutian Subproject	Yutian Yiheyuan Ecological Agricultural Co., Ltd.	Ruanzhuangzi Village, Guojiatun Town, Yutian County-level City	Construct 6 digesters (total volume: 19,200 m^3), producing biogas 2.1×10^4 m^3/d, equivalent to 6.993 million m3/a. The bio-gas of 2.997 million m3/a will be supplied to 15 thousand households, 1.5984 million m3/d to the plant itself for heating, and the remaining 2.3976 million m3 to the inductees nearby. The annual production of 0.53×10^4 tons organic fertilizer and 14.05×10^4 tons liquid fertilizer, 1.13×10^4 tons of concentrated liquid fertilizer. It will use the livestock manure 116,200 thousand t annually.
3	Zunhua Subproject	Hebei Meikeduo Food Group Co., Ltd.	Xixindianzi Village, Baozidian Town, Zunhua County-level City.	Construct 16 fermentation tanks (total volume: 17,600 m^3), The annual production capacity of biogas is 802×10^4 m^3, of which 400×10^4 m^3 is for central supply to 20 thousand households and 226×10^4 m^3 for CNG, to produce 2.55×10^4 tons organic fertilizer annually. It will use 18,000 t/a silage, 20,000 t/a crop residue, 30,000 t/d livestock manure, and 25,000 t/a mushroom residue.
4	Linzhang Subproject	Hebei Runzezhimin Agricultural Science and Technology Co., Ltd.	Modern Agricultural Science and Technology Demonstration Zone of Linzhang County, Hebei Province	Construct 4 digesters (total effective volume: 10,000m^3), a daily biogas production of 8515 m^3, equivalent to 2.8384 million m3/a. the bio-gas of 1.533 million m3/a will be supplied to 7000 households, 0.4584 million m3/a to the plat itself for heating the digesters, and the 0.847 million m3/a to the organic fertilizer plant. An annual biogas residue organic fertilizer of 1.31×10^4 tons, an annual biogas liquid organic fertilizer of 2×10^4 tons, annual consumption of 2.1167×10^4 tons silage straw.
5	Chengde Subproject	Chengde County Green Energy and Organic Fertilizer Co., Ltd.	Beigushan Village, Sangou Town, Chengde County, Chengde City, Hebei Province	Construct 8 digesters (total volume: 20,000 m^3), an annual biogas production of 541.23×10^4 m^3, of which 3.8559 million m3/a will be used to produce purified biogas of 265.09×10^4 tons. 2.1195 million purified bio-gas will be supplied to 14060 households, 0.5314 million m3/a purified bio-gas will be supplied to Sangou Town High School and industries. The remaining 0.6889 million m3/a will be used for heating the digesters and the 0.8675 million m3/a will be used in the organic fertilizer plant. a annual commercial organic fertilizer of 0.623×10^4 tons, an annual liquid organic irrigation fertilizer of 1.14×10^4 tons, an annual biogas liquid fertilizer of 3.08×10^4 tons, annual consumption of 4.27×10^4 tons silage corn straw.
6	Laoting Subproject	Hebei Construction & Investment	Hantuo Village, Laoting Town, Laoting County, Hebei Province	Construct 16 digesters (total volume: 3.211×10^4 m^3). Annual consumption of 7.49×10^4 tons silage to produce biogas of 904×10^4 m^3 with 4.38 million m3/a supplying for 20000 households, and production of 2.6547 million m^3/a CNG, to construct 2 CNG filling stations.

No.	Subprojects name	Implementation agencies	Construction sites	Construction scales and contents (including gas pipelines)
		Group Energy Investment Co., Ltd.		An annual biogas residue fertilizer of 15500 tons and liquid fertilizer 11,000 t.

Note: As in current stage, the position of all the gas filling stations have not been identified yet, an EMF has been developed to provide the guidance on the EA preparation and approval for the gas filling stations.

1.2 The experiences and lessons of previous agricultural waste biogas projects in rural areas

1.2.1 International biogas engineering developments situation

Since 1950s, developed countries established intensive livestock farms in the outskirts of towns. Because of the generation of large amount of manures and sewages everyday which is difficult to deal with and utilize, serious environment pollution was resulted in. Especially due to the oil price rising in the 1970s, energy has become the most important strategic resource. So Europe, United States and other developed countries started to develop biogas engineering to deal with livestock manure, sewage, and etc.

(1) Europe

The development of European biogas technology began in the late 1970s, when people began to pay attention to renewable and green energy. European biogas technology and management experience is in the forefront of the world, and Europe is the most popular area of large and medium-scale biogas plant in the world. In 2006, the European Union issued a roadmap of renewable energy to clear that renewable energy is a key element in the future sustainable development. *Renewable Energy Bill* formulated in 2008 proposed that the share of renewable energy would account for 20% of the final energy consumption by 2020. Biomass energy accounted for 2/3 of renewable energy, and played a key role in the completion of the renewable energy target. Biogas occupies an important proportion in biomass energy. In order to achieve the goals, the EU members set out their respective action plans and incentive policies to promote development of renewable energy including biogas.

Germany is a typical representative of the development of small and medium sized farm biogas projects, the main driving force comes from the introduction of a number of incentives to encourage policies. German biogas project development was mainly due to the supporting and promoting of the renewable energy law and relevant policies to. Back in 2000, the *Renewable Energy Priority Law* (EEG 2002) was promulgated, and subsequently amended many times. Renewable Energy Law

promulgated in 2000 clearly stipulated, “give priority to biogas generation and give price subsidies for 20 years”. It created an excellent legal environment for the majority of farmers to increase revenue via constructing biogas project and generation electricity using biogas. By the end of 1999, there was only 850 biogas projects in Germany. Construction rapidly developed after renewable energy law was enacted. 900 biogas projects were constructed by 2003 in Germany, equivalent to the construction numbers in 1990-2000. In 2004, *Renewable Energy Law* was first amended to clear that small-scale biogas projects (installed capacity less than 150 KW) included in the scope of subsidies, and also gave subsidies for biomass feedstock (energy crops and manure), biogas new technology (dry fermentation, biogas purification), integrated thermal utilization, and etc. 2,141 new biogas projects in Germany was constructed in 2004-2008, that was more than twice of the construction number in 2000-2003. It was second amended in 2009 to increase the basic subsidy for small-scale biogas projects, gave additional subsidies for using energy crop as raw materials, cogeneration and other thermal energy using ways, and gave additional subsidies for using manure (at least 30%) and biological garbage (food and municipal waste) as raw materials. 3419 new biogas projects had been constructed by Germany in 2009-2011, 1.6 times of the number in 2004-2008. Since the implementation of the new renewable energy law would reduce subsidized prices in 2012 to cause the impulse of biogas construction, 1,310 biogas projects were built in 2011. By the end of 2011, the total German biogas projects reached 7,215 sets with installed capacity of 2904 MW and generating electricity of 19.4TWh which accounted for 3% of the national electricity consumption. Renewable energy law was amended several times to guide the development direction of biogas projects better and promote the development healthily and rapidly. However, the revision edition in 2009 played some negative effects, such as extensive use of ensilage materials to cause energy crops competing with food crops for land, causing the rise of land rents.

Danish biogas development began in the 1970s, first biogas project was mainly to gain energy in order to deal with the energy crisis. Afterwards, it turned out that biogas had a significant effect to solve the agriculture, energy and environmental

issues. Denmark is famous for centralized biogas project from mixed raw materials, which is seen as the factory of energy production, manure and organic waste treatment, nutrient redistribution. Currently, there are 21 centralized biogas projects, 60 farm biogas projects, 5 industrial waste treatment biogas projects, 64 sewage treatment biogas projects in Denmark, where the sewage comes from sewage treatment plant treatment. Denmark mainly adopts the following measures to promote biogas projects development.

(1) Construction subsidies. The subsidy is 30%-0% of total cost in the end of 1980s, and 20% from the end of 1990s to 2012.

(2) Legal provisions. Strict rules for manure treatment and utilization, and collect manure and waste disposal fees.

(3) Feed-in tariff. Danish biogas generation price guarantees 10 euro cents per kWh, and electricity of cogeneration adds the energy price.

(4) Tax incentives. As renewable energy, biogas earnings can excuse national tax.

In 2009, Danish government formulated a government green growth plan to increase the ratio of manure for biogas from 5% to 50% by 2020, and biogas enjoyed the equal transmission rights with natural gas to use natural gas pipelines. So biogas producers and natural gas suppliers have equal opportunities to make money. In March 2012, the Danish government agreed the proposal of the majority party in Congress in modificatoion of biogas electricity price to 1.15 DKK/kWh (about 15.4 euro cents/kWh). The bill was executed in 2012, the Danish Biogas Association said that this resolution made biogas projects profitable from biogas subsidies. Subsidies was not only appropriate for centralized biogas cogeneration projects, but also for the projects entering gas pipeline. In the next eight years, it will gradually reduce to 0.1 DKK/kWh.

Table 1.1-2 Biogas project numbers of major EU countries

States	Farm biogas projects	Landfill gas projects	Industrial waste biogas projects	Organic wastes biogas projects	Centralized and mixed fermentation biogas projects
Germany	3711				
Denmark	60		5	64	21
Austria	350	62	25	134	
Sweden	7		4	209	13
France	8		127	80	

In Europe, biogas projects with the goal of waste treatment and energy production mainly use the following process:

①Continuous stirred tank reactor（CSTR）

CSTR is suitable for the single or mixed materials concentration of 8-12%, and most of biogas projects in Germany are using this technology.

②Plug-flow anaerobic digestion process

Plug-flow anaerobic digestion process is suitable for treating high suspended solids materials, especially for anaerobic digestion of cow dung, but not for manure with sand.

③Dry fermentation process

This process is mainly suitable for high concentration of solid material, in particular for the anaerobic digestion of energy crops, organic waste and etc.

(2) USA

In the biogas process and technology, USA mainly uses four kinds of anaerobic digestion processes such as anaerobic pond by membrane covered through, continuous stirred anaerobic digestion tank, plug-flow anaerobic digester, two-phase anaerobic digestion processes. The characteristics of continuous stirred anaerobic digestion tank and plug-flow anaerobic digester process are similar to the European'. In 1970s, for rising of oil prices, some biogas facilities construction was triggered. In 1970-1990, approximately 140 biogas projects were constructed with the primary purpose of energy. However, due to poor facilities, non-standard design, unreasonable installation, and poor management, the majority of these early biogas digesters were

scrapped or stopped. America lacks of subsequent policy support and subsidies, and its biogas development is slower comparing with Europe and PRC. According to the national pig enterprise survey from University of Minnesota in 2009, USA only had 10 pig enterprises setting up biogas projects. Currently, there are about 70,000 dairy farms and 100,000 pig farms in America, where little biogas projects are set. So agricultural biogas projects are snubbed. In recent years, under the pressure of energy shortage and environmental protection (EP), biogas technology has received increasing attention, and was expected to obtain a new development.

(3)Experience summary

Through the analysis for development of foreign rural waste biogas projects, the development of biogas projects mainly depends on policy environment and product subsidy price, and ultimately depends on the profitability of biogas projects. In Germany, Denmark, Sweden and Italy, biogas products have higher subsidy price and preferential policies to be profitable, so biogas projects develops rapidly. Although the United States, UK, France, Spain also are highly developed industrialized countries with advanced science, technology and equipment, the biogas projects are unprofitable and develop slowly due to the lower subsidy price and cumbersome procedures for the end products.

Meanwhile, according to the revision on renewable energy policy for several times in Germany, the development of biogas projects should fully consider the balance between renewable energy and agricultural resources. The competition of energy crops and food crops for land because of profit-driven and the insufficient utilization of raw materials for low benefit renewable resources should be avoided.

1.2.2 Domestic biogas engineering development situation

PRC held a national conference on biogas in 1979 and set up a biogas engineering association in 1980. Medium and large scale livestock and poultry farm biogas engineering technology developed rapidly in recent years. By the end of 2012, 91952 biogas projects had been built in PRC with the total pool volume of 14334.3 thousand m^3 and annual biogas volume of 1983597.9 thousand m^3, including 338 treatment projects for industrial solid waste and 91614 treatment projects for

agricultural waste.

Table 1.1-3 The comparison of biogas projects in PRC and Germany

Project	Germany	PRC
Purpose	energy	Environment, energy
Number	2700	3500
Average pool volume (m^3)	1000	283（including： <100m³, 66%; <100-1000m³, 25%; >1000 m³, 9%）
Biogas production	The total biogas production of PRC is only 17.6% of Germany.	
Installed capacity (MW)	670	6.7
Generating capacity	The generating capacity of PRC is only 0.16% of Germany.	

Figure 1.2-1 Pig waste processing biogas project

Figure 1.2-2 Chicken manure biogas project

The rural waste resource is very large-scale each year in Hebei Province. A lot of exploration and practice are conducted to produce biogas using rural wastes. Many projects basically achieved stable operation, such as biogas projects using livestock

manure and large and medium scale project of bio-fertilizer using biogas residues and liquid.

(1) Beijing large biogas project

The Beijing Deqingyuan large-scale biogas project is located in Zhangshanying Town, Yanqing County, Beijing City. Project supporting organization is Deqingyuan Farming Ecological Park which has 3 million laying hens, 212 tons of daily chicken manure production, and 170 tons per day of waste water. The project uses CSTR, constructs 4 anaerobic digesters (each volume of 3000 m^3), 4000 m^3 secondary fermentation tank (biogas liquid tank), 2000 m^3 gas storage cabinets, 3000m^3 rain wastewater collection pool and ancillary facilities and equipment, and installs 2 set of 1063KW generators.

The project began producing biogas in 2007 with daily production of 15,000 m^3. Through underground pipeline, the biogas was offered to the nearby Shuiyuxin Village freely, and more than 500 village households benefited. Deqingyuan chicken manure biogas plants was connected to the grid in 2009, which supplied 14 million/year electricity to the North China Power Grid. Meanwhile, 160 thousand tons biogas liquid and biogas residues was produced annually using as high quality organic fertilizer. The biogas project is running in good condition currently.

(2) Straw biogas project of Qing County, Hebei

In reference to the experience of Dongyaozhuang Village straw biogas project construction, a large-scale straw biogas project was constructed by Hebei Gengzong biomass energy development Co., Ltd. in Gengguantun Village, Qing County. The project used the vertical flow mesophilic anaerobic fermentation process. The project included two fermentation tanks of 1000 m^3 and a fermentation tank of 650 m^3 to meet the demand of 3000 households for cooking. According to the project operation experience, 2 kg dry straw or 5.5-7.5 kg fresh straw can produce 1m^3 biogas with tank volume production rate of 1.2 m^3/m^3 day. Biogas Institute in Ministry of Agriculture carried out the on-site monitoring on the project operation for 33 days (July 15, 2007 to August 31, 2007). The review comments were as follows: tank volume production rate reached 1.1 m^3/m^3 day. 1 kg straw could produce about 0.5 m^3 biogas. Straw

biogas project in Gengguantun village, Qing County was monitored by the Biogas Institute in Ministry of Agriculture on January 2010. After that, professor Mei Zili reported the average gas production rate of 1.2 m^3/m^3 day. Hebei Science and Technology Achievements Transformation Services Center identified the project on June, 2012. The result showed that "the achievement was national initiative, filled the domestic blank, and reached the domestic leading level". This biogas project was running from 2009 with stable production and meet the requirements.

(3) Shandong chicken manure biogas project

Shandong Minhe Husbandry is the largest broiler breeders enterprise in PRC, owning 23 broiler farms and 8 commercial chicken farms, producing 500 tons chicken manure per day. The chicken manure was originally sold to farmers as fertilizer. Considering the ecological benefits and EP, the company built manure biogas power generation project with imported technology and equipment, which is the largest-scale biogas power generation project in the national livestock industry.

Currently, Minhe Husbandry biogas power generation project can dispose chicken manure about 180,000 tons annually, sewage about 120,000 tons; and produce 10.95 million m^3 biogas, 21.9 million kWh electricity and above 20 tons of solid and liquid organic fertilizer. Power generated by the company is sold to grid with annual income up to more than 13 million RMB. Penglai City has large-scale fruit farm, so that organic fertilizer sales is very good.

Currently, the company is waiting for the third party certification (TPC) to determine its CO_2 emission reductions. It is expected that the project can transfer to the World Bank over 60,000 tons greenhouse gas emissions reduction with annual income of about 6.34 million RMB.

The company has initially formed a recycling industry chain with "chicken-fertilizer-biogas-electricity-biomass". The chicken manure is used to produce biogas; biogas is used for power generation which is sold on grid; waste heat is used to warm biogas projects and greenhouses; biogas residue and liquid are used as organic fertilizer for surrounding vineyards, orchards and farmlands. The company also plans to build 10 thousand mu demonstration area for comprehensive utilization

of biogas and fertilizer and breeding balance to truly form integrated industrial cycle chain.

1.2.3 Previous experiences and lessons for rural waste biogas project

The scale of successful straw biogas projects is small. Biogas production is lower than 5000 m^3/d, equivalent to an installed capacity of 1145 kW (lower than calorific value). In addition, following problems in the biogas projects implementation process are found during the investigation.

(1) Financial investment is different

Because the each district leadership has different understanding of biogas project, some cities financial investment is millions or even more than ten million RMB, and in other cities the investment is very little. Lack of funds become a major limiting factor for biogas project construction.

(2) Technical force is not enough to ensure construction quality

On the one hand, the domestic farmer-technicians of biogas engineering are in increasing numbers, and the new technologies are promoted by the new energy offices (workstation) in rural areas vigorously, which still cannot meet the demand. On the other hand, the knowledge of present technicians and managers is old, which is needed to be updated. Some cities and counties do not have the specialized agencies and lack of professional technicians and it is difficult to ensure the quality of biogas construction.

(3) Emphasizing economic effect, neglecting environmental pollution

The biogas construction units pay attention to the improvement of biogas production rate and economic effect. The design and construction of pollution prevention in biogas production process, the storage of biogas residue and liquid and the secondary pollution during the use of biogas are usually be neglected. Generally the followings are the main reasons:

a. design parameters: The unsuitable design or break of the dike-dam of the fermentation pond will lead to the pollution incident, which have a negative effect on the local flora and fauna as well as the residents that rely on the surface water or groundwater downstream.

b. fermentation technology: The EA team carried out the field investigation to the project, and find that large amounts of water is used to flush livestock and corrals by most of the breeders. Overuse of flush water diluted manure of the digester will result in the ratio of manure to water lower than the proper one (2:1). The corral flush water with high organic loading discharged into the receiving water directly will also pollute the surface water and groundwater as the non-point source.

C. Management: If the fermentation ponds are mismanaged, the overflow incident or the discharging of the fermentation materials into the surface water body will pollute the receiving water. For the biogas liquid is of high concentrations of nutrients (nitrogen and phosphorus), the phenomenon that discharging into the water from the biogas pools in the practical operation is caused by the poor management which will lead to the producing of too much water.

D. transportation: If the manure are needed to be transported to a centralized digester, improper transportation or mechanical problem of the transportation vehicle will lead to the soil and water pollution. So these issues have been given serious consideration in the preparation of the EMP for this project.

e. agricultural application: In addition, excessive or wrong time application of organic fertilizer (when the farmland soil is saturated or fertilizing in the adverse time, e.g., the initial stage of the rainy season) has a potential threat on the groundwater. Improper fertilization timing cause the amount of fertilizer applied is more than plants use, especially the utilization of nitrogen. Excessive nitrogen will infiltrate, penetrate through the root zone of plants, and ultimately enter into the groundwater, which will threat to the health of children and pregnant women.

1.3 Purpose of the environment management plan

The purpose of EMP is direct at the inevitable environment impact of this project. Therefore, a set of technically feasible, financially sustainable and operational environment countermeasures should be formulated. The implementing measures including abatement, management and institution building of environmental management sector and construction units need to specify explicitly to eliminate or

compensate the adverse effects of the project on society and environment and minimize to the acceptable level.

The specific roles are as follows:

(1) Clear the environment mitigation measures of affected target

Project Office, environmental impact assessment (EIA) and design units should carry out the in-site check and validation of the affected targets in detail, put forward effective environment mitigation measures and bring it into the engineering design.

(2) Provide environment guidance documents

The environment management plan reviewed by World Bank (WB) will be provided to owners, construction supervising units in construction and operation period and other related units as the document of EP

(3) Clear the responsibilities and roles of related units.

Clear the responsibilities and roles of the related functional departments and regulatory agencies, and propose the communication channels and ways of different departments.

(4) The effect evaluation of control measure implementation of environmental monitoring plan.

1.4 Preparation of environment management plan and assessment scope

1.4.1 Preparation of environment management plan

The environment management plan of the project should be compiled according to the national and provincial environment management rules strictly. Meanwhile, it should meet the requirements of the security policies of PRC and WB.

The project has been classified into Category B according to "*World Bank Operational Policy l-Environmental Assessment*" OP4.01. All the elements of EIA will be included in the EMP, which will provide the guidance for the environment management of each subproject. Proper measures of construction and environment management, the monitoring plans of environment, social and other aspects, as well as the enhancing and training plans of environment management institution will be

included in the environment management plan.

Moreover, the environment management framework attached in the environment management plan will provide guidance for the selection of new sub-projects and the preparation of the environment and social documents in implementation period.

1.4.2 Identification of environment tools

As request of WB, different EA instruments will be used in accordance with the requirements of the types and scales of the project. The environment management plan consists of the environmental codes of practice (ECOP) and environment management framework (EMF). Meanwhile, the EMP for specific sensitive points will be prepared based on the characteristics of each subproject.

The corresponding ECOP will be carried out for small-scale civil engineering and gas pipeline engineering. Since these subprojects distributed in 6 counties, the utilization way of biogas and bio-fertilizer, the sensitive points involved, as well as the EP and mitigation measures are different to some extent, and the EMP for the sensitive points will be executed. The project preparation, evaluation and negotiation of Hebei Rural Renewable Energy Development Project will take a long time. In order to regulate the implementation and operation of new subprojects which have to be incorporated into the EMP, each subproject needs to be screened and prepared based on their own characteristics as EMF arranged in this plan.

1.4.3 The EMP evaluation scope

6 large-scale biogas subprojects in Tangshan, Hengshui, Chengde and Handan City are built in the first batch of this project.

According to domestic guidelines of EIA, assessment degree of each environment elements in subproject EIA, the local natural environment and social environment conditions, pollutant emissions characteristics of the project, the assessment scope of possible environment influence in EMP implementation process of the project is determined comprehensively. The assessment scope of this plan includes the assessment scope of all subproject EIA. The scope includes: ① the collection and influence area of raw materials; ② The location and influence area of

biogas plants and gas stations; ③the surrounding influence scope of biogas pipelines.

The locations of gas filling station for each subprojects are not identified at the present stage. Therefore, their assessment and related approval requirements are included into EMF.

According to the on-site survey, the location area of each biogas plant is shown in Table 1.4-2.

Table 1.4-2 The location area of each biogas plant

No.	Subproject name	Biogas plant
1	Anping Subproject	Main part of Hebei Yufeng Jingan Farm Co., Ltd, where is in the south of Dongzhaizi Village, Anping County
2	Yutian Subproject	Ruanzhuangzi Village, Guojiatun Town, Yutian County-level City
3	Zunhua Subproject	Xixindianzi Village, Baozidian Town, Zunhua County-level City, Hebei Province
4	Linzhang Subproject	Modern Agricultural Science and Technology Demonstration Zone of Linzhang County, Hebei Province
5	Chengde Subproject	Beigushan Village, Sangou Town, Chengde County, Chengde City, Hebei Province
6	Laoting Subproject	Hantuo village, Laoting Town, Laoting County, Hebei Province

The biogas produced by this project is mainly used by the surrounding farmers, and the rest is compressed and purified for buses, taxi and so on.

Table 1.4-3 supplying and influence area of biogas plants

No.	Subproject name	Pipeline
1	Anping Subproject	Laying along the village roads between biogas plants and Xingzhai and Wangpu Community. The main influence scope is on both sides of 20 m from the pipeline center line.
2	Yutian Subproject	Laying along roads. The main influence scope is on both sides of 20 m from the pipeline center line.
3	Zunhua Subproject	Laying along the Bangkuan Road and extending in the east-west direction. The main influence scope is on both sides of 20 m from the pipeline center line.
4	Linzhang Subproject	Laying from biogas plants and extending in four directions along WeiFeng Provincial Road, Chaliu Provincial Road and Lincheng County Road. The main influence scope is both sides of 20 m from the pipeline center line.
5	Chengde Subproject	Laying from biogas plants along radial line. The main influence scope is on both sides of 20 m from the pipeline center line.
6	Laoting Subproject	Laying from gas station to householders along branch route. The main influence scope is on both sides of 20 m from the pipeline center line.

According to domestic guidelines of EIA and determination assessment level of

each environment elements in subproject EIA, combined with the local natural environment, social environment conditions and pollutant emissions characteristics of the project, assessment scope of the project EMP is determined as following table.

Table 1.4-4 Assessment scope of subprojects

Environmental factors	Assessment scope				
	Collection scope and impact area of raw materials	Location and influence area of biogas plants			Surrounding influence scope of biogas supply pipelines
		Waste gas impact	Noise impact	Environmental risk	
Anping subproject	Five farms, and the surrounding area	2500	180	62.1	both sides of 20 m from the pipeline center line
Yutian subproject	Eight raw material collection sites in Guojiatun Village and surrounding straw collection area	2500	180	81.4	both sides of 20 m from the pipeline center line
Zunhua subproject	Surrounding straw collection area	2500	180	70.8	both sides of 20 m from the pipeline center line
Linzhang subproject	20 ensilage site and surrounding straw collection area	2500	180	70.8	both sides of 20 m from the pipeline center line
Chengde subproject	surrounding straw collection area	2500	180	72	both sides of 20 m from the pipeline center line
Laoting subproject	surrounding straw collection area	2500	180	78.5	both sides of 20 m from the pipeline center line

1.5 Impact factors identification

1.5.1 Environment impact factors identification

The adverse impact of the project mainly will occur during the construction period and the operation period. The impact of construction period includes the environment impact and social impact of pipeline construction, biogas plants, power stations, gas stations and ensilage pool construction. The impact of operation period mainly is the pollution of air, noise and water environment caused by waste gas, waste water and noise during the biogas plant operations. Meanwhile, livestock manure and straw are collected and used at project operation period to produce clean fuels which replace coal and oil. The project will help to reduce local water and air environment pollution load and improve environment air quality. Biogas residue and liquid are used to

produce biological fertilizer, reducing the application amount of chemical fertilizer, being helpful to improving the soil environment, and improving agricultural products quality. In addition, it will also lead to positive social benefits. At the same time, some adverse impacts to the social environment, ecological environment and the natural environment may also be produced in the operation period.

Impacts during construction and operation periods mainly include:

(1) The natural environment impact:

Construction period:

The impact of biogas plants construction mainly is dust from the transport, temporary piled-up and using process of construction materials, as well as temporary storage yards for digging and waste soil. The cooking fume from construction workers can cause atmospheric pollution, and their domestic sewage may pollute nearby water bodies. Construction machinery noise has some effects on the residents living near the site. The Frequent movement of construction vehicles will cause some traffic congestion. Construction waste, piled-up and storage of waste soil in construction period, and transportation process have some impact on the residents living near the site. Construction process does not use inflammable and explosive materials, therefore the risk of fire and explosion does not exist.

Due to that biogas pipeline construction is small without use of large-scale construction machinery and in short construction time, there is less effect on waste gas and noise.

Operation period: The project produces and supplies biogas and bio-fertilizer by collecting livestock manure and straw to reduce the consumption of coal and inorganic fertilizers. CNG instead of gasoline has a significant positive impact on atmosphere, soil and water environment. The flue gas containing NOx from biogas power generation stations has some negative impact on atmosphere. Wastewater in the project is mainly workers domestic sewage, excessive biogas liquid and breeding wastewater from subproject using pig manure as raw materials, resins regeneration wastewater from demineralized water section, etc. All of domestic sewage discharge into the biogas facilities. Excessive biogas liquid and breeding wastewater reuse or

discharge on standard after disposed by sewage treatment facilities. Resin regeneration wastewater of demineralized water section is mainly the acid-alkali wastewater, which is used for dust suppression of the factory ground by splashing after being neutralized. There are pump house, steam turbine, generator and other high-level noise equipment in operation stage, which have some negative influence on the operator and residents living near the plant area. Biogas plants, pipelines, fire, and explosion can threaten the personal safety and traffic safety of vehicle transporting compressed biogas. Biogas residue and liquid are stored in plant area with a negative effect on the surrounding environment. Improper disposals of domestic waste and discarded desulfurizer also have a negative effect on the environment.

(2) The impact on ecological environment

Construction period: Permanent occupation of land by the project will reduce the vegetation quantity and change land use. Vegetation of the site will be destroyed in construction process. In steep slopes, digging, filling and temporary piling of earthwork will cause soil erosion.

Operation period: The emission of waste gas containing H_2S, NH_3, NOx, will influence the living conditions of surrounding residents, crops and vegetation.

(3) The impact on social environment

The project implementation is bound to bring a certain impact on the social economy of the proposed construction area. Firstly, the main impact comes from land expropriation. Secondly, environment landscape is also influenced unfavorably. Construction and material transport have a role in promoting economic development and employment opportunities.

In summary, the main environmental impact factors in construction and operation period are shown as follow:

(1) Natural environment: construction dust, cooking fume from construction workers, construction noise, adverse effects from waste gas, noise and solid waste in biogas plants on surrounding residents in operational period, high-level noise impact on the operation staff, environmental risks from gas filling station and gas pipeline on surrounding residents, and the positive effect generated from replacement of coal

by biogas, inorganic fertilizers by bio-fertilizer, gasoline by vehicle biogas, etc.

(2) Ecological environment: changing land use by biogas plants, vegetation loss and soil erosion caused by biogas plants and temporary pipeline construction, etc.

(3) Social environment: promoting economic development and employment opportunities , improving the liying quality of farmers, reducing emission of greenhouse gas, effect on resident living caused by land occupation, blocking traffic by pipeline construction, and effect from transportation dust on residents along the transportation routes, etc.

(4) Electro-magnetic radiation effect: All power gernerated in the project is for interal use within the plants，without involving booster station. The electricity voltage is far less than the 110 kV whcih is the threshold for the electromegnetic EA, thus the electromagnetic is very minor and can be negelectible.

(5) Environmental risk and safety impact: The personal security is influenced by accident risk from biogas cabinets, gas filling stations and gas pipeline explosion, such as high temperature and electric shock safety.

After the above analysis, the recognition matrix of environmental impact in the project is obtained and shown in Table 1.4-5.

Table 1.4-5 The judging of environment impact factors in different stages

Project features / Impact Factors		Construction period					Operation period							
		Construction	Site clean-up	Transport and pile-up of materials	Transversing engineering	Construction camp	Waste gas emissions	Wastewater emissions	Solid waste	Noise	Fire and explosion risks	Gas supply	Power generation	Bio-fertilizer
Natural environment	Ambient air	-○	-☆	-○		-○	-☆		-○		-☆	+★	-○	+☆
	Surface water	-○	-○					-○	-○					
	Underground water				-○				-○					+☆
	Acoustic environment	-☆	-○	-☆						-☆			-●	
	Electromagnetic environment													
	High-temperature environment													
	Reduction of greenhouse gas emission						+★					+★		
Ecological environment	Crops						-○							+☆
	Soil	-○	-○					-○						+☆
	Surface vegetation		-☆		-☆		-○	-○						
	Land use	-☆	-☆	-○	-○	-○								
Social environment	Economic development	+☆		+○	-○						-★	+★	+☆	+☆
	Employment expansion	+○	+○	+○	+○							+☆	+☆	
	Occupational health	-○	-○				-○	-○	-○	-★	-★	-☆		
	Life quality				-☆		-○	-○	-○	-○	-☆	+★		
	Environmental landscape	-☆	-☆		-☆		-○						-○	
	respiratory disease	-☆			-☆		+★					+☆		

Notes：+ positive effect. – negative effect. ★ great impact. ☆ general inpact. ○ slight impact.

1.5.2 Evaluation factor screening

Accordding to the environmental impact factors and environmental characteristics of project site analyzed and identified by the pollution sources in each subproject, the control indicators listed in national and local EP standards and regulations and the relevant requirements from the WB, the evaluation screening results in the project are shown in Table 1.5-1.

Table 1.5-1 the identification results of environmental impact factors in each subproject

Behaviors influencing the environmental resources and values	Potential damages and benefits effects for natural or social environment	Basis for impact analysis	Typical mitigation measures	Project types and the recognition of possible impact factors	
				Biogas, bio-fertilizer and power generation engineering	Gas supply pipelines, gas filling station engineering
1. Potential environmental problems in the construction period of project					
the sensitive points such as traversing highway, village, surface water, irrigation facilities, and so on	Blocking traffic, the effect caused by waste gas and wastewater on surrounding environment and surface water	Laying pipelines, sensitive points location, construction methods, social impact, environmental impact	Sufficient considering for sensitive points avoidance in line selection of construction design and site selection stage		√
	Schools, hospitals, nursing homes, etc.	Construction noise and safety of students from school	Prohibiting construction during noontime (12:00-14:00), nighttime (20:00-6:00) and college entrance examination and high school entrance exam time		√
Temporary land occupied for pipeline construction	Pipeline excavation for the temporary land occupied can cause effects on farmland, crops and pedestrian safety, block traffic.	Areas occupied, social impact, and economic value	The notice should be put up to inform the public at least five days and indicate the beginning and ending time when it is necessary to interrupt municipal services. Before the completion of construction, vegetation restoration sh		√

			ould be carried out for the dest ructed land, at least be restored to the state before constructio n. Contractor has the duty to prepare execution pipeline ECOP for each project.		
Temporary stacking area for building materials	Effect on land use and production, pedestrian safety	Area, purpose and location of occupied land	Supervision of the construction activities	√	√
Vegetation clean-up	Ecological damage from land occupation	Vegetation type/area damaged (mainly is farmland), economic value, ecological landscape destroyed	Clearing method	√	√
Waste generated in earthwork engineering	Soil and nutrients erosion	Excavation, backfilling and temporary positions of piled earth, natural drainage patterns	Monitoring obligations of the contractor (drainage and sedimentation tanks)	√	√
	Temporary Land occupation and destruction of water conservancy facilities	Location, scope, land occupation purposes	Contractor is obliged to submit a “management plan of temporary land occupation and water conservancy facilities".	√	√
	Dust and other particles emissions	The location, distance and wind direction for residential areas	Project construction schedule, contractor obligations (sprinkle), monitoring on earthworks activities	√	√
Transport of construction materials and engineering equipment	Particles and noise	Material volume, traffic capacity	Prohibiting open-top carriage and wrecked cars on roads	√	√
Construction workers	Hiring local labor can bring direct benefits to local	Predicted number of employed persons,	Obligations of the contractor (implemented in the small-scale	√	√

employment	residents.	Evaluated number and proportion of local employed staffs	civil engineering ECOP)		
	Pollution of surrounding surface water by domestic sewage	Surface water quality, standards of environmental quality and emission	Obligations of the contractor: carrying out small-scale civil en gineering ECOP	√	√
The generated solid waste	Soil pollution	Types and quantities of waste: domestic garbage, construction waste, spoil	Obligations of the contractor: carrying out small-scale civil engineering ECOP	√	√
Project completion	without restoring the construction site	Location and area of the te mporary land, the equipment that may be used and waste generated	Contractor is obliged to prepare the implementation of small-scale civil engineering ECOP	√	√
2、Potential environmental impacts in the operation period of project					
Operation of biogas power generation	Noise	Noise standards, distance to the nearest residential area, occupational health	Purchasing low-noise equipments, strengthening routine maintenance and monitoring	√	
	Effect from wastewater discharge	Disposal and treatment of wastewater from soft water preparation	Used for dust suppression by splashing after being neutralized in plant	√	
	Solid waste	Composition, categories	Disposal measures for solid waste	√	
	Effects from fume emission	Ambient air quality in the project region	Environmental quality standards, emission standards, fume pollutant monitoring, low nitrogen combustion technology, desulfurization and denitrification technology	√	
	Electromagnetic and thermal influence	Occupational monitoring	Safety assessment, occupational health assessment	√	
	Fire, explosion	Environmental risks	Risk prevention measures and		√

			emergency plans		
Biogas and bio-fertilizer engineering	Effects from waste gas emission	Ambient air quality in the project region	Environmental quality standards, emission standards, measures for reducing odor	√	
	Effects from wastewater discharge	The treatment and discharge destination of ensilage pool waste water, biogas liquid and sewage			
	Noise	Noise standards, distance to the nearest residential area	Purchasing low-noise equipments, strengthening routine maintenance and monitoring	√	
	Solid waste	Discarded desulfurizer, garbage, biogas residue, sludge	Discarded desulfurizer is sent to manufacturer for recycling and garbage is collected and disposed by the local sanitation department.	√	
	Soil	Soil contamination near biogas fermentation tanks and biogas residue and liquid pool, heavy metals and organic pollution produced by organic fertilizer application, soil quality improvement by using organic fertilizers instead of direct application of chemical fertilizer	Manure, bio-fertilizer ingredients	√	
	Environmental risks (fire, explosion)	Ambient air quality, environmental risks of fermentation tank, purification compressed workshops and	Environmental quality standards, emission standards, measures for reducing odor, environmental risk prevention measures, emergency		

		gas cabinets	plans		
	Social impact	Living standard, the ability and willingness to pay	Supplying heat and electricity can promote economic development and improve living standards of local residents. Reasonable pricing, implementation of subsidy policy	√	
Gas pipeline of the project	Replacement coal by biogas for reducing emission of air pollutants	Reduction of air pollutant emission			

Table 1.5-2 The screening results of evaluation factors

Evaluation factors screening results of biagas, bio-fertilizer, and power generation projects				
Environmental factors			Engineering emission factors	Evaluation factors
Ambient air	Operation period	Current situation evaluation	NH_3, H_2S, NO_x	Normal pollutants:SO_2, NO_x, PM_{10}
		Impact prediction		Particular pollutants: NH_3, H_2S
	Construction period	Impact analysis	air-borne dust	air-borne dust
Surface water environment	Operational period	Current situation evaluation	Sewage, coming from the flushing fecal wastewater of Yutian subproject by solid-liquid separation, goes into wastewater treatment station, and then use for irrigation. Part of the wastewater from the Anping subproject after pretreatment is discharged into Sewage Treatment Plant of Anping County. In other subprojects, ensilage pool wastewater is discharged into biogas equipments. Wastewater from soft water preparation system after neutralization is used for dust suppression sprinkler.	pH, SS, COD_{Cr}, BOD_5, NH_3-N, total phosphorus, fecal coliforms
		Impact analysis		
	Construction period	Impact analysis	Domestic wastewater will be reused on site.	Basically no impact on surface water
Groundwater environment	Impact analysis		biogas liquid and biogas residues digesters, biogas equipments, seepage prevention for straw storage pool	General analysis of groundwater
Vibration, noise	Operation period, construction period	Environmental sensitive points and operating personnel	Operation period: internal combustion engines, fans and other noise producing equipments. Construction period: construction machinery noise	Equivalent sound level A; occupational health
		Factory boundary noise		Equivalent sound level A
Ecological environment	Impact analysis		——	Vegetation, land use, soil and phyto-toxiciity, soil erosion
Solid waste	Impact analysis		Operation period: household garbage, biogas residues, discarded desulfurizer, sludge; Construction period: building materials, earthwork temporary stacking, earthwork balance	Operation period: reasonableness of the solid waste disposal; Construction period: reasonableness of temporary stacking measures
Environmental risks			Construction period: fire, explosion	Life and property safety impact analysis
Social impact			Construction period: traffic jams, the impact to commercial street, schools, living quality of residents, land acquisition and resettlement.	Proceed to impact analysis

		Operation period: the ability to pay, willingness to pay, gender issues.	

Screening results of gas supply pipeline and gas station engineering evaluation factors			
Environmental factors		Engineering emission factors	Evaluation factors
Ambient air	Current situation evaluation	TSP, PM_{10}, SO_2, NO_2	TSP, PM_{10}, SO_2, NO_2
	Air-borne dust in construction period	TSP	TSP
	Operation period	TSP, SO_2, NO_2	TSP, SO_2, NO_2
Surface water environment	Current situation evaluation	COD_{Cr}, BOD_5, NH_3-N, fecal coliform	COD_{Cr}, BOD_5, NH_3-N, fecal coliform
Noise	Ambient noise	Equivalent sound level A	Equivalent sound level A
	Construction noise	Equivalent sound level A	Equivalent sound level A
Ecology	Impact analysis in construction period	Vegetation, land use, and soil erosion	Vegetation, land use, soil, erosion
Solid waste	Solid waste disposal impact analysis	household garbage, digging and waste soil, mud	household garbage, digging and waste soil, mud
Environmental risks	Operation period: fire and explosion	CH_4, life and property safety impact analysis	CH_4, life and property safety impact analysis
Social impact	Social environment impact analysis	Construction period: traffic jams, traffic and safety of commercial street and schools, living quality of residents. Operation period: the ability to pay, willingness to pay, gender issues.	Construction period: traffic jams, traffic and safety of commercial street and schools, living quality of residents. Operation period: the ability to pay, willingness to pay, gender issues.

1.6 Evaluation levels and evaluation methods

According to the project EIA outline, WB project concept phase security meeting minutes, Chinese relevant technical standards and guidelines, and subproject EIA documents, assessment grades of various environment elements are summarized and shown in table 1.6-1.

Table 1.6-1 Assessment grades of various environment elements

No.	Environmental elements	Assessment grades
1	Atmosphere environment	Three-level
2	Surface water	Impact analysis
3	Underground water environment	Three-level
4	Noise environment	Three-level
5	Ecological environment	Impact analysis
6	Solid waste	Impact analysis

1.7 The environmental sensitive points

According to the characteristics of the project and the surrounding environment features, the project does not involve sensitive sites such as water source protection area, nature reserve, scenic spot, and etc. Therefore, the sensitive receptors within the impact area of the project have been screened through site survey. The main survey objectives are surrounding residential areas, schools, hospitals, nursing homes, kindergartens, and etc. Assessment scopes of subprojects are identified in accordance with Chinese national guidelines and the WB's requirements. According to the investigation results of the EP objectives, combining project characteristics, the possible EP targets of each subproject construction and operation periods are screened to determine environmental sensitive points.

Through screening, it is identified that during the operation stage there are no sensitive receptors around the bio-gas plants; the sensitive receptors during the construction stage are limited to the villages, roads and irrigation facilities along the pipelines. The screening results of the subproject environmental sensitive points are shown in table 1.7-1.

Table1.7-1 The screening results of environmental impact sensitive points

No.	Subproject name		Sensitive points	Orientation
1	Anping Subproject	Construction period	Township road	E
		Operation period	——	——
2	Yutian Subproject	Construction period	Huangjiashan Village	N
			Xinshuyu Village	NNE
			Shanzhuang Village	ENE
			Xiaolizhuang Village	E
			Luanzhuangzi Village	SE
			Xingjiawu Village	S
			Sijiaoshan Village	SW
			Guangongling Village	SW
			Township road	S
		Operation period	——	——
3	Zunhua Subproject	Construction period	Wangjiapu Village	NW
			Qujiapu Village	W
			Xiaocaogezhai Village	E
			Provincial Road S356	——

			Da-qin Railway	——
			Canal	——
		Operation period	——	——
4	Linzhang Subproject	Construction period	Jia Village	W
			Xidiqiu Village	SW
			Beizhang Village	SE
			Shuangmiao Village	SE
			3 township and county roads	——
			Provincial Road S212	——
		Operation period	——	——
5	Chengde Subproject	Construction period	Provincial Road S145	——
			Jing-Shen Expressway	——
			Laoniu River	——
		Operation period	——	——
6	Laoting Subproject	Construction period	Dongdazhuang Village	S
			Wantuo Village	SE
			Shao Village	SE
			Donggaoge Village	E
			Dongzhuang Village	SE
			Laomumiao Village	SE
			Xigong Village	SE
			Donggong Village	SE
			Yucai Primary School (Shaozhang Village)	SE
			Provincial Road S044	
			Tanggang Motorway, Coastal Motorway	——
			2 township and county roads	——
			Xiaochang River	——
		Operation period	——	——

2. Policies, Laws and Regulations and Basis of Compilation

2.1 Basis of Compilation

2.1.1 National laws and regulations

In accordance with Notice on Strengthening EIA on World Bank Loan Project, Hebei Rural Renewable Energy Development Demonstration Project Loaned by WB must observe EP laws, regulations and standards in China and carry out environment impact assessment system. Based on the premise that environment impact assessment in China is conducted, IFC technical requirement must also be taken into consideration. Environment management plan must hand over to WB's investigation.

Currently, domestic environmental supervision and management system is under the leadership of State Council, executed by Ministry of Environmental Protection and local environmental bureau. Besides, relative ministries set up separate departments responsible for environmental issues of local area, which are also under the supervision and guidance of the Ministry of Environmental Protection.

2.1.1.1 National laws and regulations

(1) Environmental Protection Law of the People's Republic of China (December 26, 1989);

(2) Water Pollution Prevention and Control Law of the People's Republic of China (PRC) (June 1, 2008);

(3) Law of the Peoples Republic of China on the Prevention and Control of Atmospheric Pollution (September 1, 2000);

(4) Law of the Peoples Republic of China on the Prevention and Control of Environmental Noise (March 1, 1997);

(5) Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste (April 1, 2005);

(6) PRC Environmental Impact Assessment Law (September 1, 2003);

(7) Law of the People's Republic of China on Water and Soil Conservation (March 1, 2011);

(8) Water Law of the People's Republic of China (October 1, 2002);

(9) Cleaner Production Promotion Law of the People's Republic of China (Revised on February 29, 2012);

(10) Renewable Energy Law of the People's Republic of China (2009 Amendment);

(11) Circular Economy Promotion Law of the People's Republic of China(January, 2009);

(12) Land Administration Law of the Peoples Republic of China (August 28, 2004);

(13) Agriculture Law of the People's Republic of China(December, 2002);

(14) Law of the Peoples Republic of China on Protection of Cultural Relics (October 2002);

2.1.1.2 Laws and regulations

(1) National Ecological Environmental Protection Program (November 28, 2005);

(2) Regulations on the Administration of Construction Project Environmental Protection of the People's Republic of China (November 1998);

(3)Ordinance of preventing pollution for scaled livestock breeding((the State Council directive 643);

(4) Notice of issues related to the approval of construction projects major pollutants emission control (Office of the State Environmental Protection Administration 25, 2003);

(5) Classified management directory of Construction project environmental impact assessment (Environmental Protection Department (EPD), Directive 2, September 2, 2008);

(6) Temporary Act of Environmental Impact Assessment of Public Participating (HF [2006], February 14, 2006);

(7) Decision of the State Council on Several Issues Concerning Environmental Protection (GF [96] No. 31, August 3, 1996);

(8) Opinions on strengthening the key tasks of environmental protection (GF [11] No. 35, October 17, 2011);

(9)Environmental protection regulations of Hebei Province(March 25, 2005);

(10) Ordinance of water pollution control of Hebei Province (October 25, 1997);

(11) Ordinance of air pollution control of Hebei Province (November 3, 1996);

(12) Regulations on the Administration of Construction Project Environmental Protection of Hebei Province (the eighth National People's Congress standing committee of Hebei province announcement 80, December 17, 1996);

(13) Ordinance of the reduction of pollutant emission of Hebei Province(the eleventh National People's Congress standing committee of Hebei province, May 27, 2009)

(14) Provisions of several issues of the construction project environmental management(Environmental protection office of Hebei Province 65, 2007);

(15) Support, restricted and prohibited construction project list in environmentally sensitive areas of Hebei Province(revision 2005);

(16) Implementation opinions on regional ban(limited) construction project in Hebei Province(on Trial) (Hebei Province government 59, 2009);

(17) Notice of the further strengthening the audit of environmental impact assessment(Environmental protection office of Hebei Province 86, 2011);

(18) Notice of the further strengthening the public participation of environmental impact assessment(Environmental protection office of Hebei Province 238, 2010);

(19) Construction site environmental and health standards (Ministry of Construction 66, 2004);

(20) Technical Specifications for Pollution Treatment Projects of Livestock and Poultry Farms. (HJ497-2009)；

(21) Technical standard of preventing pollution for livestock and poultry breeding (HJ/T81-2001)；

(22) Criteria for designing of biogas plant in scale livestock and poultry breeding Farms (NY/T 1222-2006)；

(23) Technical requirement for non-hazardous treatment of animal manure (NY/T 1168-2006)；

(24) Technical standard of preventing pollution for livestock and poultry breeding (HF[2010]151);

(25) Technical specification for operation maintenance and safety of biogas plant in scale animal and poultry farms (NY/T1221-2006).

2.1.2 Planning and Document related to this project

(1)The 12th Five-year plan for environmental protection of Hebei Province(January, 2012);

(2) The 12th Five-year plan for comprehensive energy reduction work program;

(3) The 12th Five-year plan for national economic and social development of Hebei Province (2011-2015);

(4)"four gas (Coal bed methane, coke oven gas, natural gas and coal gas)" industry integrated development plan of Hebei Province(November, 2009)

(5) Embodiment of Hebei Rural Renewable Energy Development Demonstration Project (Draft) (Chinese academy of agricultural engineering, November 4, 2013);

(6) Social Impact Assessment of Hebei Rural Renewable Energy Development Demonstration Project (National Research Center for Resettlement, Hohai university, August, 2013);

(7) Resettlement action plan of Hebei Rural Renewable Energy Development Demonstration Project (National Research Center for Resettlement, Hohai university, October, 2013);

(8) The overall urban and rural planning of subproject region

(9)Feasibility study of subproject

2.1.3 World Bank Safeguard policies, environment, health and safety guidelines

2.1.3.1 Safeguard policies

WB Safeguard policies are to give consideration to social and environmental impact brought by projects invested by WB, including analysis of possible impact and measures to mitigate negative influences. It can not only avoid damage to environment or human, but also improve project design, improve work efficiency as well as protect reputation of WB and borrower.

Safeguard policies triggered for this project are shown as below:

Table 2.1-1 correlation analysis of this project and Safeguard Policies

Serial No.	WB safety insurance policy	correlation	illustration
1	OP4.01 Environmental Assessment	related	In construction period and operation period，this project will have certain impacts on the surrounding environment, thus EIA is needed. Through environmental screening, WB classified it as class B.
2	OP4.04Natural Habitats	Not related	There is no natural reserve around projects, all subprojects are located in rural areas with high- intensity agricultural activities, no subprojects in scope of natural habitats
3	OP4.09 Pest Management	Not related	the project will only use crop residues of existing farm, thus no increased agricultural production and pesticides are needed for the project.
4	OP4.10Indigenous people	Not related	The project does not involve concentrated population of ethnic minorities, this projectdoes not trigger this policy.
5	OP4.11physical cultural resources	Not related	No subproject site locate in or nearby any physical cultural resources

6	OP4.12involuntary resettlement	related	Subprojects involve land acquisition
7	OP4.36 Forestry	Not related	The project only use existing crop residues and animal wastes as feedstock for the biogas facilities., no Subprojects involve in the use of forest products as raw materials
8	OP4.37safety of dams	Not related	No subproject involve in the safety of dams
9	OP7.60projects in disputed areas	Not related	No subproject locate in disputed areas
10	OP7.50projects on international waterways	Not related	No subproject on international waterways

Through environmental screening, WB classified this project as class B. This project is related to WB Safety insurance policies as below:

(1) OP4.01 Environmental Assessment

(2) OP4.12involuntary resettlement

(3) BP17.50 Access to Information

2.1.3.2 EHS

《World Bank environment, health and safety guidelines》(EHS)，includes Air Emissions and Ambient Air Quality, Wastewater And Ambient Water Quality, WASTE MANAGEMENT. Noise. Occupational Health And Safety, Electronic Transmission And Distribution.

(1) World Bank environment, health and safety guidelines ---EHS;

(2) GENERAL EHS GUIDELINES: INTRODUCTION;

(3) World Bank environment, health and safety guidelines ---EHS: Air Emissions and Ambient Air Quality;

(4) World Bank environment, health and safety guidelines ---EHS: Wastewater And Ambient Water Quality;

(5) World Bank environment, health and safety guidelines ---EHS: Noise;

(6) World Bank environment, health and safety guidelines ---EHS: Mammalian Livestock Production;

(7) World Bank environment, health and safety guidelines ---EHS: Waste Management.

2.2 Environmental assessment guidelines

(1) Technical guidelines for Environmental Impact Assessment. General program (HJ2.1-2011)；

(2) Guidelines for Environmental Impact Assessment. Atmospheric Environment (HJ2.2-2008)；

(3) Technical guidelines for Environmental Impact Assessment. Surface water environment (HJ/T2.3-1993)；

(4) Technical Guidelines for Environmental Impact Assessment. Groundwater Environment(HJ610-2011)；

(5) Technical Guidelines for Environmental Impact Assessment. Noise Impact Assessment (HJ2.4-2009)；

(6) Technical Guidelines for Environmental Impact Assessment, ecological impact Assessment (HJ19-2011)；

(7) Technical Guidelines for environmental risk assessment on projects (HJ/T 169-2004)

(8) Guidelines for technical review of environment impact assessment on construction projects (HJ616-2011)

(9) Identification of major hazard installations for dangerous chemicals (GB18218-2009)

2.3 Conformance with related policies and planning

2.3.1 China's 12 th Five-Year Plan

"China's 12th five year plan"noted that accelerate the development of new energy, promote clean and efficient use of traditional energy source, adjust the structure of the energy consumption, increase the proportion of non-fossil energy. In the conference" highlights 10 key tasks, promote 10 practical technology", Ministry of Agriculture strongly advocated the development of production and application of bio-organic fertilizer, and improve the environment to ensure food safety.

Outline of 12th five year development of Hebei Province proposed positive development of circular agriculture, promote the resource recovery and reuse of livestock manure and other waste, form a circular agriculture develop mode. Strengthen the standardization and marketization of agriculture, complete agricultural standard system, promote the unified industrial operating rules and technical specifications, accelerate the development of pollution-free, green, organic and landmark agricultural production.

2.3.2 China's 12 th Five-Year Plan of air pollution control in key areas

"China's 12 th Five-Year Plan of air pollution control in key areas"noted that, Beijing，Tianjin and Hebei are complex and serious polluted areas, at where the fine particulate matter and ozone environmental issues should be focus controlled, These areas included: Beijing, Tianjin, Shijiazhuang, Tangshan, Baoding and Langfang.

The plan noted that, the emission of SO_2, NO_x and industrial fumes in focus controlled areas should decrease by 12%, 13% and 10%, the work of VOC(volatile organic compounds) pollution prevention and control should be carried out in full swing; Air quality should be improved, the concentration of IPM(inhalable particle matter), SO_2, NO_x and fine particulate matter should decrease by 10%, 10%, 7% and 5%.

The biogas produced by the project can replace coal and gasoline for local residents' living and vehicles use. As biogas is a kind of clean energy, the implementation of the project can reduce local use of coal and gasoline, which to some extent reduce the emission of SO_2, NO_x and industrial fumes.

2.3. 3 The 12th Five-Year Plan of eco-environment protection of Hebei Province

"The 12th Five-Year Plan of eco-environment protection of Hebei Province" noted that, the overall objective during the 12th Five-Year is that, the emission of major pollutants be reduced significantly, the quality of urban and rural environment be improved significantly, the general deterioration of eco-environment be basically suppressed.

This project can make comprehensive utilization of rural straw, manure, etc., the produced biogas can replace coal and gasoline, which reduce the emission of SO_2, NO_x from the source.

2.4 Evaluation criteria

This management plan made comparative analysis between applicable national standards and "World Bank environment, health and safety guidelines"(EHS)，including includes Air Emissions and Ambient Air Quality, Wastewater And Ambient Water Quality, WASTE MANAGEMENT. Noise. Occupational Health And Safety, Electronic Transmission And Distribution, and finalize the evaluation criteria.

2.4.1Environmental quality standard

1、 Ambient air quality standard

Environmental quality standard adopts Ambient air quality standard (GB3095-2012), see Figure 2.4-1.

Table 2.4-1 Concentration Limits of Elementary Items in Ambient Air Pollutants

Pollutant name		TSP	PM_{10}	SO_2	NO_2	CO
Standard source		μg/m ³	μg/m ³	μg/m ³	μg/m ³	mg/m ³
Secondary standard in GB3095-2012	Annual average	200	70	60	40	—
	Average for 24h	300	150	150	80	4
	Average for 1h	—	—	500	200	10

2、Environmental quality standard for surface water

According to "water function zoning of Hebei Province"(Department of water resources of Hebei Province [2004]42), Water area within the evaluation scope applies to corresponding level in Environmental quality standard for Surface Water (GB3838-2002).

Groundwater within the evaluation scope applies to category III in Environmental quality standard for Groundwater (GB/T14848-93), refer to Table 2.4-2 for specific standard limit.

Table 2.4-2 Standard Value of Surface/ Ground Water Environmental Quality

Surface/Groundwater	Item	Standard values	unit	Standard source
Surface water	pH	6～9	--	category Ⅱ of Environmental quality standard for Surface Water (GB3838-2002)
	Chemical oxygen demand(COD)	≤15	mg/L	
	(NH_3-N)	≤0.5		
	Petroleum	≤0.05		
	Sulphide	≤0.1		
	Chloride	≤250		
	Fluoride	≤1.0		
	pH	6～9	--	category III of Environmental quality standard for Surface Water (GB3838-2002)
	Chemical oxygen demand(COD)	≤20	mg/L	
	(NH_3-N)	≤1.0		
	Petroleum	≤0.05		
	Sulphide	≤0.2		
	Chloride	≤250		
	Fluoride	≤1.0		
	pH	6～9	--	category Ⅳ of Environmental quality standard for Surface Water (GB3838-2002)
	Chemical oxygen demand(COD)	≤30	mg/L	
	(NH_3-N)	≤1.5		
	Petroleum	≤0.5		
	Sulphide	≤0.5		
	Chloride	≤250		
	Fluoride	≤1.5		

Groundwater	pH	6.5~8.5	--	category III of Environmental quality standard for Groundwater (GB/T14848-93)
	Total hardness	≤450	mg/L	
	Permanganate index	≤3.0		
	Total dissolved solids	≤1000		
	Nitrite	≤0.02		
	Nitrate	≤20		
	(NH_3-N)	≤0.2		
	Chloride	≤250		
	Fluoride	≤1.0		
	Sulfate	≤250		
	Cyanide	≤0.05		
	Color	≤15		

Table2.4-3 Water quality standards of subprojects

Serial No.	Subproject	Surface Water (GB3838-2002)		Environmental quality standard for Groundwater (GB/T14848-93)
		Surface Water Name	Standard Category	
1	Anping	Hutuo River	Ⅳ	Ⅲ
2	Yutian	Guo River Shuangcheng River	Ⅱ Ⅲ	Ⅲ
3	Zunhua	Sha river	Ⅳ	Ⅲ
4	Linzhang	Zhang River Wei River	Ⅳ Ⅳ	Ⅲ
5	Chengde	Luan River	Ⅳ	Ⅲ
6	Laoting	Chang River	Ⅴ	Ⅲ
7	Guye	Sha River Shiliu River	Ⅳ Ⅳ	Ⅲ

3. Environment quality standard for sound

According to "Environment quality standard for Noise(GB3096-2008)", subproject's acoustic environment category applies to corresponding level, mostly category 1,2, or 4a. Comparative analysis of national standards and EHS standards see table 2.4-4, Environment quality standard for Noise of subprojects see table 2.4-5

Table 2.4-4 Comparative analysis of national standards and EHS standards

unit: dB(A)

Sound Environment	Environment quality standard for Noise(GB3096-2008)			EHS Noise level Guidelines	
	Category	Daytime	Night time	Daytime	Night time
Field scope(industrial, residential confounding region)	2	60	50	70	70
Sensitive points (village, school, etc.)	1	55	45	55*	45
Traffic route	4a	70	55	——	——

Table 2.4-4 shows that, national standards have the same or stricter values than EHS standards in Sensitive points (village, school, etc.), Field scope(industrial, residential confounding region) and Traffic route. Therefore, all subprojects use national standards for evaluation.

Table 2.4-5 Environment quality standard for Noise of subprojects

Serial No.	Subproject	Environment quality standard for Noise(GB3096-2008)	
		Region	Category
1	Anping	Regions nearby Field scope	2
2	Yutian	Regions nearby Field scope	2
3	Zunhua	Regions South of project(nearby S356) or biogas pipeline near Daqin railway Other Regions nearby Field scope	4a 2
4	Linzhang	Regions South of project, or biogas pipeline near S212 Other Regions nearby Field scope	4a 2
5	Chengde	biogas pipeline near Highway Changshen and Highway Jingchneg Other Regions nearby Field scope	4a 2
6	Laoting	Regions nearby Field scope biogas pipeline near Highway Tanggang , Highway coastal and S044	2 4a
7	Guye	Regions South and west of project, biogas pipeline near south outer ring road Other Regions nearby Field scope	4a 2

4. Environmental quality standard for soil

Apply to secondary standard in Environmental quality standard for soils(GB15618－2008), refers to Table 2.4-6 for details.

Table 2.4-6 Standards for soil assessment

Environmental elements	Standard and category	Item	Standard value(mg/kg)
Soil environment	《Environmental quality standard for soils》(GB15618－2008)category II (Soil pH value >6.5~7.5)	Cd	≤0.45 mg/kg
		Hg	≤0.70 mg/kg
		As	≤30 mg/kg
		Cu	≤100 mg/kg
		Lead	≤80 mg/kg
		Cr	≤200 mg/kg

5. Environmental quality standard for electric power transmission and distribution

The standard for Power Frequency Electric Field and Power Frequency Magnetic Field in domestic refer to "Procedural regulations for Environmental Impact Assessment of 500kV ultrahigh pressure electric power transmission and transformation project"(HJ/T24-1998)，and in WB refer to "EHS Guidelines for Electric Power Transmission and Distribution".

The standard for Radio Interference in domestic refers to "Radio Interference limits of ultrahigh pressure alternating current Overhead Transmission Lines"(GB15707-1995); there is no according standard for 0.5MHz, 46dB(μV/m) Radio Interference in WB. refers to Table 2.4-7 for details.

Table 2.4-7 Environmental quality standard for electric power transmission and distribution

Scope of application	item	unit	Domestic standards		EHS	
			Standard source	value	**Standard source**	value
power transmission and transformation	Electric Field	V/m	HJ/T24-1998	4000	EHS Guidelines for Electric Power Transmission and Distribution	5000
	Magnetic Field	uT		100		100
	Radio Interference	dB(μV/m)	GB15707-1995	Under the condition of sunny day, 0.5MHz test frequency, 20m from the boundary conductor projection , 110kV Radio Interference limits of ultrahigh pressure alternating current Overhead Transmission Lines≤ 46dB(μV/m)。	——	

Table 2.4-7 shows that, national standards have the same or stricter values than EHS standards in Power Frequency Electric Field and Power Frequency Magnetic Field, as well as Radio Interference. Therefore, all subprojects use national standards for evaluation.

2.4.2 Pollution discharge standard

A. Standard for air pollutants discharge

(1)Emission standard of air pollutants for gas-fired boiler and engine

Most subprojects use gas-fired boilers for the heat preservation of Fermentation Room, Guye and Linzhang subproject use gas-fired engine for electricity generation. The relevant standard in domestic refer to "Emission standard of air pollutants for coal-burning oil-burning gas-fired boiler(GB13271-2001)", in EHS refer to "EHS Guidelines for air emissions and ambient air quality". Refer to Table 2.4-8for specific values.

Table 2.4-8 Emission standard of air pollutants for gas-fired boiler and Engine

item	unit	GB13271-2001	EHS Engine (natural gas) =3MWth to < 50MWth	EHS gas-fired boiler
Particulate Matter	mg/Nm ^{3}	50	N/A	N/A
SO_2	mg/Nm ^{3}	100	N/A	N/A
NO_x	mg/Nm ^{3}	400	200 mg/Nm3	320mg/Nm^3
smoke blackness	--	1	--	

Table 2.4-8 shows that, national standards have the same or stricter values than EHS standards in Particulate Matter, SO_2, and smoke blackness. Therefore, all subprojects use national standards for evaluation. The NO_x emission standard in EHS is stricter than in domestic standard.

In addition, the gas-fired internal combustion engine of Linzhang subproject is <3MW, and thus the EHS standards for gas fired engine is not applicable to the project. The limit for the NOx emission provided in the GB13271-2001 is applicable to Linzhang sub-project.

The finally Emission standard of air pollutants for gas-fired boiler and engine for evaluation see table 2.4-9.

Table 2.4-9 Emission standard of air pollutants for gas-fired boiler and engine for evaluation

item	unit	value		Standard source
Particulate Matter	mg/Nm ^{3}	50		GB13271-2001 Table1, Table2, Ⅱ period
SO_2	mg/Nm ^{3}	100		
smoke blackness	--	1		
NO_x	mg/Nm ^{3}	Gas-fired boiler	320	EHS, table 1.1.2, Gas-fired boiler
		Gas-fired engine	200	EHS, table 1.1.2, Gas-fired engine =3MWth to < 50MWth

(2)Emission standards for odor pollutants

The emission of odor pollutants refers to "Emission standards for odor pollutants(GB14554-93)," see Table 2.4-10 for specific values

Table 2.4-10 Emission standards for odor pollutants unit: mg/m ^{3}

Control item	Concentration restriction	Standard source
Odor concentration	20 (non-dimensional)	GB14554-93
Ammonia	Emission limit: 1.5mg/m^3 Rate of emission: 4.9kg/h	
Hydrogen sulfide	Emission limit: 0.06mg/m^3 Rate of emission: 0.33kg/h	

(3)Emission standards for other air pollutants

Other air pollutants refer to "Integrated emission standard of air pollutants(GB16297-1996)".

B. Standard for water pollutant discharge

The wastewater in all the sub-projects will be reused except for Anping sub-project. In Anping subproject, the livestock wastewater and biogas liquid is partly reused for production, partly discharged to the subproject's wastewater pre-treatment station and then to Anping municipal wastewater treatment plant by pipeline.

The water quality of wastewater treated by Anping wastewater pre-treatment station meet the requirements of "Integrated wastewater discharge standard(GB8978-1996)"(grade III), "Discharge standard of pollutants forlivestock and poultry breeding (GB18596-2001)", and influent quality of Anping wastewater treatment plant. The effluent quality of Anping wastewater treatment plant meet the requirements of "Discharge standard of pollutants for municipal wastewater treatment

plant(GB GB18918-2002)"(grade I A). Refer to Table 2.4-11a and b for specific values.

Table 2.4-11a Pollutant Discharge Standard for Municipal WWTP（GB18918-2002）

Item	COD_{Cr}	BOD_5	SS	TP	NH_3-N	TN	Fecal Coliform
Influent（mg/L）	400	150	200	8.0	80	——	10^7
Effluent（mg/L）	50	10	10	0.5	5（8）	15	10^3（head/L）
Removal rate %	95.0	87.5	95.0	83.3	85.7	——	——

In Yutian project, the wastewater will be discharged into wastewater treatment station of the project, the treated wastewater meet the requirements of " Standards for irrigation water quality (GB5084-2005)", and be used for nearby farmland irrigation. Refer to Table 2.4-11 b for specific values.

Table2.4-11 b Standards for irrigation water quality (dry farm)

No.	item	unit	value
1	BOD_5	mg/L	100
2	COD_{Cr}	mg/L	200
3	SS	mg/L	100
4	An-ionic surfactant	mg/L	8
5	Water temperature	℃	35
6	pH	mg/L	5.5-8.5
7	Total salt	mg/L	1000
8	chloride	mg/L	350
9	sulfide	mg/L	1
10	Total mercury	mg/L	0.001
11	Cadmium	mg/L	0.01
12	Total arsenic	mg/L	0.1
13	chrome	mg/L	0.1
14	lead	mg/L	0.2
15	Number of faecal coliform bacteria	Per 100mL	4000
16	Number of ascaris eggs	Per L	2

C. Standard for solid waste control

solid organic fertilizer for returning to farm shall meet with Technical requirement for"Technology code for land application rates of livestock and poultry manure (GB/T25246-2010)", with livestock manure as raw material for bio-organic fertilizer, its hygiene indicators should comply with table2.4-12, with livestock manure as raw

material for biogas fertilizer, its biogasresidues and liquid should comply with table 2.4-13. Heavy metal content in the organic fertilizer refer to " Organic Fertilizer (NY 525 – 2011) ", Table 2.4-14.

Table 2.4-12 Hygiene standard for Compost

Control item	Hygiene standard	Standard source
Death rate of Roundworm ovum	95%~100%	GB/T25246-2010
Number of faecal coliform bacteria	10^{-1}~10^{-2}	
Flies	No live maggot, pupa or flies around the pile	

Table 2.4-13 Hygiene standard for Biogas fertilizer

Control item	Hygiene standard	Standard source
sedimentation rate of Roundworm ovum	≥95%	GB/T25246-2010
ovum of japonicum and hookworm	No ovum of japonicum and hookworm be found in biogas liquid	
Number of faecal coliform bacteria	10^{-1}~10^{-2}	
Mosquito, Flies	No live larvae, maggot, pupa or flies around the pile	
Manure residue in the biogas tank	Shall meet the requirements of table 2.4-12	

Table 2.4-14 Heavy metal content standard in the organic fertilizer

Control item	Hygiene standard (mg/kg)	Standard source
Total As	15	NY525-2011
Total Hg	2	
Total Pb	50	
Total Cd	3	
Total Cr	150	

D. Emission standard of noise

⑴ Emission standard of noise during construction

The emission of noise during construction refers to “Emission standards of environment noise for boundary of construction site(GB12523-2011),” see Table 2.4-15 for specific values

Table 2.4-15 Emission standard of noise during construction unit: dB(A)

Day time	Night time
70dB(A)	55 dB(A)

⑵ Emission standard of noise during operation

The emission of noise during operation refers to “Emission standards for industrial enterprise noise at boundary (GB12348-2008)”, see Table 2.4-16 for specific values.

Table 2.4-16 GB12348-2008 noise level standards unit: dB(A)

Period / **category**	**Day time**	**Night time**
1	55	45
2	60	50
4	70	55

EHS environmental noise standards refers to “EHS Guidelines: environmental noise management” (see Table 2.4-17).

Table 2.4-17 EHS noise level guidelines unit: dB(A)

Period / **category**	Day time	Night time
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Table 2.4-16 shows that, national standards have the same or stricter values than EHS standards. Therefore, all subprojects use national standards for evaluation. Refer to Table 2.4-18 for specific values.

Table 2.4-18 Noise Emission standard for subprojects during operation

Serial No.	**Subproject**	GB12348-2008	
		region	**category**
1	Anping	at boundary	2
2	Yutian	at boundary	2
3	Zunhua	at boundary	2
4	Linzhang	South boundary North, west, east boundary	4 2

Serial No.	Subproject	GB12348-2008	
		region	**category**
5	Chengde	at boundary	2
6	Laoting	at boundary	2

3. Environment Baseline

3.1Environment situation

3.1.1Natural environment situation

3.1.1.1 Geographical Position

Hebei Province is in the northern part of China, it covers the region of E113 °27'-119 °50' to N36 °05'-42 °40', with Bohai gulf to its east, Beijing Municipality surrounded by it, Tianjin Municipality to its east, Shandong and Henan Province to its south, Liaoning and Inner Mongolia Province to its north, Shanxi Province to its west. It is the only province in China which includes plateau, mountain, hill, plain, lake and beach. Land area of Hebei Province is 188,000km^2. The provincial capital is Shijiazhuang which has 283km far from Beijing.

Hebei province comprises 11 prefecture-level cities: Shijiazhuang, Tangshan, Qinhuangdao, Handan, Xingtai, Baoding, Zhangjiakou, Chengde,Cangzhou, Langfang, Hengshui, it has 37 districts, 22county-level cities, 107 counties, 6 autonomous counties, 1970 towns, 50201 villagers' committees, 72.87 million people.

The regions of Hebei Rural Renewable Energy Development Demonstration Project are located in Tangshan, Chengde, and Hengshui. The location situations of those 3 cities are as follows:

Tangshan is located in the eastern part of Hebei Province, covers the region of E117°31’~119°19’ to N 38°55′~40°28’, with Qinhuangdao across the Luanhe river on the west, with Tianjin on the east, with Bohai gulf on the south, with Chengde across The Great Wall on the north. It covers 17040 km^2, the land area is 13472km^2, and the sea area is 4440km 2. Tangshan involves 7 districts, 5 counties, 2 county-level cities and 4 TEDAs (Technical Economic Development Area).

Chengde is located in northeast of Hebei Province, covers the region of E115°54’~119°15’,N 40°11′~42°40’, which in the middle of North China and Northeast China, with Beijing on its southwest, with Tianjin on its south, back against Liaoning and Inner Mongolia on its north, adjacent to Qinhuangdao, Tangshan and Zhangjiakou in the province. The total area of Chengde is 39375km^2 with 3.7 million

people, involves three districts and eight counties: Weichang Manchu and Mongolia autonomous county, Fengning Manchu Autonomous County, Longhua, Luanping, Pingquan, Chengde, Kuancheng Manchu Autonomous County, Xinglong, Shuangqiao District, Shuangluan District and Yingshouyingzi mining district.

Handan is the third largest city in Hebei, in the south of Hebei, the middle of Central Plains Economic Area and the central Shanxi-Hebei-Shandong-Henan（E115°54’~119°15’,N40°11′~42°40’）, with Shandong Liaocheng on its east，Henan Linan on its south，Shanxi Linan on its west, and Xingtai on its north. The total area is 12000km^2 with 10.16 million people, involves 5 Districts, 1 city, 14 counties, 96 towns, 118 townships, 28 offices, 461 neighborhood committees and 5252 villages.

Hengshui is located in the southeast of Hebei, covers the region of E115°10′-116°34′, N37°03′-38°23′, with Dongguang, Wuqiao and Dezhou on its east, Shijiazhuang and Shenze on its west. The total area is 8815km^2, with3 districts, 2 county-level cities, 8 counties, 63 towns, 49 townships, 7 streets, 4994 village committees, and 92 neighborhood committees.

The location of subprojects in the following table:

Table 3.1-1 Location of subprojects

Name	Prefectures	Position
Laoting Project	Laoting belongs to Tangshan City, in northeast of Hebei, the centrally of Beijing-Tianjin-Tangshan-Qinhuangdao area and andlink Persian gulf heartland. The Bohai gulf near its east and south sides, with Qinhuangdao on its north, Tangshan Luannan on its west. The total area is 1308 km^2. It is the largest coastal county in Hebei Province.	lie in Hantuo Village Laoting Town, geo-location：N39°23′25.62″, E118°54′30.64
Yutian Project	Yutian belongs to Tangshan City, in south of Yanshan, the Central of Jizhong Plains, Zunhua on its north, Baodi and Ninghe on its south, Jinxian on its west, Fengrun on its east. The total area is 1165km^2. The terrain from northeast to southwest gentle slope, Landform is obvious zonation, formed the northern hilly, Central Plains, the southern low-lying land.	located in Ruanzhuangxzi Village Guojia Town, geo-location：N39°57'12.86", E117°48'36.05"
Zunhua Project	Zunhua belongs to Tangshan City, located in the south of Yanshan. It is in the west of Beijing, the south of Tianjin and Tangshan, the central of Beijing-Tianjin-Tangshan-Chengde, 158km far from Beijing in the west, 75km far from Tangshan in the	located in Xixindianzi Village Baozidian Town, geo-location：N40°8′ 48.11", E117°48′ 0.68"

	south, 175km far from Chengde in the north, 150km far from Qinhuangdao in the Southeast. Total area is 1521km^2, has 0.7 million people.	
Chengde Project	Chengde County belonged to Chengde City, located in the north of Hebei. It is in the west of Pingquan, the south of Kuancheng and Xinglong, the northwest of Longhua, the west of Beijing, the northeast of, the southwest of Inner Mongolia Ningcheng County and Beijing Miyun. Things wide 87 km, 95km long from north to south, total area is 4040km^2.	located in Gushan Village Sangou Town, geo-location：N 41 °0'5.7"、E118 °15'40.85"
Anping Project	Anping County belonged to Hengshui City，located in the central of Hebei. It is in the west of Raoyang, the south Shenzhou and Xinji, the east of Shenze and Anguo, the north of Boye, the northwest of Lixian, total area is 493km^2.	located in the southeast of Hebei Yu Feng Jing an aquaculture Co. Ltd. Dongzhaizi Village Anping County ,geo-location：N 38 °13'31.83",E115 °34'33.25"
Linzhang Project	Linzhang County belonged to Handan City. It is in the central of centa-city，the west of Taihang Mountain and Weixian, the east of Cixian, the north of Chengan, the south of Anyang,，Things wide 35 km, 26.5km long from north to south, total area is 744.06km^2.	located in the Linzhang County Modern Agricultural Demonstration Park，geo-location：N114 °36'50.86",E36 °18'32.05"

3.1.1.2 Terrain, Geology, Hydrology

Hebei Province has a complex terrain including mountains, hills, basins and plains. The terrain of Hebei Province consists of three major geomorphologic units: Bashang Plateau, Yanshan and Taihang Mountains and Hebei plains. The whole area is high in the northwest, low in southeast, sloping from northwest to southeast. The northwest part is formed by mountains, hills and plateaus, basins and valleys, the central and south-east part is the vast plain. The terrain gradually is lowered from southeast to northwest.

The Bashang Plateau is a part of the Inner Mongolia Plateau, the elevation is 1200m-1500m, accounting for an area 8.5% of the province. Yanshan and Taihang Mountains ,multi-basin hills, the elevation is under 2000 m, in an area 48.1% of Hebei. The Hebei plains is a part of the North China Plain, the elevation is under 50 m, representing an area 43.4% of Hebei.

The environment conditions of the Project in the table 3.1-2 :

3.1.1.3 Meteorology

Hebei is belonging to sub-humid warm temperate continental monsoon climate zone, the winter shows cold and less snow, the summer shows hot and regular rainfall, the spring has universal sand wind, the autumn has cloudless day. The mean

temperature from 4℃ to 13℃, -4-2℃ In January, 20-27℃ in July, the northwest temperature higher than the southeast, has 110-220days of frost-free season one year. Average precipitation is 400-800 mm. The meteorological information of the project see the following table 3.1-3.

Table3.1-2 Environment conditions of the Project

Project	Laoting Project	Yutian Project	Zunhua Project	Chengde Project	Anping Project	Linzhang Project
Topography	Laoting county belongs to the Luanhe River alluvial plain, flat, North High South low, elevation 1-15 m	flat terrain, slightly northwest high southeast low, hilly in the northern , plains in the central, marsh land in the south	Plain 1/3, hills 1/3, mountains 1/3	mainly with mountainous region, plain and hills	Anping County is located in the Taihang piedmont alluvial fan front, territory for the Hutuo River alluvial plain.	taihang piedmont alluvial plain, the slope of the ground is 1/2000, height above sea level is 58-85m
Engineering geology	Soil parent material of Northern plain is the Luanhe River wash, in the southern coastal plain is the marine deposit. To be a sedimentary environment	the earth's crust is formed of sand and gravel and clay composition, surface is clay soil, surface tens of meters for dense sand	The soils include Brown earths and Cinnamon soils, Brown soil distributed in the northern mountainous area with an altitude of 300 meters above the low mountain. Cinnamon soil distribution at an altitude of 300 meters below the hilly and plain region.	north high south low, average precipitation is 12000-1700m	Flat terrain, slightly east high west low, average slope 1/3250.	the project site strata of Quaternary alluvium, from ground to underground 15m in clay and sandy loam.
Hydrogeology	groundwater depth is 20-60m	the position of project belongs to hilly fissure water, well depth 50-180m	Quaternary system of sand and gravel pore aquifer, groundwater depth is 4.6-8.6m	Alpine geological area, groundwater depth is 10-12m	Subsurface water is flowing from southeast to northwest	the overall flow of groundwater from southwest to northeast, the aquifer is divided into four water bearing formation, the first aquifer: bottom depth in the West about 20m

Table 3.1-3 Meteorology of the Project

Elements	Laoting	Yutian	Zunhua	Chengde	Anping	Linzhang
average wind speed（m/s）	3.2	2.1	1.5	1.2	2.4	2.2
maximum wind speed（m/s）	11.0	22.7	21.0	20.4	20.0	16.0
average temperature（℃）	10.6	11.6	10.9	9.4	12.4	13.5
peak temperature（℃）	38.7	40.4	40.5	41.3	41.3	41.6
lowest temperature（℃）	-21.2	-22.9	25.6	-29.0	-22.4	-21.8
average relative humidity（%）	66	60	60	59	54	54
average precipitation（mm）	589.7	655.4	724.7	560.0	513.6	544.1
maximum precipitation (mm)	1158.6	1153.1	1224.0	860.1	832.1	982.6
minimum precipitation (mm)	286.6	315.8	338.2	310.5	330.1	332.6
sunshine duration（h）	2569.1	2433.4	2608.2	2606.2	2526.7	2363.2
static wind frequency（%）	12	26	10	51	12	17
annual maximum wind	ENE	W	SE	W	S	S

3.1.2 Ecological condition

Hebei Province is the only one which has plateau, mountains, hills, plains, lakes and coastal in China.

The ecological environment of the project is shown in the table 3.1-4.

Table 3.1-4. Ecological environment

Project Name	Soil	Plants and animals
Laoting project	project field at Luanhe alluvium	The project is located in the County suburbs, which has been developed by human acitivites and the ecology is dominated by artificial ecology. There are no rare animals and plants, large wild animal.
Yutian project	the surface is several meters thick viscous soil	which has been developed by human acitivites and the ecology is dominated by artificial ecology. There are no rare animals and plants, large wild animal.
Zunhua project	cinnamon soil	which has been developed by human acitivites and the ecology is dominated by artificial ecology. There are no rare animals and plants, large wild animal.
Chengde project	cinnamon soil, meadow soil	which has been developed by human acitivites and the ecology is dominated by artificial ecology. There are no rare animals and plants, large wild animal.
Anping project	meadow soil	which has been developed by human acitivites and the ecology is dominated by artificial ecology. There are no rare animals and plants, large wild animal.
Linzhang project	light loam ; clay	which has been developed by human acitivites and the ecology is dominated by artificial ecology. There are no rare animals and plants, large wild animal.

3.1.3 Social and Economic

3.1.3.1 Administrative region and Population

Hebei Province involves Shijiazhuang Tangshan, Qinhuangdao, Handan, Xingtai, Baoding, Chengde, Cangzhou, Langfang, Zhangjiakou, Hengshui, This project involve Tangshan, Chengde, Handan and Hengshui. The administrative regions of project Location are shown in table 3.1-5.

Table 3.1-5 Administrative region of project Location

Project	Administrative Region and Population
Laoting project	Laoting county involves 11 towns, 3 townships, 1subdistrict, 533 administrative villages, and 11 communities. The agricultural acreage is 944000 mu, it has 497000 people. The Project location of Laoting town has 86700 people, the agricultural acreage is 100000 mu, the land mass is 93.6 km^2
Yutian project	Yutian county involves 14 towns, 6 townships, 750 administrative villages. the agricultural acreage is 1040000 mu, it has 650000 people. The Project location of Guojiatun town, has 34084 people, the agricultural acreage is 3884 hectare, the land mass is 86 km^2.
Zunhua project	The Land mass of Zunhua is 1521 km^2, involves 25 towns, 2subdistrict,, 648 administrative villages, 130000 people. The Project location of Dibaozidian, has 39000 people, the land mass is 76.8 km^2, the agricultural acreage is 65000 mu
Chengde project	Chengde county involves 25 towns, 17 townships, 421 administrative villages, the land mass is 4040 km^2, 47000 people. The Project location of Sangou Town has 29100 people.
Anping project	The Land mass of Anping county is 493km^2， the agricultural acreage is 33000 hectares,318000 people. The Project location of Anping, has 20000 people
Linzhang project	Linzhang county involves 5 towns,9 townships, 425 administrative villages, the agricultural acreage is 750000 mu. The Project location of Anping has 75000 people

3.1.3.2 Economic

Hebei Province's GDP reached 2657 billion yuan in 2012, had an increase of 8.40% over last year. The primary industry reached 318 billion yuan, had an increase of 6.68% over last year, account for 52.69% of GDP.

The average disposable income of the urban citizen reached 20543 yuan， had an increase of 12.3% over last year. The average disposable income of the rural dwellers reached 8081.39 yuan, had an increase of 13.5% over last year. Main the business income of enterprises above designated size reached 4304 billion yuan, the light industry reached 879 billion yuan; make up 20.44% of the total. The heavy industry reached 3424 billion yuan; make up 79.56% of the total. , The Coal, oil, black metal mining, non-ferrous metal mining , make up 10.18%、24.73%、12.61%、3.09%、9.52% of the total respectively.

The regional economies of project location see in table 3.1-6。

Table 3.1-6 Regional economies of project Location

Name	regional economies
Laoting project	County-wide GDP reached 28 billion yuan in 2012, working population reached 262405, the per capita net income of farmers reached 10458 yuan,, gross output value of farming, forestry, animal husbandry and fishery reached 10.69 billion yuan, the planting area is 92177 hectare.
Yutian project	County-wide GDP reached 30.8 billion yuan in 2012, working population reached 331491, the per capita net income of farmers reached 10122 yuan,, gross output value of farming, forestry, animal husbandry and fishery reached 10.06 billion yuan, the planting area is 125757 hectare.
Zunhua project	County-wide GDP reached 519.82 billion yuan in 2012, working population reached 330319, the per capita net income of farmers reached 10087 yuan,, gross output value of farming, forestry, animal husbandry and fishery reached 6.5 billion yuan, the planting area is 64440 hectare.
Chengde project	County-wide GDP reached 10.52 billion yuan in 2012, working population reached 212781, the per capita net income of farmers reached 5608 yuan,, gross output value of farming, forestry, animal husbandry and fishery reached 3.6 billion yuan, the planting area is 36642 hectare.
Anping project	County-wide GDP reached 8.9 billion yuan in 2012, working population reached 14771, the per capita net income of farmers reached 8582 yuan,, gross output value of farming, forestry, animal husbandry and fishery reached 2.6 billion yuan, the planting area is 49673 hectare.
Linzhang project	County-wide GDP reached 10 billion yuan in 2012, working population reached 377002, the per capita net income of farmers reached 8759 yuan,, gross output value of farming, forestry, animal husbandry and fishery reached 4.9 billion yuan, the planting area is 92390 hectare.

3.1.3.3 Physical culture resources

according to the information collected and site survey, it is identified that the locations of the subprojects are all in the rural area where agricultural activities is frequent; and the proposed project is not in or near any physical culture resources.

3.2 Environment quality

3.2.1 Ambient air

Environmental monitoring data, monitoring agencies, monitoring date and evaluation results of subprojects see in the table 3.2-1, the location of the monitoring point see the figure。

According to the monitoring data of Laoting project, Zunhua project, Linzhang project, Chengde project and Anping project, the monitoring factors of these area conformed to the grade ii in *Ambient air quality standards (GB3095-2012)* and the

maximum permissible concentration value of the hazardous material in the atmosphere of residential area in *Hygienic standards for the Design of Industrial Enterprises (GBZ 1-2002),* the regional environment is in good condition. According to the monitoring data of Yutian project, The hourly concentration *and daily* concentration of SO_2、NO_2、PM_{10} conformed to the grade ii in *Ambient air quality standards(GB3095-2012),* The maximum permissible concentration of H_2S conformed to *Hygienic standards for the Design of Industrial Enterprises(GBZ 1-2002),* the monitoring data of NH_3 exceed the standard, the super standard multiple is 28.7%、7.1%.

3.2.2 Groundwater Environment

Groundwater environment data, monitoring agencies, monitoring date and evaluation results of subprojects see in the table 3.2-2, the location of the monitoring point see the figure.

According to the monitoring data of subprojects, the monitoring factors of these area conformed to the grade iii in *Quality standard for ground water (GB/T14848-93),* the groundwater environment is in good condition.

Table 3.2-1 Environmental monitoring and Results

Name	agencies	date	monitoring point	pollutant	Hourly average	hourly standard	daily average	daily standard
Yutian project	Tangshan municipal environment monitoring center station	2011.7.30-8.5	Ruanzhuangzi Village	PM_{10}	——	——	0.102-0.147	0.680-0.980
				SO_2	0.010-0.064	0.020-0.128	0.010-0.059	0.067-0.393
				NO_2	0.002L*-0.059	0.042-0.246	0.010-0.019	0.083-0.158
				NH_3	0.071-0.415	0.355-2.075	——	——
				H_2S	0.001L-0.003	0.050-0.300	——	——
			Huangjiashan Village	PM_{10}	——	——	0.108-0.146	0.720-0.973
				SO_2	0.009-0.053	0.018-0.106	0.010-0.049	0.067-0.327
				NO_2	0.002L-0.046	0.042-0.092	0.012-0.032	0.083-0.267
				NH_3	0.038-0.232	0.190-1.160	——	——
				H_2S	0.001L-0.003	0.050-0.300	——	——
Anping project	Hengshui environmental monitoring station; Anping environmental monitoring station	2013.5.6-5.12	site of the factory	PM_{10}	——	——	0.063-0.097	0.420-0.647
				SO_2	0.040-0.082	0.080-0.164	0.038-0.049	0.253-0.327
				NH_3	0.057-0.094	0.285-0.470	——	——
				H_2S	0.0005-0.001	0.285-0.470	——	——
			Dongzhaizi Village	PM_{10}	——	——	0.053-0.096	0.353-0.646
				SO_2	0.027-0.098	0.054-0.196	0.028-0.043	0.187-0.287
			Jiatun Village	PM_{10}	——	——	0.082-0.111	0.547-0.740
				SO_2	0.041-0.081	0.082-0.162	0.037-0.049	0.247-0.327
			Qiantun Village	PM_{10}	——	——	0.064-0.088	0.427-0.587
				SO_2	0.025-0.055	0.050-0.110	0.033-0.050	0.220-0.333
				NH_3	0.060-0.099	0.300-0.495	——	——
				H_2S	0.0005-0.003	0.050-0.300	——	——
			Nanzhangwo	PM_{10}	——	——	0.068-0.092	0.453-0.613

Name	agencies	date	monitoring point	pollutant	Hourly average	hourly standard	daily average	daily standard
			Village	SO_2	0.024-0.057	0.048-0.114	0.033-0.048	0.220-0.320
				NH_3	0.063-0.092	0.315-0.460	——	——
				H_2S	0.0005-0.003	0.050-0.300	——	——
Zunhua project	Zunhua environmental monitoring station;	2012.11.8-11.12	Xixindianzi Village	PM_{10}	——	——	0.375-0.965	1.26-3.22
				SO_2	0.028-0.055	0.056-0.11	0.036-0.4	0.245-0.268
				NH_3	0.0005-0.004	0.050-0.4	——	——
				H_2S	0.010-0.010	0.05-0.05	——	——
			Zhoujia Village	PM_{10}	——	——	0.340-0.904	1.13-3.01
				SO_2	0.027-0.054	0.054-0.108	0.034-0.039	0.233-0.26
				NH_3	0.0005-0.004	0.050-0.4	——	——
				H_2S	0.039-0.169	0.195-0.845	——	——
Chengde project	Advanced Standards Technical Services Co. Ltd.	2014.2.9-2.17	Beigushan Village	PM_{10}	——	——	0.124~0.216	0.827-1.44
				SO_2	0.019-0.091	0.038-0.182	0.027~0.056	0.18-0.373
				NO_2	0.025-0.074	0.125-0.37	0.029~0.054	0.3625-0.675
				NH_3	0.010L-0.036	0.05-0.18	——	——
				H_2S	0.005L	0.50	——	——
			Dachang Village	PM_{10}	——	——	0.09~0.279	0.6-1.86
				SO_2	0.021-0.083	0.042-0.166	0.026~0.053	0.173-0.353
				NO_2	0.020-0.072	0.1-0.36	0.027~0.053	0.338-0.662
				NH_3	0.010L-0.026	0.05-0.13	——	——
				H_2S	0.005L	0.50	——	——
			Fangshengou Village	PM_{10}	——	——	0.093~0.285	0.62-1.9
				SO_2	0.014-0.086	0.028-0.172	0.022~0.051	0.147-0.34
				NO_2	0.022-0.066	0.11-0.33	0.026~0.048	0.325-0.6
				NH_3	0.010L	0.05	——	——

Name	agencies	date	monitoring point	pollutant	Hourly average	hourly standard	daily average	daily standard
				H_2S	0.005L	0.50	——	——
Laoting project	The automatic release system of air quality in	2014.3.24-.3.30	occupation technical school	PM_{10}	——	——		0.126-0.234
				SO2	——	0.037-0.158	——	——
				NO2	——	0.026-0.104	——	——
	Beijing Aodaqing Environmental quality testing Co. Ltd.	2014.3.26-3.28	Jituo Village	NH_3	0.036-0.073	0.315-0.365	——	——
				H_2S	0.002	0.2	——	——
			Hantuo Village	NH_3	0.052-0.064	0.26-0.32	——	——
				H_2S	0.001	0.1	——	——
			Sanchakou Village	NH_3	0.056-0.064	0.29-0.32	——	——
				H_2S	0.001	0.1	——	——
Linzhang project	Tangshan municipal environment monitoring center station	2014.2.28-2.24	Luocun Village	PM_{10}	——	——	——	0.062~0.094
				SO_2	——	0.019~0.063	——	0.027~0.056
				NO_2	——	0.015~0.060	——	0.018~0.044
			site of the factory	PM_{10}	——	——	——	0.063~0.088
				SO_2	——	0.020~0.065	——	0.035~0.055
				NO_2	——	0.017~0.055	——	0.026~0.052
			Beizhang Village	PM_{10}	——	——	——	0.067~0.093
				SO_2	——	0.023~0.058	——	0.031~0.053
				NO_2	——	0.017~0.056	——	0.025~0.041

PS：*In the case of No valid numerical detected, set the numerical value as the half of Limit value

Table 3.2-2 Groundwater environment data（mg/L）

Name	Agencies	Monitoring date	Monitoring point	Pollutant	pH	Total dissolved solids	Total hardness	permanganate indices	NH_4-N	Nitrate nitrogen	Nitrite nitrogen	Total coliforms
Yutian project	Tangshan municipal environment monitoring center station	2011.8.12-2011.8.13	Huangjiashan Village	Record	7.25-7.27	386-390	296-320	0.81-0.86	0.028-0.037	0.25-0.62	0.003L	3
				percentage standard rate	0.167-0.173	0.386-0.390	0.658-0.711	0.270-0.287	0.140-0.185	0.013-0.031	0.075	1
			Ruanzhuangzi Village	Record	7.55-7.57	254-258	162-178	0.45-0.49	0.025L-0.04	0.37-0.48	0.003L	2
				percentage standard rate	0.373	0.252-0.258	0.360-.396	0.150-0.163	0.063-0.200	0.024-0.019	0.075	1
			Sijiaoshan Village	Record	7.77-7.79	242-245	139-165	0.30-0.35	0.025L	0.78-0.86	0.003L	0.333
				percentage standard rate	0.513-0.520	0.242-0.245	0.309-0.367	0.100-0.117	0.063	0.039-0.043	0.075	0.667
Anping project	Hengshui environmental monitoring station; Anping environmental monitorin	2013.5.9-2013.5.11	site of the factory	Record	7.05-7.26	442-448	—	1.01-1.07	0.10-0.14	0.399-0.401	0.003L	1
				percentage standard rate	0.03-0.17	0.442-0.448	—	0.34-0.36	0.500-0.700	0.020-0.020	0.075	0.333
			Nanzhangwo Village	Record	7.10-7.19	424-432	—	0.99-1.08	0.11-0.12	0.055-0.655	0.003L	2
				percentage standard rate	0.07-0.13	0.424-0.432	—	0.33-0.36	0.550-0.600	0.003-0.033	0.075	0.667
			Qianpu	Record	7.05-7.	423-424	—	0.96-1.10	0.09-0.10	0.093-0.106	0.003L	2

	g station		Village		25							
				percentage standard rate	0.03-0.17	0.423-0.424	—	0.32-0.37	0.450-0.500	0.004-0.005	0.075	0.667
Linzhang project	Tangshan municipal environment monitoring center station	2012.8.1	Beikong Village	Record	7.71	202	1	297	0.432	9.56	0.018	0.01L
				percentage standard rate	0.356	0.367	0.1	0.149	2.16	0.32	0.18	0.05
			Ganglingcheng Village	Record	7.43	308	0.8	529	0.237	19	0.018	0.01L
				percentage standard rate	0.215	0.56	0.08	0.265	1.18	0.63	0.18	0.05
			site of the factory	Record	7.45	310	0.9	510	0.242	19.1	0.018	0.01L
				percentage standard rate	0.225	0.564	0.09	0.255	1.21	0.64	0.18	0.05
		2012.8.2	Beikong Village	Record	7.55	200	0.8	289	0.42	9.48	0.018	0.01L
				percentage standard rate	0.275	0.364	0.08	0.145	2.1	0.32	0.18	0.05
			Ganglingcheng Village	Record	7.22	438	0.9	805	0.424	18	0.019	0.01L
				percentage standard rate	0.11	0.796	0.09	0.403	2.12	0.6	0.19	0.05
			site of the factory	Record	7.17	430	1.1	795	0.426	17.9	0.019	0.01L
				percentage standard rate	0.085	0.782	0.11	0.398	2.13	0.6	0.19	0.05
Chengde project	Advanced Standards Technical Services	2014.2.10	Sujiaying Village	Record	7.3	899	241	1.52	0.02L	9.335	0.0095	0.01L
				percentage standard rate	0.2	0.899	0.5356	0.5067	0.05	0.46675	0.475	0.05
			Dayang	Record	7.165	281	242	0.86	0.02L	9.72	0.003	0.01L

	Co. Ltd.		Village	percentage standard rate	0.11	0.281	0.5378	0.2867	0.05	0.486	0.15	0.05
			Beigushan Village	Record	7.205	421	252.5	1.045	0.02L	10.545	0.0165	0.01L
				percentage standard rate	0.1367	0.421	0.5611	0.3483	0.05	0.52725	0.825	0.05
			Fangshen Village	Record	7.08	431	249	0.86	0.02L	12.25	0.0075	0.01L
				percentage standard rate	0.533	0.431	0.553	0.2867	0.05	0.6125	0.375	0.05
			Beishui spring phreatic water	Record	7.19	469	286	0.92	0.02L	15.7	0.01	0.01L
				percentage standard rate	0.1267	0.469	0.6356	0.3067	0.05	0.785	0.5	0.05
			Beishui spring artesian water	Record	7.3	386	288	1.14	0.02L	14.85	0.0545	0.01L
				percentage standard rate	0.2	0.386	0.64	0.38	0.05	0.742	2.725	0.05
Laoting project	Beijing Aodaqing Environmental quality testing Co. Ltd.	2014.3.26	Jintuo Village	Record	0.85	43.60%	77.30%	23.30%	18.00%	96.50%	0.003L	——
			Hantuo Village	percentage standard rate	0.84	45.20%	85.80%	26.70%	10.50%	94.50%	0.003L	——
			Sanchakou Village	Record	0.84	48.20%	93.80%	30.00%	30.00%	95.50%	0.003L	——
		2014.3.27	Jintuo Village	percentage standard rate	0.97	42.50%	81.30%	20.00%	22.00%	87.00%	0.003L	——

			Hantuo Village	Record	0.96	46.80%	90.90%	16.70%	23.00%	87.50%	0.003L	——
			Sanchakou Village	percentage standard rate	0.97	47.50%	91.60%	20.00%	26.50%	86.50%	0.003L	——
Zunhua project	Zunhua environmental monitoring station	2013.12.18	Dacaogezhuang Hantuo Village	Record	7.05	500	—	—	—	4	—	0.01L
				percentage standard rate	0.03	0.5	—	—	—	0.2	—	0.05

PS：* In the case of No valid numerical detected, set the numerical value as the half of Limit value.

3.2.3 Sound environmental quality

Sound environmental quality data, monitoring agencies, monitoring date and evaluation results of subprojects see in the table 3.2-3, the location of the monitoring point see the figure.

According to the monitoring data of subprojects, the monitoring factors of Yutian project, Anping project, Zunhua project, Laoting project, conformed to the grade ii the Environmental quality standard for noise (GB 3096－2008).Linzhang project, Chengde project conformed to the grade iii in the Environmental quality standard for noise (GB 3096－2008).

Table3.2-3 Sound environmental quality data dB（A）

Yutian project（monitoring agencies ： Tangshan municipal environment monitoring center station）				
Date and place	2011.8.1		2011.8.2	
	Daytime	Nighttime	Daytime	Nighttime
North boundary	43.3	40.9	38.6	37.0
South boundary	43.6	39.5	42.8	37.2
East boundary	39.0	35.5	44.5	38.4
West boundary	47.9	39.8	52.9	40.8
Standard value	60	50	60	50
Evaluation results	reach standard	reach standard	reach standard	reach standard
Yutian project（monitoring agencies ： Hengshui environmental monitoring station; Anping environmental monitoring station ）				
Date and place				
	Daytime	Nighttime	Daytime	Nighttime
North boundary	52.8	46.3	55.9	48.7
South boundary	52.2	48.2	58.3	49.5
East boundary	57.9	45.2	56.4	48.8
West boundary	57.8	47	56.6	49.3
Standard value	60	50	60	50
Evaluation results	reach standard	reach standard	reach standard	reach standard
Zunhua project（monitoring agencies ： Zunhua environmental monitoring station ）				
Date and place	Daytime		Nighttime	
North boundary	50.6		35.9	
South boundary	48.8		37.1	

East boundary	50.7	38.7
West boundary	52.6	40.2
Standard value	60	50
Evaluation results	reach standard	reach standard

Chengde project（monitoring agencies ： Advanced Standards Technical Services Co. Ltd.）

Date and place	Daytime	Nighttime
North boundary	39.3	37.4
South boundary	43	39.2
East boundary	33.7	33.5
West boundary	34.7	34.2
Standard value	65	55
Evaluation results	reach standard	reach standard

Laoting project（monitoring agencies ： Beijing Aodaqing Environmental quality testing Co. Ltd.）

Date and place	2014.3.26		2014.3.27	
	Daytime	Nighttime	Daytime	Nighttime
North boundary	48.7	42.1	48.5	42.4
West boundary	49.2	43.2	48.9	43.8
South boundary	48.9	42.6	48.2	42.4
East boundary	48.2	41.5	47.8	41.8
Standard value	60	50	60	50
Evaluation results	reach standard	reach standard	reach standard	reach standard

Linzhang project（monitoring agencies ： Tangshan municipal environment monitoring center station）

Date and place	Daytime	Nighttime
North boundary	51.5	44.4
South boundary	54.4	48.0
East boundary	50.7	45.8
West boundary	49.8	46.5
Standard value	65	55
Evaluation results	reach standard	reach standard

PS：The monitoring point around the project is 1 m. away from the factory boundary..

3.2.4 Soil

Linzhang project and Chengde project monitored the Soil background value in manure testing field near the projects，， the evaluation results see as following tables.

Table3.2-4 The soil environment data of subproject

monitoring agencies：Chemical analysis and testing center of Beijing				
Sampling location	Inspecting item	Result	Standard value	Standard index
Linzhang project	pH	8.42	＞6.5	——
	Organic matter (g/k)g	15.95	——	——
	Total nitrogen（mg/kg）	98.6	——	——
	Available phosphorous（mg/kg）	23.35	——	——
	Available potassium（mg/kg）	147.35	——	——
	Cadmium (Cd)（mg/kg）	0.15	≤1.0	0.15
	Plumbum (Pb)（mg/kg）	23.1	≤500	0.0462
	Chromium(Cr)（mg/kg）	67.6	≤300	0.225
	Copper (Cu)（mg/kg）	22.9	≤400	0.0573
	Mercury (Hg)（mg/kg）	0.018	≤1.5	0.012
	Arsenic（mg/kg）	10.3	≤40	0.257
Chengde project	pH	7.5	＞6.5	——
	Total phosphorus （mg/kg）	531.33	——	——
	Cation exchange capacity cmol/kg(+)	21.48	——	——
	Total nitrogen（%）	0.06	——	——
	Mercury (Hg)（mg/kg）	0.11	1.5	0.07
	Plumbum (Pb)（mg/kg）	32.14	500	0.06
	Cadmium (Cd)（mg/kg）	0.11	1.0	0.11
	Arsenic （mg/kg）	9.31	40	0.23
	Copper (Cu)（mg/kg）	28.62	400	0.07
	Zinc (Zn)（mg/kg）	209.46	500	0.42
	Nickel (Ni)（mg/kg）	35.24	200	0.18
	Total chromium （mg/kg）	83.89	300	0.28

Manure testing field near the subprojects conformed to the grade ii in Environmental quality standards for soils (GB 15618—2008), the soil environment is in good condition.

3.3 The administration of the waste with livestock and poultry breeding

3.3.1 The resource extent of the livestock manure.

Hebei province is a large province of traditional animal husbandry，according to Hebei Economic Yearbook, the number of market pig reached 5.24 million, market beef reached 5.9 million，market poultry reached 0.7 billion, market sheep reached 25.66 million, market cow reached 6.72 million.

According to the livestock manure excretion coefficien, the livestock farms' wastes generation coefficient is as the following table.

Table3.3-1 Livestock manure excretion coefficient kg/d

Species	Dung excretion coefficient,（kg/d）	Average value（kg/d）	Amounts（million ton）	Urine excretion coefficient,（kg/d）	Average value（kg/d）	Amounts（million ton）
pig	3.50-5.00	4.25	81.35	4.66-5.00	4.83	92.45
beef	23.87-25.00	24.44	52.64	10.00-11.10	10.55	22.72
cow	30.00	30.00	73.58	11.10	11.10	27.22
sheep	1.30-2.66	1.98	18.54	0.43-0.62	0.53	4.96
chicken	0.12-0.15	0.14	36.24	——	——	——

Table 3.3-2 Average content of pollutants form the livestock and poultry faeces kg/t

Species	TN	TP	BOD_5	COD	NH_3-N
Pig Dung	5.88	3.41	37.30	52.00	3.08
Pig Urine	3.30	0.52	5.00	9.00	1.43
Beef Dung	4.37	1.18	24.53	31.00	1.71
Beef Urine	8.00	0.40	4.00	6.00	3.47
Sheep Dung	7.50	2.60	4.10	4.63	0.80
Sheep Urine	14.00	19.6	4.10	4.63	0.80
Chicken Dung	9.84	5.37	47.87	45.00	4.78

The faeces from the livestock farming is 26200 ton in Hebei province in 2012, urine is 14700 ton, N, TP, BOD5, COD ,NH3-N from these waste reached 2.3 million ton、83500 ton、8.62 million ton、11 million ton、964000 ton。

The planning of the "twelve five-year" in Hebei Province raise that, "Hebei Province will expand the percentage of the livestock and fruit industry, livestock industry in total agricultural output value to 48% ", The Planning about the development of modern agriculture in Hebei province raise that, establishing the predominance area of livestock and poultry products; place dairy farming industry in Shijiazhuang, Tangshan, Baoding, Handan; Pig industry in Shijiazhuang, Hengshui, Baoding, Tangshan, Handan. So the livestock and poultry breeding will keep rising trend in Hebei province during 2015 ~2020.

3.3.2 Management situation

Our survey found that the farm in Hebei Province existing the following problem：

（1）60% of the farms are lack of the facilities to separate the solid from the wastewater. Livestock and poultry breeding will produce a lot of waste, the amount of waste from a single pig is equivalent to that from 14 people, and the amount from an ox is equivalent to 20 people. The method of water cleaning requires a large amount of water, thus producing large amount of wastewater and the large investment.

The Technical policy of preventing pollution for livestock and poultry breeding （HJ/T81-2001）demands the farm use dry method for manure cleaning but the reality is that the small and medium-sized farms is difficult to meet the requirements.

（2）the use rate of intensive farms pollution control facilities is less than 30% in total.

Because the function of the water pollution control facilities with a high investment and operation cost, so many farms had no construction of pollution control facilities, or the facilities were not running. The sewage quality can’t meet emissions standards or direct discharge of untreated wastewater.

（3）Part of the big farms do not have enough farmland to deal with their manure.

The big, intensive livestock raising makes the large amount of emission of the livestock waste, exceeding the proper application rate to the farmland; but on the other hand, because the farms’ site selection were in the nearby suburbs of the city , the area of farmland is much less, causing the situation that the livestock waste can not be accommodated by the farmland. Such situation is more severe for the smaller farmers.

At present, There are several ways of the treatment of livestock and poultry manure：

①Fertilizer conversion technology

There is lot of nutrients which consist of crude protein, crude fat, crude fiber, calcium, potassium, phosphorus and minerals, nitrogen in livestock and poultry manure, which can be converted into good organic-inorganic fertilizations for green pollution-free food after treatment process to reduce the amount and harmful elements.

Although the scale of the organic fertilizer production has developed rapidly in China, but there is only 10% of total farmland using organic fertilizer.

With the policies promoting the use of the organic fertilizers, the demand for organic fertilizer has great potential in the future, the usage of the organic fertilizer will reach 310 million t, 30% of fertilizer sales.

According to the survey data of organic fertilizer production, only 2%~3% of the livestock manure is made into organic fertilizer.

②Feed conversion technology

The livestock and poultry manure has high content of nutrients with crude protein, minerals and trace elements. It has large nutrition for poultry and aquaculture. Through the high temperature and pressure, heating, sterilization and deodorization process, manure can be made into powder feed additive.

Because of livestock and poultry in the breeding process using various additives, most of them are remained in the manure used as feed, may causing the feed quality exceed the standard even causing poisoning problem, so the developed countries do not advocate using livestock manure processing feed, there is 1%of manure makes into feed.

③Energy conversion technology

Biogas production using anaerobic bacteria, organic substance, carbohydrate, protein and fat conversion to methane or carbon dioxide by anaerobic digestion. It plays an important role in the treatment of livestock and poultry manure and relieving the demand pressure for energy.

④Returning to the farm

According to the survey, livestock and poultry manure is returned to the farmland as fertilizer in most areas in China. The chicken manure and sheep manure can be returned to the field directly for it’s less water content, the pig manure and cow manure need to be processed with solid-liquid separation, then the dry material can be returned to farmland. According to the survey, all the chicken manure and sheep manure can be returned to farmland basically. Because of many problems such as transportation, the pig manure and cow dung returning rate is 30-50%, the rest piled on the farm or in cesspools, causing the soil, groundwater, and surface water pollution. In addition, the direct returned manure can be difficult to meet the requirements of technical requirement for non-hazardous treatment of animal manure（NY/T 1168-2006）.

The above data show that, application or discarded directly are the main way to cope with livestock and poultry manure in China, but with the problem of seasonal restrictions and the groundwater pollution. Thus it is urgent to develop proper technology for energy conversion and fertilizer conversion to tackle this problem.

3.4 Straw management status

3.4.1 The amount of straw resources

Hebei Province is one of the major grain producing areas in China. The crop planting area reached 0.13 billion mu in 2012, the wheat planting area reached 83.62 million mu, the corn planting area reached 81.15 million mu, the cotton planting area reached 14.64 million mu, the amount of straw reached 38.43 million tons.

From the year of 2000, the corn yield of Hebei presented increasing trend, till the year of 2014, the corn yield reached 16.49 million tons, and growth rate has averaged 4% a year.

The planning of the "twelfth five-year" in Hebei Province raise that,” improve and implement to make the farmers richer, develop the modern agriculture, implement the plan of grain production, to ensure the grain production capacity increase steadily during the "twelfth five-year".

The maize yields will be continuing to rise in the future. In the year of 2012, the maize yields will reach 16.49 million, growth has averaged 4.4%. In the year of 2015, the maize yields will reach 18.76 million. In the year of 2020, the maize yields will reach 20 million. The amount of straw resources is increasing in the overall trend.

3.4.2 Straw utilization status

At present, the main way of straw utilization consists of energy conversion, returning to the field, feed conversion and industrial raw materials conversion.

The way of straw utilization is different in areas for the area’s different level of economic development and different industrial structure.

(1) returning to the field

There are two ways of straw returning to the field, including mechanical crushing plugging returning and covering returning. The first way is farming the mechanical disintegration straw into the soil. The other way is covering the straw in surface.

The way of returning to the field represents 26% of the total utilization rate.

（2）feed conversion

The straw is an important source of roughage for the herbivorous livestock, from ensiling and ammoniating reaction to make straw feed. The way of feed conversion is 15% of the total utilization rate.

（3）Industrial raw materials conversion

As a native fiber, the straw fiber has excellent biodegradability. It is widely used as pulpwood, insulation material, packing material, lightweight panel materials. According to the survey, the way of industrial raw materials conversion is not common, so we do not list the statistical range.

（4）Incineration and waste

According to the survey, some farmers burn the surplus straw directly after they collected enough straw fuel. It is 15% of the total utilization rate.

3.5 The current situation of household fuel in rural area

The energy consumption in rural area includes living consumption and production consumption. According to the rural energy statistics yearbook, in the year of 2011, the energy consumption in rural area is 58.96 million ton standard coal.

3.5.1 Consumption for Living

Coal is the main source for energy consumption for daily life, because of the space heating demand in winter; secondly is the electric energy. In recent years, with the development of the rural economy, the demand for electricity in the rural area is rising rapidly.

In terms of the non-commodity energy source for daily life, straw is the most important source of energy, accounting for more than half. The forest residue used as firewood mainly is used in the rural areas of mountainous region, as new energy, biogas and solar energy has a rising trend. In addition, with a large number of commercial biogas digesters, biogas will be widely used with low price and clean energy in rural area.

3.5.2 Consumption in Production

Coal is the main fuel for heating in rural area, which is in line with the energy consumption structure in Hebei Province, which cause severe pollution to the air quality. With the continuous investment and rise of the environmental awareness, in recent years, the share of electricity in the energy consumption in f rural area is rising rapidly. The use of firewood is more than that of the straw, which is different from the household energy consumption structure in Hebei.

There is a big room for the increase of the share of household energy consumption in the whole energy structure in Hebei, which provides a good opportunity for the conversion of the straw into the bio-gas.

According to the Year Book of the Energy Statistical Information in Rural Area in China, up to 2012, there are totally 2.74 million bio-gas tanks providing bio-gas to 2980482 households

which accounts for 18% of the total ; the total yield of bio-gas in Hebei is 87650.84 X 104 m3; there are 2819 big-medium size bio-gas works producing 17.43 million m3 per year.

3.6 The Current situation of fertilizer usage

In the 60 years since China establishment, the usage of fertilizer is increasing continuously. It makes great contribution to the development of agriculture. Now China is the biggest fertilize user in the world.

According to *Hebei Economic Yearbook in 2011*, in the year of 2011, the total area of farmland in Hebei was 6.31million hectares, accounting for 5.19% of the country's total. In the year of 2013, the usage of fertilizer was 3.29 million ton, to compare with 2012(3.29 million ton), the growth was slowing down.

Table 3.6-1 Statistical results of fertilizer usage

Fertilizer usage（million ton）	2005	2010	2011	2012	Growth rate in 2011(%)
Total	3.03	3.23	3.26	3.29	1.06
Nitrogenous fertilizer	1.55	1.53	1.52	——	-0.43
Phosphate fertilizer	0.49	0.47	0.47	——	-0.44
Potassium fertilizer	0.24	0.27	0.27	——	0.78
Compound fertilizer	0.75	0.96	0.99	——	4.26

*The data is short of fertilizer usage in 2012.

Census figures show that, consumption of fertilizer has a growing trend in Hebei; nitrogenous fertilizer usage has reached 67% of total.

The proportion of phosphate fertilizer consumption and potassium fertilizer consumption is 1：0.49~0.57, to compare with the proportion of developed country (1:0.4~0.45), the structure of energy consumption in China calls for further restructuring.

3.7 Respiratory disease

As a resource-based industrial province, there are lots of resource enterprises distributed in Hebei Province, such as Mines, steel mills, coking plant and cement factory.

The major businesses and residents energy is from coal, this type of energy consumption structure causes serious air pollution. The regional air pollution is a typical coal smoke pollution which consists of SO_2, NO_x and particulate matters.

The epidemiologic study shows that, there is a close relationship between air pollution and respiratory disease. In the year of 2013, when the project area be

suffered in haze weather, the respiratory disease patient had a fourfold increase. The number of respiratory disease patient in the heating period is significantly larger than the non-heating period.

4. Contents of Project

4.1 Construction content and scale

Hebei Rural Renewable Energy Development Demonstration Project is a large-scale biogas project which contains about 10 subprojects. There are 6 subprojects in the first batch of the project, including Laoting, Yutian, Zunhua, Chengde, Linzhang and Anping, and the second batch includes Jizhou, Longhua, Luanxian which have been included in the Environmental Management Framework (EMF). The first batch of the project include 47 newly-built biogas digesters and enjoy a total effective volume of $12.1\times10^4 m^3$, a daily biogas production of $12.86\times10^4 m^3$ and an annual biogas production of $4282.97\times10^4 m^3$. $22.94\times10^4 m^3$ tons of straws and $24.16\times10^4 m^3$ tons of livestock manure will be used every year to produce solid and liquid organic fertilizer at 7.91×10^4 and 12.02×10^4 tons, respectively. The produced biogas can offer 9.61×10^4 households for cooking and heating, and offer vehicle gas for bus or taxi; in addition, the bio-gas will be used for heating the digesters. The construction scale is shown in table 4.1-1.

Table 4.1-1 Composition of Hebei Rural Renewable Energy Development Demonstration Project

No.	Name	Location	Biogas system	Organic fertilizer production system	Generating systems	Gas supply service scope	Gas filling system
1	Laoting subproject	Located in Hantuo village, Laoting town, Laoting county	First batch of the project: a set of apparatus with biogas fermentation, purification and storage, and over-flow gas torch is built, including 16 fermentation tanks (total volume: 32110 m^3). Second phase of the project (screened into EMF): Xinzhai Town, Matouying Village, Ningzhuang Village substations and offsite CNG filling station. Each substation is equipped with two anaerobic fermentor tanks (total volume: 2414 m^3), a 1000 m^3 double-film waterless gas tank with appropriate auxiliary facilities for production and life and gas pipelines. The annual production capacity of biogas is 904×10^4 m^3 with 4.38 million m3 to supply 20,000 households CNG is265.47×10^4 m^3.	A set of organic fertilizer production system is built. The annual production capacity of biogas residue fertilizer is 15500 tons and biogas liquid is 11000 tons. it will use the silage at 74900 t/a.	——	biogas compressor and the corresponding main gas pipelines 36.1 km and linking pipeline 216 km to supply 20000 households	2 CNG filling station with a compressor，two sets of gas filling machines and four gas storage wells (screened into EMF)
2	Yutian subproject	Located in Ruanzhuangzi village, Guojiatun town, Yutian	A set of apparatus with biogas fermentation, purification and storage, and over-flow gas torch is built, including: 6 mesophilic anaerobic fermentation tanks (total volume: 19200 m^3), The annual production capacity of biogas is 699.3×10^4	A processing workshop of organic fertilizers, a solid and a liquid organic fertilizer production system.	——	2.997 million m^3 /a biogas is supplied for 15000 households in the radius of 3 km. The main pipes of 107.95 km will be	——

No.	Name	Location	Biogas system	Organic fertilizer production system	Generating systems	Gas supply service scope	Gas filling system
		county	m^3, where 299.7×10^4 m^3 will be supplied to 15000 households, and the $159.84X10^4$ m^3 for biogas boiler and 2.3976 million m3 for nearby industrial use.	The annual production capacity of solid organic fertilizer is 0.53×10^4 tons, liquid fertilizer 14.05×10^4 tons. It will use the livestock manure at 116,200 t/a.		made, and 321.1 km linking pipeline, and 14 gate stations.	
3	Zunhua subproject	Located in Xixindianzi village, Baozidian town, Zunhua county	A set of apparatus with biogas fermentation, purification and storage, and over-flow gas torch is built, including 16 fermentation tanks (total volume: 17600 m^3). The annual production capacity of biogas is 802×10^4 m^3, where 4 million m^3 is for nearby households,and CNG 2.26 million m^3.	A processing workshop of organic fertilizers, a solid fertilizer production system. The annual production capacity of solid organic fertilizer is 2.55×10^4 tons. It will use 18000 t/a silage, 20,000 t/a straw, 30,000 t/a livestock manure	——	4 million m^3 biogas is supplied for 20000 households. The main pipes is 92 km and linking pipeline 320 km.	——

No.	Name	Location	Biogas system	Organic fertilizer production system	Generating systems	Gas supply service scope	Gas filling system
				and 25,000 t/a mushroom residue			
4	Chengde subproject	Located in Beigushan village, Sangou town, Chengde county	8 anaerobic fermentation tanks (total volume: 20000 m^3, The annual production capacity of biogas is 541.23×10^4 m^3, where 385.59×10^4 m^3 will be purified into 2.6509 million m3 purified biogas per year. 2.1195 million m3 purified biogas will be supplied to 14060 households, and 0.5314 million m3 purified biogas for Sangou Town High School and industries. The remaining 0.6889 million m3 biogas will be used to heat the raw material, and 0.8675 million m3 biogas for the fertilizer workshop.	A processing workshop of organic fertilizers, a solid and a liquid organic fertilizer production system. The annual production capacity of solid organic fertilizer is 6230 tons, liquid fertilizer 1.14×10^4 tons and biogas liquid fertilizer 3.08×10^4 t. It will use the silage at 42700 t/a.	——	2.1195 million m^3 biogas for the use by 14060 households. construction of trunk pipe 53.2 km and linking pipe 70 km, and 25 gate stations.	——
5	Anping subproject	Located in the south of Dongzhaizi village, Anping	6 fermentation tanks (total volume: 28200 m^3). Annual biogas production is 10.5256 million m^3. 5.3144 million m^3 /a for households and 2.866 million m^3/a CNG will be produced, construction of 1	2 organic fertilizer processing workshops, a set of solid organic fertilizer production system for each	——	5.3144 million m^3/a biogas is supplied for 20000 households. construction of trunk pipe 1 km, and linking	A CNG station, a set of natural gas equipment for purification and compression, two

No.	Name	Location	Biogas system	Organic fertilizer production system	Generating systems	Gas supply service scope	Gas filling system
		county	CNG gas filling station. A 2000m^3/d sewage treatment station (not using WB loan)	workshop, for production of 12954 tons/a solid fertilizer and 33215 t/a liquid fertilizer, it will use silage 14600 t/a and livestock manure 86900 t/a.		pipe 9 km, and 6 gate stations.	sets of filling equipments (screened into EMF)
6	Linzhang subproject	Located in the Modern Agricultural Demonstration zone, Linzhang county	4 fermentation tanks (total volume: 10000m^3) The biogas production is 283.84 ×10^4 m^3/a, including 153.3×10^4 m^3/y for households, 45.84×10^4 m^3/y for heating in plant, and the remaining for the biogas generator and hot-blast stove of organic fertilizer.	An organic fertilizer processing workshop, A set of solid and a liquid organic fertilizer production system. Production of solid organic fertilizer is 1.31×10^4 tons/a and liquid fertilizer 20000 t/a. it will use silage and straw at 21167 t/a.	The project is equipped with 2 sets of 100 kW biogas generator (gas consumption: 5079m^3, power generation: 2665kw). The electric power is self-used.	153.3×10^4 m^3/a biogas is supplied for 7000 households construction of 30 km trunk pipe, and 21 km linking pipe.	——

Note: As the location of the gate stations are not determined yet, the EA for the gate stations has been included in the EMF.

4.2 Construction scheme

The first batch of this project includes 6 subprojects, and the engineering facilities include collection and storage of raw material, pretreatment, biogas production, biogas utilization, biogas residues and liquid utilization and so on.

he overall scheme of project is shown in table 4.2-1.

Table 4.2-1 Construction scheme of Hebei Rural Renewable Energy Development Demonstration Project

Item	Subproject	Raw material collection, storage and pre-treatment	Biogas production facilities	Biogas use facilities	Fertilizer production facilities	Misc. structures
1	Anping	One silage yard, total volume 23000 m3,; one mixed feeding workshop with the area 129 m2.	6 CSTR digesters, total volume 28200 m3; 2 double film gas storage tanks with total volume 1500 m3; one desulferization workshop, 99 m2.	One biogas purification workshop, 90 m2; one pressure boost station, 240 m2; trunk pipe 1 km, linking pipe 9 km, and 6 gate stations.	One biogas liquid tank, 2700 m^3 ; solid-liquid separation chamber, 96 m2; solid organic fertilizer workshop, 850 m2; product warehouse, 500 m2; raw material warehouse, 540 m2; one liquid organic fertilizer workshop, 500 m2.	One laboratory, 32.4 m2; One central control room, 54 m2, one power control room, 32.4 m2; one toilet, 32.4 m2; one guard room, 64.8 m2.
2	Yutian	Two conditioning tanks, 350 m3 (collection of manure and conditioning quality of wastewater)	6 middle temperature digesters (3200 m3); control system	Biogas purification equipment; biogas compression equipment; 2 set of biogas storage and delivery equipment, 5000 m3 (including torch);one biogas heating equipment (including heat exchanger); two tankers for CNG transportation; 14 sets of cylindrical gas storage boxes; household meters, 15000; trunk pipe 107.95 km, linking pipe 321.1 km, 14 gate stations.	One wastewater treatment station (including 3000 m3 aerobic tank); two sets of solid-liquid separation equipment; organic fertilizer equipment, 16 t/d; liquid fertilizer equipment, 40 t/d.	Functional building, 650 m2: purification workshop, 80 m2; boiler house, 150 m2; mechanical maintenance chamber, 48 m2, power distribution chamber, 64 m2, guard room 13.5 m2, equipment warehouse, 48 m2, management office, 200 m2
3	Zunhua	Silage pool, 25600m3，raw material warehouse, 5000 m2 ，raw material reception and mixing chamber, product outlet chamber	16 anaerobic digesters, (each 1100 m3), 2 inoculums storage tanks (each 796 m3).	Biogas purification workshop, 120 m2; biogas purification equipment, trunk pipe 92 km, linking pipe 320 km.	8 aerobic composting tanks, each 1050 m3; window yard, 6000 m2; solid fertilizer production workshop, 2000 m2; compost storage house, 1500 m2, fertilizer products warehouse, 1500m^2	Administrative building, 1800 m^2 , laboratory 310 m^2, central control room 50 m^2, boiler house 144 m^2, firefighting pump chamber 30 m^2, guard room 30 m^2, fire fighting tank 1200m^3

Item	Subproject	Raw material collection, storage and pre-treatment	Biogas production facilities	Biogas use facilities	Fertilizer production facilities	Misc. structures
4	Linzhang	Equipment warehouse,420 m2, silage pool 37000 m^3	4 digesters, materials inlet 60m^3、pump pit 60 m^2、material inlet tank 50 m^3、outlet pumping chamber 50.24 m^2、material inlet chamber 240 m^2	2 bases for wet gas storage tank,2wet gas storage tanks, pressure boost room 43.2 m^2、power generation room 144 m^2、boiler house 144 m^2，trunk pipe 30km，linking pipe 21km.	Biogas liquid tank 648m^3、solid-liquid separation room 108 m^2、solid fertilizer production room 1410 m^2、liquid fertilizer production room 1260 m^2、fertilizer products storage room 750 m^2、drying yard 4700 m^2	Fire fighting pump chamber 82.8 m^2、fire fighting water tank 500m^3、wall 570m, pump chamber 43.2 m^2、
5	Chengde	Silage pool 10200m^3, straw crushing yard 500 m2, two material inlet chambers (each 60 m3), two pump pits (each 60 m2)	8 digesters	4 bases for gas storage tanks, gas purification workshop 100 m^2, gas purification room 440 m^2, canning room 400 m^2，trunk pipe 53.2km，linking pipe 70km，gate stations 25	Solid-liquid separation room 100 m^2，solid fertilizer production room 1500 m^2，solid-liquid separation tank 845 m3, biogas liquid tank 800 m3, drying yard 1400 m2, liquid fertilizer production room 1160 m2, warehouse 2320 m2.	Boiler house 180 m2, fire fighting pump room 20 m2,
6	Laoting	Silage pool in Hantuo , 66111 m^3; silage pool in Jiangge, 11000 m^3, silage in other tree sub-stations, each 8250 m3.	Material inlet room, 324m2; returning biogas storage tank 1800m^3, bases for digesters 1522.9m^3	Gas purification room 680 m^2, bases for double-film gas tank 648.01m^3，one purification equipment, shed 360 m2, two CNG filling stations, gas filling island and shed 1008 m2, trunk pipe 36.1 km, linking pipe 216 km.	Solid fertilizer production room, 1200 m^2; liquid fertilizer production room, 900 m^2; dewatering room, 618 m^2; biogas residue tank 1500 m3;bio-gas liquid tank 1880m^3	Office building 1120 m^2，boiler house 595 m^2，fire fighting pump room 112.5 m^2，power distribution room 210 m^2，guard room 32.5 m^2，warehouse 1200 m^2，mechanical maintenance room 700 m^2，fuel shed 350 m^2

4.3 Description of project process

4.3.1 Biogas process

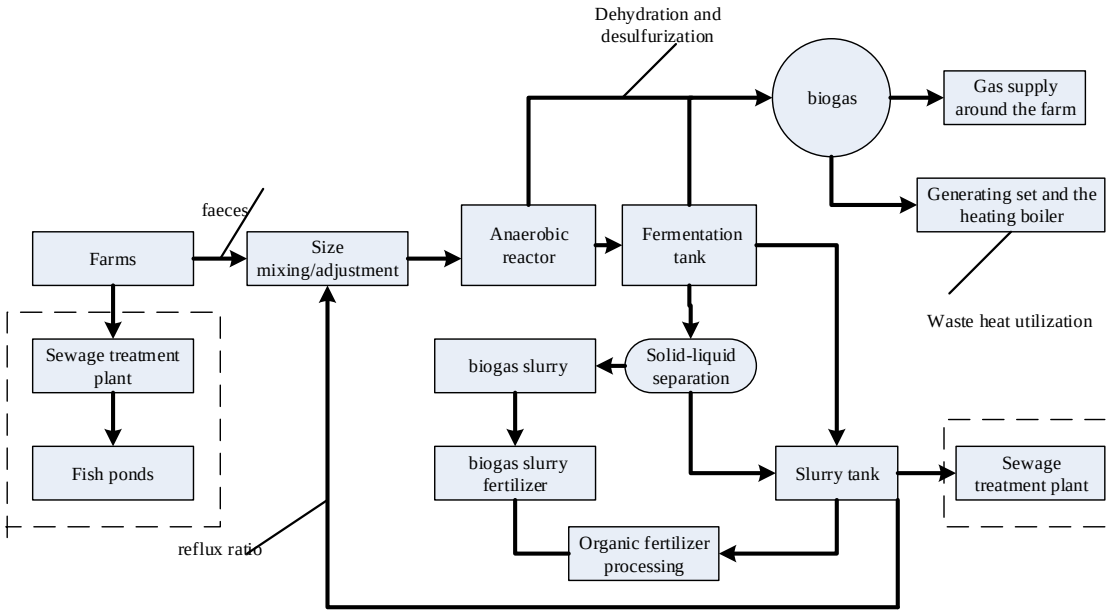
According to the characteristics of the types of raw material and fermentation processes, 3 processes are applied in the 6 subprojects including: CSTR process, vertical flow anaerobic digestion process, and plug-flow dry-fermentation process, as follows:

1） CSTR process

CSTR process is applied in the regions of Anping and Yutian due to its mature and steady in technology.

The mixing device set inside the CSTR process enable the reactants mixed completely and the temperature distributed evenly. CSTR process has the following features, such as admission of high TS materials, high automatic degree, simple operation, and high gas-production rate.

CSTR process flow diagram is shown in Figure 4.3-1.



Notes: contents in the dashed box are specific parts for some subproject

Fig. 4.3-1 CSTR process flow chart

2）Vertical flow anaerobic digestion process（VPF）

Straw is the main raw material to build the engineering of biogas supply for the three subprojects of Linzhang, Laoting and Chengde. TheVPF is selected.

The maize straw is high in carbon, which consists of lignin, cellulose, pectin, waxiness and other chemical compounds. The carbon-rich material has a higher ratio of C: N. Therefore, the decomposition speed is slower in biogas fermentation and the fermentation period is longer. So the VPF and the mesophilic fermentation are

selected.

VPF process flow diagram is shown in Figure 4.3-2.

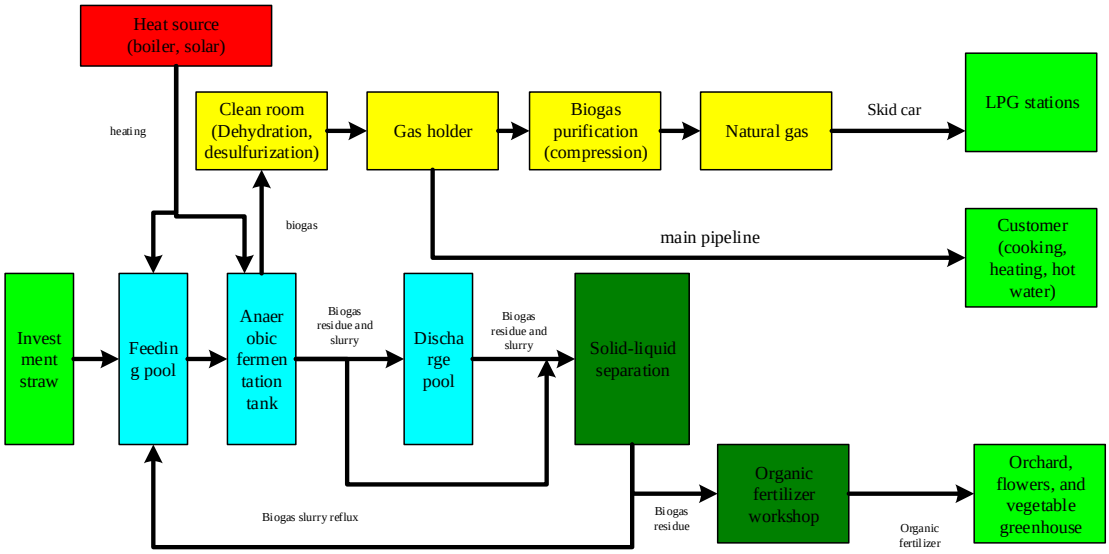


Figure 4.3-2 VPF Process flow diagram

3) Garage-style dry-fermentation process

The raw material of Zunhua subproject is a mixed material which mainly contains livestock manure, straw supplemented. The garage-style dry fermentation process is used for the subproject.

The main raw materials for fermentation of the project are chicken manure and silage straw. The dry matter in chicken manure and straw silage are 55% and 90%, respectively. Both of them are relatively high，therefore, anaerobic fermentation process of high concentration is used. If we use wet high concentration fermentation，more water is needed，and then more biogas liquid is obtained. The results are increase the cost of running first, and then increase the difficulty of subsequent processing for biogas liquid, which is not useful for the continuous running and the subsequent development of the project. Therefore, dry-fermentation process is the optimal process for the raw material with higher dry matter.

Garage-style dry-fermentation Process flow diagram is shown in figure 4.3-3.

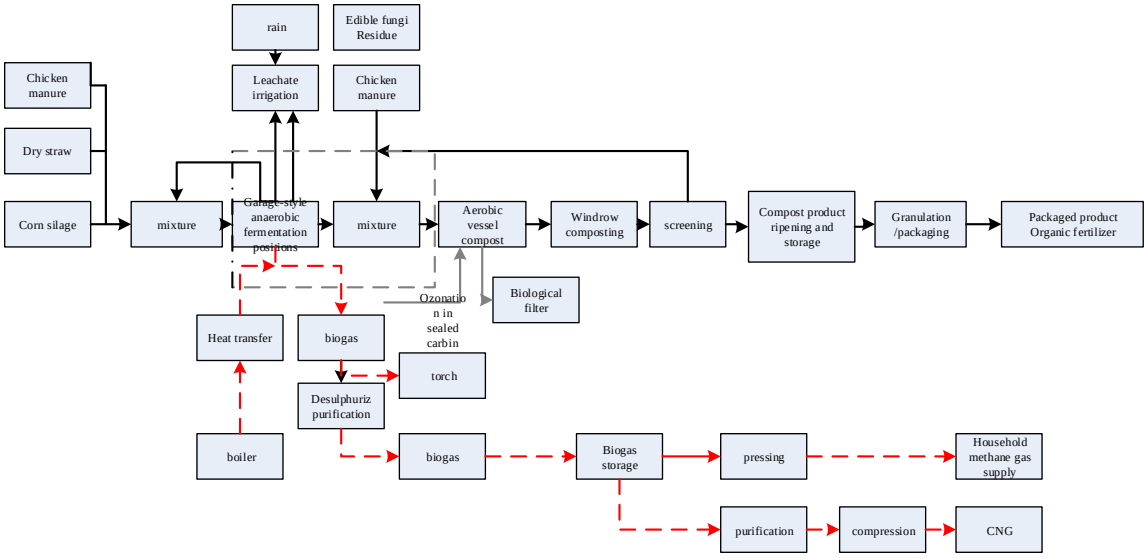


Figure 4.3-3 Garage-style dry fermentation process flow diagram

4.3.2 Biogas desulfurization purification process

The biogas produced by anaerobic reactor is a mixed gas with saturated steam, including gas fuel CH_4, inert gas CO_2, H_2S and suspended granular impurities. H_2S is poisonous and has serious corrosives. Therefore, the new produced biogas should not be used for fuel directly. There are more purification treatments are needed, such as steam-water separation, desulfurization and so on. The biogas desulfurization is the main problem.

H_2S content in the biogas for purification and household must less than 6 mg/m^3. Therefore, the desulfurization purification treatment for biogas is necessary.

4.3.2.1 Purification process

Purification process could be carried out via 4 methods, including adsorption, pressure swing adsorption, cryo-condensation, and membrane separation.

1. Adsorption purification

Adsorption method is applied in 3 subprojects, such as Zunhua, Anping and Linzhang, because of its maturity and steady.

The adsorption process could be accomplished using the physicochemical absorption properties between amine solution (primary amine, secondary amines, tertiary amine and steric hindrance effect) and CO_2. Under the condition of compression and ambient temperature, CO_2 in biogas is absorbed. Under decompress and heating condition, the adsorption process occurred in the regeneration tower, leading to the purified CO_2 released from the concentrated solution, as well as the regeneration of the solution. The regenerated solution can absorb CO_2 again, and realize the continuous process of biogas decarbonization and methane purification.

And also the decarbonized solution could absorb and regenerate, continuously.

2. Pressure swing absorption

The method is used to purify the fermentation biogas in the subprojects of Yutian and Chengde.

Pressure swing absorption method uses the selective adsorption characteristic of absorbent (such as molecular sieve) to carbon dioxide. In other words, carbon dioxide has higher separation factor on the adsorbent compared with other Gaseous components and is easy to remove from biogas. In the process of adsorption，the carbon dioxide from raw material is adsorbed in the adsorption tower under the condition of pressure. Methane and other weak adsorption gases are discharged as purified gas. Decompressing the adsorption column and even vacuumizing it to release the adsorbed carbon dioxide after the adsorption is saturated. To ensure the sequential treatment of the gas, two adsorption towers are needed at least, or more, for pressure swing absorption method.

3. Membrane separation purification

Laoting subproject applies the dehydrated biogas, which is obtained by membrane separation purification.

This purification method is achieved through the different membrane permeability of gas components under pressure-driven. Usually, the carbon dioxide seepage velocity is rapid and is discharged as fast gas in the form of transmitted gas, while methane seepage velocity is slow and the purified gas product is obtained as low gas in the form of remaining gas. In engineering, multi-stage membrane separation technology is often adopted in order to improve the concentration of methane gas.

4. Cryo-condensation purification

Cryo-condensation purification method considers the characteristic of carbon dioxide. The liquefaction temperature of carbon dioxide is high. Thus, the carbon dioxide in the biogas is liquefied through low temperature and methane is discharged as non-condensable gas in the form of purified gas product. Heat recovery technology is often used to recycle the remaining energy, which contributes to decreasing operational energy consumption.

Table 4.3-1 Comparison of different biogas purification technology

project	Absorption	Pressure swing adsorption	Cryo-condensation	Membrane separation
Methane recovery	high	medium	higher	low
Purified methane concentration	high	high	high	higher
Regeneration gas purity	high	higher	high	medium
Operational energy consumption	medium	low	high	low
Equipment Investment	medium	higher	high	high
Technology maturity	high	high	medium	low

Biogas purification engineering mainly adopts the absorption and pressure swing adsorption. Cryo-condensation and membrane separation is rarely applied due to technology maturity and economical, etc.

4.3.2.2 Desulfurization process

Biogas desulfurization mainly includes biological desulfurization and chemical desulfurization.

1. Biological desulfurization: The colorless sulfur bacterias, such as thiobacillus thiooxidans, thiobacillus ferrooxidan, etc., are used in this method. The H_2S is oxidized to sulfur under micro-oxygen condition. This desulfurization method has been widely used in the German biogas desulfurization and some engineering in the domestic have also been applied. The advantages of this method include no catalyst, no-dealing with chemical sludge, little biological sludge, low consumption, recycling sulfur, high removal efficiency. The key technology of desulfurization is how to control the redox processes in the desulfurization tower according to the H_2S concentration.

This technology is suitable for engineering of large scale and high sulfur in gas. Subprojects of Chengde, Laoting and Anping apply this method to desulfurization.

2. Chemical desulfurization: The biogas is passed through the desulfurizer bed. The H_2S in biogas contacts with active Fe_2O_3, which generates Fe_2S_3. Then the desulfurizer containing sulfide contacts with oxygen in the air, and iron sulfides are converted into Fe_2O_3 and sulfur in the presence of water. This desulfurization regeneration process can recycle repeatedly until that most of voids on the surface of Fe_2O_3 desulfurizer are covered by sulfur or other impurities and inactivity. The

regeneration Fe_2O_3 can continue removing H_2S in the biogas. The above reactions are exothermic, but the process of regeneration reaction is slower than the desulfurization reaction. The above two process are often separated in engineering in order to make the Fe_2S_3 regenerate to Fe_2O_3 completely.

Chemical desulfurization is suitable for engineering of small scale and low sulfur in gas. Subprojects of Yutian, Linzhang apply this method to desulfurization.

Zunhua subproject uses double desulfurization of "biological desulfurization + activated carbon adsorption" to desulfurization for biogas.

4.3.3 Organic fertilizer production process

The main raw materials of solid organic fertilizer and liquid organic fertilizer are biogas residue and biogas liquid. The specific components of biogas residue and biogas liquid are shown in table 4.3-2.

Table 4.3-2 Biogas residue and liquid composition table

Fertilizer	Organic matter（%）	Amino acids（%）	Total nitrogen（%）	Total phosphorus（%）	Total potassium（%）	Application scope
biogas liquid	/	0.03-0.08	0.02-0.07	0.02-0.06	0.0049-0.01	Biogas liquid can be used directly for a variety of crops as a basal, as well as topdressing
biogas residue	35-50	10-24.6	0.78-1.61	0.4-0.71	0.6-1.2	Biogas residue can be used directly as a basal and can also composting before application.

4.3.3.1 Solid organic fertilizer

There are two types of solid organic fertilizer production process in this project according to different requirements of organic fertilizer.

Subprojects of Anping, Linzhang, Chengde and Laoting adopt direct production process using biogas residue and liquid to produce organic fertilizer. Zunhua subproject mix into livestock manure in the process of production and Yutian subproject needs to add the straw in order to adjust effective components content in the organic fertilizer.

(1) Direct production of organic fertilizer using biogas liquid

The feed liquor is obtained through anaerobic fermentation in reactor. After

discharge, the part of biogas residue is gained by solid-liquid separation. Then the drying biogas residue is transported to solid organic fertilizer production line to make solid organic fertilizer and this solid organic fertilizer can be applied in the surrounding farmland. The solid organic fertilizer production process is shown in figure 4.3-4.

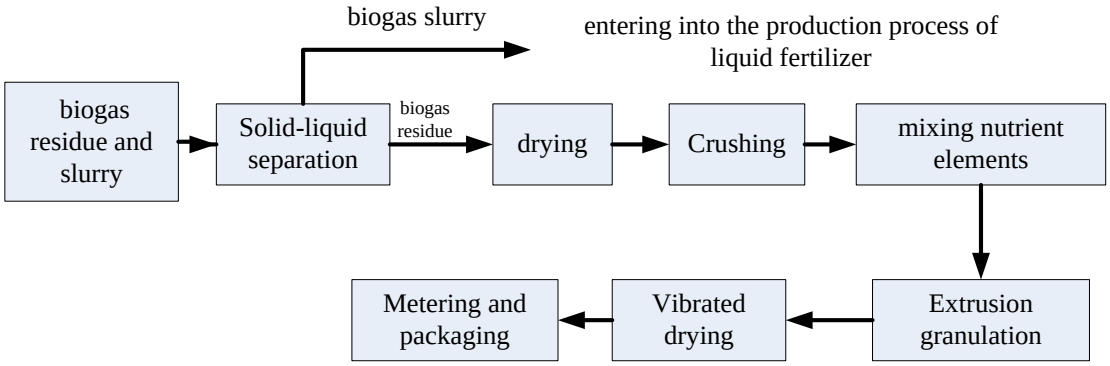


Figure 4.3-4 The solid organic fertilizer production process

①Crushing

The caking part of the biogas liquid is crushed through crusher to make the biogas residue powdered, which facilitate subsequent processing and utilization.

②Mixing nutrient elements

Broken biogas residue is placed into the blender, adding the appropriate number of raw material according to the formula into it, and then stirring until homogeneous to release.

③Extrusion granulation

Homogeneous materials arrive to the belt conveyor through the buffer silo, and then enter into granulator. Granulator creates cylindrical particles.

④Vibration drying

Granulation fertilizers arrive to the vibratory dryer through the belt conveyor. In order to ensure activity of beneficial bacteria and drying effect, it is important to pay special attention to control of the temperature of the air into the dryer and increase air-input amount, so as to bring the steam out of the dryer.

⑤Measuring and packaging

The dried solid particles are finished organic fertilizer. It is packed through the measuring and packaging equipment, and is put into warehouse to store for sales.

（2）Biogas residue produces organic fertilizer after inoculating fermentation.

Linzhang project uses the process of biogas residue producing organic fertilizer

after inoculating fermentation, to meet the existing organic fertilizer product standards of Hebei Runze Zhimin Agricultural Science and Technology Co., Ltd.

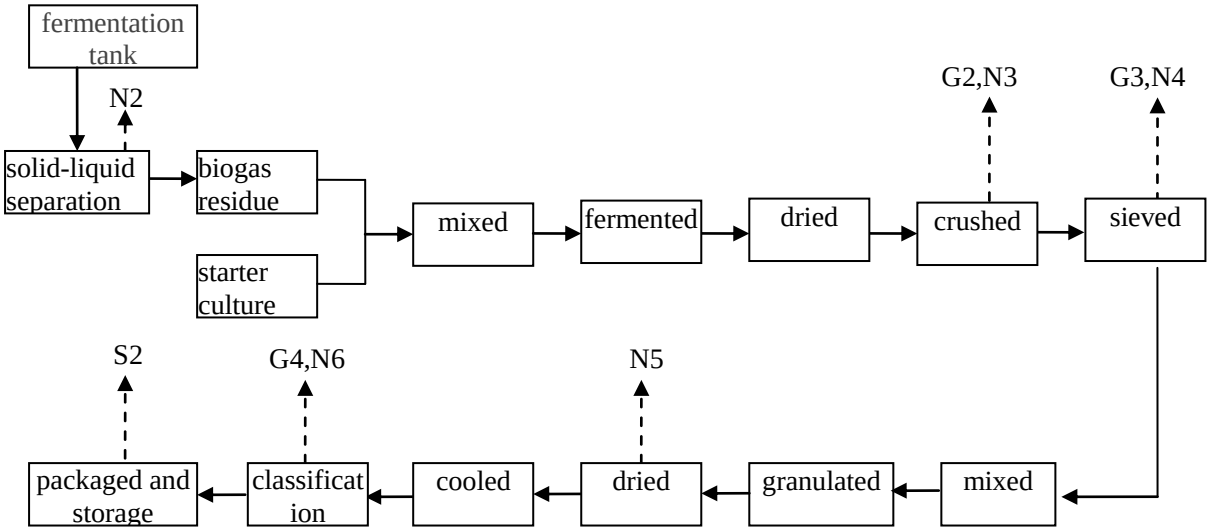


Figure 4.3-4 Production process flow diagram of biogas residue organic fertilizer

①Separation and drying

After fermentation materials are discharged to the solid-liquid separator via rotor pump, the biogas residue fall in the yard, the biogas liquid flows to the pool. Biogas residue after solid-liquid separation is 65% moisture content, transported by forklift to the yard to be dried.

②Inoculation, fermentation

Biogas residue processing system transport biogas residue less than 65% moisture content to organic fertilizer processing workshops using forklifts, then the microbial fermentation bacteria is inoculated, add a variety of nutrient elements and stir well, so that it will fully decomposed by fermentation.

③Mixed nutrients

Decomposed biogas residue is dried, crushed and sieved, then add a certain proportion of humus acid, nitrogen, phosphorus and potassium and other fertilizer elements by measuring transmission belt.

④Extrusion granulation

Homogeneous materials arrive to the belt conveyor through the buffer silo, and then enter into granulator. Granulator creates cylindrical particles.

⑤Vibration drying

Granulation fertilizers arrive to the vibratory dryer through the belt conveyor. In order to ensure activity of beneficial bacteria and drying effect, it is important to pay special attention to control of the temperature of the air into the dryer and increase

air-input amount, so as to bring the steam out of the dryer.

⑥Measuring and packaging

The dried solid particles are finished organic fertilizer. It is packed through the measuring and packaging equipment, and is put into warehouse to store for sales.

(3) Production after adjusting aerobic composting and windrow composting

Zunhua subproject need add livestock manure and ferment to product organic fertilizer in order to meet the standards of organic fertilizer products.

①Aerobic composting in warehouse

Biogas residues discharged from the fermentation tank containing about 35% dry matter mix with bacteria residues and chicken manure to contain about 40% dry matter. The mixture is sent to warehouse for aerobic composting 10-12 days.

②Windrow aerobic composting technology

The fertilizer in aerobic composting warehouse is sent to fermentation workshops to pile into trapezoidal cross-section windrows. Total materials be composted 15 days in fermentation workshops to complete the decomposing process. Thus dry matter concentration can achieve 65% suitable for forming granules.

③Granulation for commercialization

Decomposed organic fertilizer is screened and sent to the granulation workshop by the transmission system. The granules' diameter is 3-5 mm using by extrusion granulation process. These granules become organic fertilizer containing 10%-15% water after drying system (drying temperature more than 100℃) and cooling system. Then the granules go through screening system to classify, the unqualified back to the granulation workshop.

④Testing and packaging

The organic fertilizer granules go through testing and the qualified pass through the weighing and filling system to become bags of commercial organic fertilizer which is stored in warehouse for sale.

4.3.3.2 Liquid organic fertilizer

The matter discharged from anaerobic fermentation reactor goes through solid-liquid separation to obtain biogas liquid. The biogas liquid is stored in solid-liquid separation pool. The biogas liquid as raw material is transported to liquid organic fertilizer production line to make liquid organic fertilizer, which can be applied in the surrounding farmland. The production process of liquid organic fertilizer is shown in figure 4.3-5.

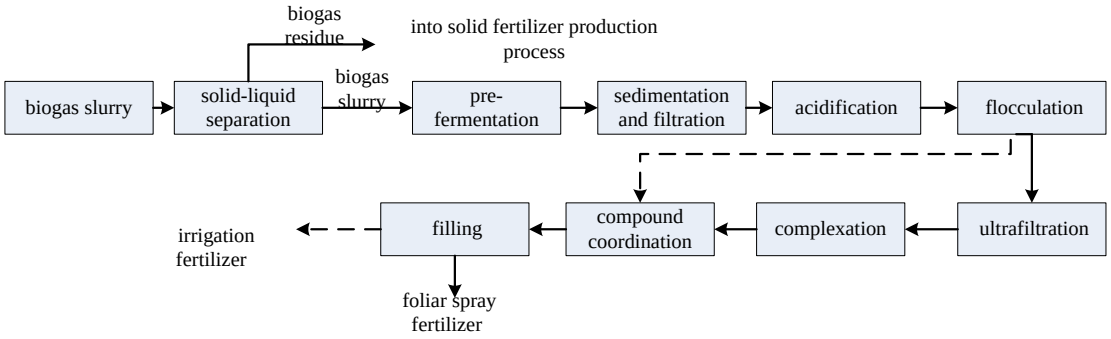


Figure 4.3-5 The production process of liquid organic fertilizer

The production process of liquid organic fertilizer is described as follows:

① Solid-liquid separation

The mixture of the biogas residue and liquid produced by the subproject go through solid-liquid separation machine for primary solid-liquid separation. Then the biogas residue and liquid are separated. The solid portion is to make solid fertilizer. The liquid portion goes through solid-liquid separation machine for secondary solid-liquid separation, which is supported by commercial organic fertilizer system. The suspended solid in the liquid is removed to enter the subsequent production processes for producing liquid organic compound fertilizer. The aperture mesh in primary solid-liquid separation is usually 0.75mm, while pig and chicken feed mostly is fine materials, so the concentration of SS is high and the aperture of SS is small in biogas liquid. Thus in the subsequent organic production line is supported by the solid-liquid separation machine with aperture mesh generally less than 0.25mm.

②Pre-fermentation

The biogas liquid from solid-liquid separation is pumped to pre-fermentation tank for pre-fermentation. A certain amount of spare biogas liquid is stored in the tank to be adjusted according to the requirement of the production efficiency.

③Sedimentation and filtration

According to product categories and requirements of application methods, the particulate matter (aperture mesh ≥0.25mm) is removal from biogas liquid using sedimentation and filtration tower.

④Complex fermentation

The temperature, the stirring speed and the ratio of supplementary material are controlled in the complex fermentation tank to achieve the enrichment of fulvic acid, amino acid and multiple organic acids, according to the product requirements for enrichment of fulvic acid, amino acid, and multiple organic acids.

⑤Flocculation

Biogas liquid flowed from the complex fermentation tank is pumped up to flocculation tank. Flocculating agent and defoamer are added appropriately and stirred. The flocculate is scraped out. The purpose is to further remove the tiny suspended particles and bubbles in the liquid, in order to facilitate the product complexation and compound.

⑥Ultrafiltration

When producing foliar-fertilizer, microparticles in liquid are needed to remove. Then the state of water soluble with the particle size of ≤ 0.1 mm is obtained, which ensure sprinkle-nozzle will not be blocked.

⑦Complexation

Some trace elements, such as Iron, zinc, copper, manganese, molybdenum, selenium, boron, etc, are added to make them complex with humic acid, amino acid and organic acid effectively, according to the requirements of the product.

⑧Compound coordination

A large number of elements are added to chelation, according to different types of fertilizer and different requirements of crop nutrient.

⑨Filling

Fertilizer that after complex formulation is pumped up to finished product tank. The quality of the products should be controlled to prevent the temperature rise, mildew or crystallization, and moderate gas stir is used. Commodity is obtained after filling.

4.4 Component analysis

4.4.1 Biogas component analysis

The main component of biogas is methane(CH_4), which usually accounts for 50%-70% of the total volume,（Methane content varies according to different raw materials. Methane content of fermentation from straw and cow dung mixture is about 55-60%). The second is carbon dioxide accounting for about 30%-40% of the total volume. The rest is hydrogen sulfide, hydrogen and other gases accounting for about 5% of the total volume.

Table 4.4-1 Biogas product index

component ingredient	composition	content (%)	Comment
Main ingredient	CH_4	50-70	
	CO_2	30-40	
Common ingredient	H_2S	＜5	Generally is 0.5-2g/m^3
	H_2		

Notes: Calorific value of per cubic metre biogas is about 21MJ (CH_4 60%), corresponding to the calorific value of 1.45m^3 coal gas or 0.69m^3 natural gas.

According to the rules of *Biogas engineering technical manual* (NY/T1220.2-2006), the quality of biogas produced from biogas engineering need to meet the following requirements:

Table 4.4-2 Biogas quality requirements

Number	Standard content	Standard index
1	Net calorific value	18MJ/m^3
2	Hydrogen sulfide content	20mg/m^3
3	Biogas temperature	≤35℃

4.4.2 Dried dung component analysis

Hebei Rural Renewable Energy Development Demonstration Project includes Anping subproject, Yutian subproject, Zunhua subproject, whose raw materials of biogas devices contain pig manure and chicken manure. Zunhua subproject should add livestock manure in the production of organic fertilizer, so the moisture content and organic matter content will influence the operation effect, and nitrogen and phosphorus content will decide the fertility of the final product (organic fertilizer). Accordingly, this report collected test results of the owners existing pig and chicken manure component in Yutian and Zunhua subprojects, and proceeded composition analysis of the collected manure.

Table 4.4-3 Test results of livestock manure component

Subproject name	Test institutions	Livestock manure types	Test factor	Index amount
Yutian Project	China Agricultural University	Pig manure	Moisture content	71.16%
			Organic matter content (dry basis)	34.9%
			Total nitrogen content	16.18g/kg
			Total phosphorus content	28.71g/kg
			Available phosphorus	8.503g/kg
			Available phosphorus/ total phosphorus content	29.6%
			Total potassium content	4.8g/kg
			Available potassium content	3.797g/kg
			Available potassium/ total potassium	79%
			pH	7.98
Zunhua Project	Hebei institute of microbiology	Chicken manure	TS	25.55
			VS	20.98
			Ash	4.57
			C	38.05
			N	3.19
			H	4.259
			C/N	11.93

4.4.3 Organic fertilizer component analysis

Our country issued *the organic fertilizer* (GB/T 1.1-2002) as the organic fertilizer product quality standard in 2002, and revised it in 2011. The standard set out the appearance of the organic fertilizer, organic matter content, heavy metal content, the death rate of round worn ova, number of fecal coliforms and other indexes. The standard is suitable for organic fertilizer made by fermentation and decomposion from livestock manure as raw material. Therefore it is suitable for Anping, Yutian, ZunHua, LinZhang subprojects, which use livestock manure as raw material to produce organic fertilizer.

The components of high-quality biogas liquid organic fertilizer (containing humus acid soluble fertilizer) and organic fertilizer of Linzhang subproject owner (Hebei Runze Zhimin Agricultural Science and Technology Co., LTD.) are tested by Hebei Province Institution of Supervision and Inspection Product Quality on February15, 2012. Test results are shown in table 4.4-1 and 4.4-2:

Table 4.4-1 Organic manure test results of Hebei Runze Zhimin Agricultural Science and Technology Co., LTD.

Test items	Test results	Standard request
The mass fraction of total nutrient(nitrogen+phosphoric Anhydride+potassium oxide)（according to dry base）	14.6	≥5.0
Total cadmium, mg/kg	1	≤3
Total mercury, mg/kg	0.01	≤2
Total lead, mg/kg	19	≤50
Total chromium, mg/kg	5	≤150
Total arsenic, mg/kg	1	≤15
The death rate of roundworn ova, %	100	≥95
Number of fecal coliforms, colony-forming unit/g	＜3	≤100
The mass fraction of moisture, %	6	≤30
pH	6.5	5.5-8.5
The mass fraction of organic matter, %	56	≥45

Table 4.4-2 Test results of high quality biogas liquid organic manure from Hebei Runze Zhimin Agricultural Science and Technology Co., LTD.

Test item	Test results	Standard request
The mass fraction of total nutrient(nitrogen+phosphoric Anhydride+potassium oxide)	221	≥200
Humic acid content	34	≥30
Total cadmium, mg/ L	4	≤10
Total mercury, mg/L	0.1	≤5
Total lead, mg/L	16	≤50
Total chromium, mg/L	8	≤50
Total arsenic, mg/L	2	≤10
Substances not dissolved in water, g/L	38	≤50
pH	6.5	4-10

Test results show that biogas liquid organic fertilizer and solid organic fertilizer produced by Hebei Runze Zhimin Agricultural Science and Technology Co., LTD. All can meet the current organic fertilizer quality standards.

At present, there are no quality standards for the organic fertilizer produced by agricultural waste composting. Because N, P and K contents of different crops' straw are different, straw nutrient content difference is large. But the organic matter content is 40-70% in general, and the content of humus is 20-40% in general.

5 Major environment impacts and environmental mitigation measures

5.1 Screening of environmental sensitive receptors

5.1.1 Surrounding environment for individual subproject and potential protection objects

Surrounding potential protection objectives of six subprojects are identified statistically by combination of the surrounding environment and EIA, respectively. The results are shown in table 5.1-1.

Table 5.1-1 Surrounding environment for biogas plants and gas filling station

Subproject	Potential Sensitive Receptors		Orientation	Distance
Yutian subproject	Biogas plants	Huangjiashan Village	N	2000m
		Xingshuling Village	NNE	1900m
		Shangzhuang Village	ENE	1300m
		Xiaolizhuang Village	E	2400m
		Ruanzhuangzi Village	SE	1100m
		Xingjiawu Village	S	2500m
		Sijiaoshan Village	SW	1600m
Zunhua subproject	Biogas plants	Xixindianzi Village	NE	400
		Wangjiapu Village	NW	1556
		Qujiapu Village	W	1480
		Zhoujiazhuang Village	SW	2000
Laoting subproject	Biogas plants	Yuzhuang Village	N	930
		Hantuo Village	NW	380
		Gaosun Village	NE	2100
		Xijituo Village	E	870
		Donggaozhuang Village	E	1700
		Xinminju Village	E	800
		Xinzhuanghu Village	SW	2000
		Dongdazhuang Village	SW	1800
		Sanchakou Village	S	2200
Chengde subproject	Biogas plants	Beigushan Village	SW	400
		Gushanxiaofanggou	S	550
		Gushanxigou	W	1100

		Beishuiquan Village	SE	1800
		Beishuiquan primary School	SE	1900
		Dayushugou Village	S	1600
		Dayushugouli	SW	1700
		Fangshengou Village	SE	950
		East Mountainof Fangshengou Village	W	1300
		Saohugou	N	900
		Sujiaying Village	N	1000
		Dachang Village	NW	900
		Shuimo	NW	1200
		Liujiagou	NE	1200
Anping subproject	Biogas plants	Houpu Village	E	1000
		Dongzhaizi Village	NW	1000
		Xizhaizi Village	NW	1200
		Qianpu Village	SE	1200
		Jiatun Village	SW	1600
		Nanzhangwo Village	S	2000
		Zhengjiazhuang Village	SE	2200
		Xiliangwa Village	NE	2300
	Gas filling station	Datongxin Village	NW	400m
		Ligezhuang Village	NE	850m
		Houliuying Village	SE	750m
		Yangmazhuang Village	S	1000m
		Beizhang Village	S	550
Linzhang subproject	Biogas plants	Luo Village	N	835
		Xiwuchakou Village	E	1245
		Haowang Village	SE	1440
		Beizhang Village	S	550
		Beikong Village	SW	705

Table 5.1-2 Surrounding environment for gas pipeline

Subproject name	Potential Sensitive Receptors	Orientation	Distance
Yutian subproject	Huangjiashan Village	N	<200m
	Xingshuyu Village	NNE	<200m
	Shangzhuang Village	ENE	<200m
	Xiaolizhuang Village	E	<200m
	Ruanzhuangzi Village	SE	<200m
	Xingjiawu Village	S	<200m
	Sijiaoshan Village	SW	<200m
	Guangongling Village	SW	<200m

	Rural road	S	<200m
Zunhua subproject	Wangjiapu Village	NW	<200m
	Qujiapu Village	W	<200m
	Xiaocaogezhai Village	E	<200m
	Province highway S356	——	traversing
	Railway Daqin line	——	traversing
	Ditch	——	traversing
Laoting subproject	Dongdazhuang Village	S	<200m
	Wantuo	SE	<200m
	Shao Village	SE	<200m
	Donggaoge Village	E	<200m
	Dongzhuang Village	SE	<200m
	Laomumiao	SE	<200m
	Xigong	SE	<200m
	Xigong	SE	<200m
	Yucai primary school (Shaozhuang Village)	SE	<200m
	Province highway S044	——	traversing
	Tanggang Motorway, Coastal Motorway	——	traversing
	2 rural and county road	——	traversing
	Xiaochanghe	——	traversing
Chengde subproject	Provincial Road S145	——	traversing
	Jing-Shen Expressway	——	traversing
	Laoniu river	——	traversing
Anping subproject	Rural road	E	<200m
Linzhang subproject	Jia Village	W	<200m
	Xidiqiu Village	SW	<200m
	Beizhang Village	SE	<200m
	Shuang miao Village	SE	<200m
	3 rural and county road	——	traversing
	Province highway S212	——	traversing

5.1.2 Determination of environmental sensitive receptors

The longest-distance of environment impact, atmospheric protection distance and health protection zone in construction period and operation period of each subproject, are obtained by the analysis of EIA (The specific data are shown in 5.2 and 5.3). The screening of environmental sensitive receptors for each subproject obtained by analysis is shown in table 5.1-3.

Table 5.1-3 Screening distance of environmental sensitive receptors for each subproject

No.	subproject	The	The longest distance of	Environmental	Environmental

		longest-standard distance of environment impact in construction period (m)		environment impact in operation period (m)		sensitive receptors screening range in construction period (m)	sensitive receptors screening range in operation period (m)
		Noise	Fugitive dust	Atmospheric protection distance	Health protection zone		
1	Linzhang	180	150	0	100	20	100
2	Anping	180	150	0	100	20	100
3	Chengde	180	150	0	100	20	100
4	Zunhua	180	150	0	100	20	100
5	Yutian	180	150	0	100	20	100
6	Laoting	180	150	0	100	20	100

Since the maximum concentration of atmospheric pollutants in each subproject is small and D10% does not appear, distance of the maximum concentration for atmospheric pollutants is not considered. Determination of the environmental sensitive receptors screening range takes into account the environment impacts in construction period of gas pipeline, such as the sensitive spots of surrounding residents and the traversing roadway, irrigation and water conservancy facilities, etc.

5.1.3 Determination of environmental sensitive receptors

The definite screening range in this project is adopted. Meanwhile, the actual conditions of each subproject are considered. Then the environmental sensitive receptors for each subproject in construction period and operation period are determined finally after screening of potential protection objects, and the results are shown in table 5.1-4.

Table 5.1-4 The results of environmental sensitive receptors

No.	Subproject name		Sensitive spots	Orientation
1	Anping subproject	Construction period	Rural road	E
		Operation period	——	——
2	Yutian subproject	Construction period	Huangjiashan Village	N
			Xingshuyu Village	NNE
			Shangzhuang Village	ENE
			Xiaolizhuang Village	E
			Ruanzhuang Village	SE
			Xingjiawu Village	S
			Sijiaoshan Village	SW
			Guangongling Village	SW
			Rural road	S
		Operation period	——	——

3	Zunhua subproject	Construction period	Wangjiapu Village	NW
			Qujiapu Village	W
			Xiaocaogezhai Village	E
			Province highway S356	——
			Railway Daqin line	——
			Ditch	——
		Operation period	——	——
4	Linzhang subproject	Construction period	Jia Village	W
			Xidiqiu Village	SW
			Beizhang Village	SE
			Shuangmiao Village	SE
			3 rural and county road	——
			Province highway S212	——
		Operation period	——	——
5	Chengde subproject	Construction period	Provincial Road S145	——
			Jing-Shen Expressway	——
			Laoniu river	——
		Operation period	——	——
6	Laoting subproject	Construction period	Dongdazhuang Village	S
			Wantuo	SE
			Shao Village	SE
			Donggaoge Village	E
			Dongzhuang Village	SE
			Laomumiao	SE
			Xigong	SE
			Donggong	SE
			Yucai primary school (Shaozhuang Village)	SE
			Province highway S044	
			Tanggang Motorway, Coastal Motorway	——
			2 rural and county roads	——
			Xiaochang river	——
		Operation period	——	——

The environmental sensitive receptors of each subproject in construction period and operation period are determined finally by determining the distance of above sensitive spots to the project and screening the sensitive spots of each subproject. Next, the environment impacts for sensitive spots in construction period and operation period are analyzed briefly.

5.2 Environment impacts and mitigation measures in construction period

5.2.1 Environment impacts in construction period

The project construction and development activities may cause environment

impacts, and these environment impacts mainly include the land occupation for project construction, the influences on soil and vegetation, the construction noise in project construction, the air-borne dust caused by earthworks and transport vehicles in construction period, the construction wastewater, the construction waste in project and domestic waste from workers, etc.

Furthermore, the cultural heritage is divided into ground cultural heritage and underground cultural heritage. The underground cultural heritage means the cultural heritage that has not been excavated. The investigation results of social assessment group indicate that there are no distributions of cultural heritage within the range of the project area.

The specific conditions are analyzed combining with every subproject as follows:

5.2.1.1 Mechanical noise

The major noise sources in project construction period include construction machinery, trailers and so on. Although the noise impact in construction period is temporary, noise will be caused from the mechanical equipment in construction process. If the reasonable regulation is not applied, the machinery noise will bring adverse impacts to the acoustic environment of surrounding area. Table5.2-1 is the Emission Standard of Environment noise for Boundary of Construction site (GB12523-2011).

Table 5.2-1 Emission Standard of Environment noise for Boundary of Construction site (GB12523－2011) unit: dB (A)

Daytime	Nighttime
70dB（A）	55 dB（A）

The noise is relative weak due to the small size of the project and no large-scale construction machinery in pipeline construction period. Adoption of this construction method mainly attributes to constraint conditions in some road section, and only the construction method of manual excavation is taken. Furthermore, bulldozer is the main machinery for backfilling , which can not produce obvious impact to the surrounding acoustic environment.

The construction noise mainly includes sporadic knock, crash from loading and unloading vehicles, yo-heave-ho and so on. These noises are mostly transient noise and the construction vehicle noise belongs to traffic noise.

(1) Forecast calculation

①The superposition formula for noise level benchmark predicted spot

$$L_{pe} = 10 \times \lg\left[\sum_{i=1}^{n} 10^{\frac{L_{pi}}{10}}\right]$$

In formula: L_{pe}—Overall acoustic level after superposition, dB(A)

L_{pi}—Acoustic level from acoustic source to benchmark predicted spot, dB(A)

n— Noise source number

The overall acoustic pressure level from each noise source spot to benchmark predicted spot is calculated using the above formula. Then the noise intensity of benchmark predicted spot is used as project noise source intensity.

② The calculation formula for acoustic pressure level from noise source to a certain predicted spot

The geometric divergence attenuation from acoustic source to acoustic acceptor spot is predicted and calculated by adopting point source attenuation model, not considering the acoustic barrier attenuation, atmospheric absorption, etc. The predictor formula is shown as follows:

$$L_r = L_{r_0} - 20\lg(r / r_0)$$

In formula： L_r —A acoustic pressure level from the acoustic source r, dB(A);

L_{r_0} —A acoustic pressure level from the acoustic source r_0, dB(A);

r— The distance from predicted spot to acoustic source, m;

r_0—The distance of monitoring equipment noise, m.

The above prediction model is adopted to predict the noise contribution of major construction machinery at different distances (Table 5.2-2).

Table 5.2-2 The noise contribution of major construction machinery at different distances

No.	Machinery name	Noise prediction value at different distances (dB(A))								Construction stage
		10m	20m	30m	40m	60m	100m	200m	300m	
1	Bulldozer	75	69	65	63	59	55	49	45	Earthwork
2	Excavator	65	59	55	53	49	45	39	35	
3	Pile driver	70	64	60	58	54	50	46	42	Pile driving
4	Concrete vibratory tamper	80	73	70	68	64	60	54	50	Structure
5	Elevator	65	59	55	53	49	45	39	35	Decoration

③Standard analysis for construction site

The relevant regulations in *Emission standard of environment noise for boundary of construction site* (GB12523-2011) is referred, and the result can be seen in table

5.2-2:

Earthwork construction period: the noise at the distance from construction site 10 m can meet the standard of noise limits in the daytime, while the standard distance is 100 m at nighttime.

Pile driving construction period: The noise at the distance from construction site 10 m canmeet the standard of noise limits in the daytime, while construction is banned at nighttime.

Structure construction period: The noise at the distance from construction site 30 m can meet the standard of noise limits in the daytime, while the standard distance is 180 m at nighttime.

Decoration period: The noise at the distance from construction site 10 m can meet the standard of noise limits in the daytime, while the standard distance is 30 m at nighttime.

5.2.1.2 Construction fugitive dust:

(1) Atmospheric pollution sources in construction period

The atmospheric pollution sources in construction period mainly include various kinds of fugitive dust which are produced in site cleaning and grading for plant area, earthwork excavation, transportation vehicles traveling, transportation and loading or unloading of construction materials, filling and excavation earthwork of construction machinery and the temporary storage for spoil. The commercial concrete is used entirely in the project and the stirring is not carried out in construction site.

①The excavated earthwork is all used for filling and site grading in low-lying area during site grading for plant area, and the excavated earthwork is not for external use. Meanwhile, a majority of spoil produced in ground excavation is used for ground backfilling and the small quantity is used as green soil in plant area (not for external use). The air-borne dust will be caused in spoil transportation and temporary stockpiling process for ground excavation spoil, which increase the concentration of total suspended particulates in ambient air.

②Since there are certain transportation vehicles in building site for transporting building materials needed in project construction, the soil from building site is taken out inevitably by vehicle tires. This part of soil is spattered on the road surface. Then the air-borne dust is caused when blowing and the vehicles pass through, which pollute the surrounding atmospheric environment. The impact area is small in windless weather, while the impact area is even enlarged to outside construction area

as the wind force increase. Furthermore, the air-borne dust will be caused by the movement of the transport vehicles out of the building site.

(2) Environmental impact analysis for construction fugitive dust

The construction dust is related to many factors, such as construction site condition, management, mechanization degree, the soil structure of construction area and the meteorological conditions of construction period, etc. Thus the determination of dust emission is a very complicated issue. The analogy method is adopted to analyze environmental impact for construction fugitive dust in this project.

Beijing Municipal Research Institute of EP has determined the fugitive dust conditions of building site in 4 construction engineering located in Beijing and the mean wind velocity is 2.4m/s in measurement. The test results are shown in table 5.2-3.

Table 5.2-3 The fugitive dust pollution of building site in Beijing area (TSP, mg/m^3)

Construction site name	Upwind direction in construction site	wind direction in construction site	Downwind direction in construction site		
	50 m		50m	100m	150m
Overseas Chinese affairs office building site	0.328	0.759	0.502	0.367	0.336
Metal materials company building site	0.325	0.618	0.472	0.356	0.332
Broadcast television building site	0.311	0.596	0.434	0.372	0.309
Jinsong neighborhoods building 5#、11#、12# building sites	0.303	0.409	0.538	0.465	0.314
Mean value	0.317	0.496	0.486	0.690	0.322

The wind direction and wind velocity of 6 subproject locations are shown in table 5.2-4.

Table 5.2-4 The wind direction and wind velocity of subproject location (m/s)

Subproject name	Wind direction	Wind velocity
Yutian subproject	WNW	2.4
Zunhua subproject	NW	1.18
Laoting subproject	SSE	2.3
Chengde subproject	NWN	2.16
Anping subproject	SSW	1.7
Linzhang subproject	S	2.4

As shown in table 5.2-4, the TSP concentration is 1.5～2.3 times of control point from upwind direction when wind velocity is 2.4 m/s, and this concentration is 1.4～2.5 times of *Ambient Air Quality Standards* (GB3095-2012) (300μg/m^3). The ambient air quality standard can be achieved basically outside region of 150 m in downwind direction of construction site.

As shown in table 5.2-4, the maximum mean annual wind velocity of 6 subprojects is 2.4 m/s, and the construction fugitive dust in this project can not influence surrounding sensitive receptors given the project surrounding conditions (shown in Table 5.1-3 and Table 5.1-4). Further, the construction fugitive dust is mainly powder caused by natural soil flying and don't include pollutant factors directly producing toxicity to people, animals and plants. This effect will disappear as the construction period is finished.

In summary, the construction fugitive dust in this project cause small impact on atmospheric environment.

5.2.1.3 Construction wastewater:

Since the workers in construction period all come from nearby villages in this project, it is not need to install construction camps. The water pollution sources in construction period include the material cleaning wastewater, moisturizing, flushing, equipment cleaning wastewater, etc. The output of production wastewater is about 3 m^3/d, and the major pollutant is SS with small quantity of wastewater and simple water quality to be used for dust suppression. The above conclusion is based on construction experience of construction department. Besides, the water-tight pit latrines are installed in construction site and are disposed by local sanitation departments.

In this project, the pipe pressure test of biogas pipeline adopts the compressed air as media without causing wastewater. No construction camps will be installed in the process of pipeline construction, while nearby villages are rented. The wastewater in pipeline construction period is mainly equipment cleaning water and domestic wastewater from workers. This wastewater quantity is not large and the wastewater from the equipment cleaning can be used for dust suppression； the domestic wastewater will be discharged into the wastewater facilities of the houses rent by the workers. .

All subprojects are civil engineering with small engineering quantity, and the longest construction time is 2 years. The wastewater quantity in construction period is small with simple water quality. Moreover, there are no surface rivers in surroundings of each subproject. The construction wastewater is all disposed reasonably, which cannot influence the local water environment.

5.2.1.4 Construction solid wastes:

The solid wastes produced in construction are mainly domestic garbage, construction waste and spoil. The domestic garbage mainly includes food waste and manure, while the construction waste is mainly pebble, stone material and so on. The solid wastes produced in construction are ordinary waste.

The construction waste will be transported to the spoil ground designated by sanitation departments. A small quantity of domestic garbage will be collected and disposed by sanitation departments after collection. The spoil produced in construction is mostly used for ground backfilling, and the remaining is used for greening soil in plant area without adverse effect upon surrounding environment.

The project proposes following measures in order to mitigate the impact of waste on surrounding environment in the transportation process of construction waste, such as covering transported construction waste by tarpaulin, forbidding spatter, transporting to designated place in designated routes by municipal authorities, forbidding littering and so on.

Therefore, the solid wastes produced in construction can't cause significant adverse effect upon surrounding environment on the premise that the measures are adopted.

5.2.1.5 Ecological environment

The project is located in the area in rural ecology with no rare wild plants and large wild animals, and the major impact in construction period is a degree of water and soil erosion in the area with steep slopes. The pipeline laying also cause adverse effect upon vegetation along and a degree of water and soil erosion. However, the construction period is short and the size of the project is small, thus causing small effect on ecological environment. The construction road utilizes the existing rural road basically with no new temporary ground. The earthwork balance condition of each subproject is shown in table 5.2-5.

Table 5.2-5 The statistics of earthwork balance in each subproject Unit: m ^{3}

No.	Region name	Earthwork excavation				Earthwork backfilling				Digging and waste soil		
		Site formation	Tank	Basis	Subtotal	Ground backfilling	Tank	Basis	Greening soil	Subtotal	Digging soil	Waste soil
1	Yutian		61575	2604	64179	38507		16045	9627	64179	0	0
2	Zunhua		45525		45525	27315		11381	6829	45525	0	0
3	Laoting		119754	1875	121629	72977		30407	18244	121629	0	0
4	Anping		3000	200	3200	1920		800	480	3200	0	0
5	Chengde		15620	2000	17620	10572		4405	2643	17620	0	0

6	Linzhang		37758	4000	41758	25055		10440	6264	41758	0	0

After recognition of local environmental conditions for each subproject, the Chengde subproject needs to establish soil and water conservation program in order to decrease water and soil erosion and protect local ecological environment. It is not necessary to establish soil and water conservation program for other subprojects, because their ecological environment impact is small.

5.2.1.6 Traversing construction

The project refers to some conditions of linear construction across road, such as gas pipeline, sewage pipeline and drainage pipe, etc. The traversing constructions of each subproject are shown as follow:

5.2-6 The statistics of traversing constructions for each subproject

Subproject name	Traversing construction	Traversing objects	Grade	Width (m)	Traversing times	Pipe Diameter (mm)	Buried depth (m)	Construction method
Yutian subproject	Gas pipeline	Rural road	Rural	5	1	100	1.5	Ditching
Zunhua subproject	Gas pipeline	Bangkuan Road S356	Province highway	25	5	100	1.5	underground penstock
	Gas pipeline	Da-qin Railway	Railway	20	2	100	1.5	Pipe-jacking
	Gas pipeline	Ditch	Ditch	5	5	100	1.5	Direct excavation
Laoting subproject	Gas pipeline	Xiaochang river	Diaphyseal drainage river	5	3	100	2	Underground penstock
	Gas pipeline	Province highway S044	Province highway	20	1	100	1.5	Underground penstock
	Gas pipeline	Tanggang Motorway, Coastal MOtorway	Superhighway	25	1	100	1.5	Laying along the road under culvert ,
	Gas pipeline	2 rural and county roads	Rural	1.4	1	100	1.5	Underground penstock
Anping subproject	Gas pipeline	Rural road	Rural	15	1	100	1.5	Direct excavation

Chengde subproject	Gas pipeline	Jing-Shen Expressway, Provincial Road S145	National highway Province highway river	120 100 100	5 8 5	100	— — 1.5	Pipe-jacking Pipe-jacking excavation
Linzhang subproject	Gas pipeline	Province highway S212	Province highway	20	1	110	—	Pipe-jacking
	Gas pipeline	3 rural and county roads	Rural and county	——	10	100	1.5	Excavation

The process of pipeline laying in the project refers to some traversing constructions, mainly including road traversing without river traversing. Pipe-jacking is often adopted in high grade traversing road such as national highway and province highway, while for low grade traversing road such as rural road, excavation is used. The different traversing types are introduced briefly as follows:

(1) Pipe-jacking traversing

In the project, the traversing roads of pipeline construction include superhighway, national highway, province highway, railway and rural road. Since the grade of rural road is low with small traffic loading, direct excavation is adopted. The Pipe-jacking traversing is used for high grade highway and railway, and pipe-jacking construction has advantages, such as no road surface destroys, no traffic interruption, small disturbance area and small environment effect, etc. The construction style and machinery for pipe-jacking are described as follows:

①Construction method: The support and hydraulic jack are installed in working pit firstly. Then the tool pipe or road header is pushed straight into the receiving pit through soil horizon and is lifted up, by virtue of the thrust between master cylinder and pipeline enclosure, intermediate jacking station. Meanwhile, the fabricated pipe section is pushed up into stratum and is embedded between the two pits, following the tool pipe or road header.

② Construction machinery: hand piece (including small hydraulic jack), oil hydraulic press, master cylinder, traveling crane (winding engine), electrical supply equipment (such as electricity box), arc welder, measuring apparatus and additional sample path, ejector block and back cushion.

(2) Excavation

The excavation is adopted for pipeline installation, and the characteristics of this

method is direct and simple construction, low construction cost, no influence on vegetation restoration and land reclamation after earthwork backfilling. Thus, the general roads sections in the project are all adopted this kind of construction method. The pipe groove should be excavated according to design requirement for plane position and elevation in the excavation construction. When manual excavation is adopted with no groundwater, the groove bottom reservation value should be 0.05-0.10 m. When machinery excavation is adopted or there is groundwater, the groove bottom reservation value must be larger than 0.15 m. The manual clear bottom should be done to achieve design elevation and then pipeline installation can be carried out.

① Groove backfilling

The pipe bottom is filled compactly by fine grained soil firstly. At the same time, two sides of pipeline are filled. Then backfilling is processed until that the distance to above pipe top is 0.5 m. The backfilling soil for filling two sides of pipeline and the space within 0.5 m of above pipe top should not include breakstone, brick, garbage, etc, and the frozen soil must no be used for backfilling. The backfilling soil should achieved compaction by layers with 0.2-0.3 m of each stratum thickness. The backfilling soil used for filling two sides of pipe and space within above pipe top of 0.5 m must be manual-compaction. When the backfilling soil exceed 0.5m of above pipe top, small machinery compaction can be used with 0.2-0.3 m each stratum thickness of loose soil.

②Construction machinery

Excavator, cutting machine and shovel are used.

The gas pipeline in the project needs to pass through a part of highway or railway. Considering that the road surface of national highway, province highway and railway are all high road grades with no cutting, department of project implementation will carry out the construction after obtaining construction permits from the highway management department. The construction methods of crossing highway adopted pipe-jacking construction in order to decrease the effect on local regional traffic in construction period. The other constructions need to cross the rural road, and direct excavation is used. The construction time is short in this part, and road surface recovery is carried out rapidly after construction. Thus, a small range of effect on the traveling for local residents is caused in a short time.

5.2.2 Environmental impact analysis for environmental sensitive receptors in construction period

5.2.2.1 Analysis of atmospheric environmental impact

The atmospheric environmental impacts in construction period are mainly construction fugitive dust. The construction fugitive dust is produced in site grading for plant area, earthwork excavation, transportation vehicles traveling, transportation and loading or unloading of construction materials, filling and excavation earthwork of construction machinery and the temporary storage for excavation.

The surroundings of biogas plants have no sensitive receptors after the above screening, and the majority of sensitive receptors are all located in the place passed or crossed by gas pipeline, such as villages, roads, facilities for farmland water conservancy, etc. Since the construction period of gas pipeline is short with section construction and some measures, such as sprinkling, road hardening, baffle and vehicle cleaning, are adopted in order to decrease the fugitive dust as much as possible, the effect on the sensitive receptors is very small. Environmental impact will disappear as the construction period is finished.

5.2.2.2 Analysis of water environmental impact

The water pollution sources in construction period include the domestic wastewater from workers, material cleaning wastewater, moisturizing, flushing, equipment cleaning wastewater, etc. This wastewater quantity is not large and the water quality is simple. The excavation depth in the project is less than 1 m without obvious effect on local hydrogeologic condition.

The surrounding household water-consumption of each subproject mainly comes from deep groundwater or central water supply by local water plant. The major pollutant in construction wastewater is SS with small quantity of wastewater and simple water quality used for dust suppression. Besides, the water-tight pit latrines are installed in construction site and are disposed periodically.

Therefore，the surrounding water environment can't be influenced in construction period.

5.2.2.3 Analysis of acoustic environmental impact

The major noise sources in construction period include construction machinery, trailers and so on. The gas pipeline laying in the project belongs to small civil construction with small pipe diameter, no large machinery and short construction

period. Thus, the project can't cause obvious effect on surrounding acoustic environment. The construction noise mainly includes sporadic knock, crash from loading and unloading vehicles, yo-heave-ho and so on. These noises are mostly transient noise and the construction vehicle noise belongs to traffic noise.

The surrounding sensitive receptors distribution of gas plant, gas filling station and gas pipeline in each subproject are shown in table 5.1-4. Sensitive receptors are not much in gas plant vicinity and the majority of sensitive receptors all locate in the place passed or crossed by gas pipeline, such as villages, roads, facilities for farmland water conservancy, etc. According to the analysis for surrounding conditions of gas station and pipeline in each subproject, the distance from the construction site to the closest sensitive receptors is all larger than 180 m. The standard from *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011) can be reached in all subprojects through distance decay. The construction noise causes small effect on nearby sensitive receptors and the noise will disappear completely after the construction period. The relevant provisions of PRC on the construction noise are compiled strictly. All construction activities are inactive between 22:00 at night to 06:00 in the next mooring and between 12:00 to 14:00 at noon. There are not large-sized machinery noise and the noise reduction measures are adopted with examining and repairing the equipment on time in order to reduce unnecessary machinery noise. The builders comply strictly with construction operation regulation. The manual excavation is adopted for school as a sensitive receptor. The construction period is focused outside of class time and it is better to operate in winter vacation or summer vacation. The construction period must not be in class time unless obtaining the agreement from school.

5.2.2.4 Analysis of ecological environmental impact

The project covering is mainly rural area without rare wild plants and large creature, and the major impact in construction period is a degree of water and soil erosion. The pipeline laying also cause adverse effect upon vegetation along and a degree of water and soil erosion. However, the construction period is short with small effect on ecological environment. The construction road utilizes the existing rural road basically with no new temporary ground.

After recognition of local environmental conditions for each subproject, the Chengde subproject needs to establish soil and water conservation program in order to decrease water and soil erosion and protect local ecological environment. It is not

necessary to establish soil and water conservation program for other subprojects, because their ecological environment impact is small.

The principle of construction accompanied by treatment is adopted in project construction. The earthwork excavation is decreased as much as possible, and the construction waste is prohibited to stack optionally. The earthwork excavation is backfilled as much as possible and backfilling doesn't borrow earthwork. The surrounding ecological environment in construction site is recovered in later period of construction by planting crops or recovering sod cover. The effects on ecological environment in sensitive receptors will disappear along with that the construction period is over.

5.2.2.5 Analysis of environmental impact in traversing construction

The traversing construction and method are shown in table 5.2-5.

(1) Traffic

Zunhua, Laoting, Chengde, Linzhang subprojects need to cross province highway. Zunhua, Laoting subprojects adopt penstock method, while Chengde and Linzhang subprojects use pipe-jacking method. The traversing constructions should obtain consent letter from the relevant administrative departments in order to prevent roadbed destruction. The crossing between pipeline and highway should be vertical, and the angle must be larger than 60 ° when cross. The protective casing should be embedded when pipeline traverse highway, and casing strength needs to satisfy the demand of road-I grade loading. The distance from top of protective casing to road base must be not smaller than 1.5 m. The safe distance should be kept more than 20 m from the center line of pipeline to the boundary range of road land, as well as parallel between pipeline and highway.

Laoting and Chengde subprojects need to cross expressway. Laying pipeline along the road under culvert and direct traversing are used. Furthermore, The traversing constructions obtain consent letter from the relevant administrative departments in order to prevent roadbed destruction. The included angle between pipeline and expressway is not smaller than 70 °.

Zunhua subproject refers to traversing railway. Pipe-jacking method is adopted and the subproject obtain consent letter from the relevant administrative departments in order to prevent roadbed destruction. The included angle between the longitudinal axis of jacking pipeline to railway should be 90 ° and protection sleeve is embedded. The inspection well for gas pipeline should be installed outside the railway protection

area. The supervision enterprise, which has relevant railway qualification, is charged with the supervision for protection sleeve of traversing railway.

Yutian, Anping and Linzhang subprojects all refer to traversing rural road and direct excavation method is adopted. The construction period should be chosen during period when pedestrian and vehicle flow are small, and the provisional auxiliary bridge is built for pedestrian and vehicle. The construction period should be short and after autumn as possible in order to avoid farming season.

(2) Farmland water conservancy

Laoting, Chengde subprojects refer to traversing the branch of small river (seasonal drought) and the penstock method is used. The directional drilling method is adopted when pipelines traverses rivers. The excess earthwork is collected strictly according to the environmental management procedures and used for backfilling. Meanwhile, it is prohibitive to stack waste and discharge any contaminants in rivers.

Zunhua subprojects refer to traversing small-sized ditch and the direct excavation is adopted. A majority of ditches is used for agricultural irrigation and the minority is natural drainage ditch. The construction period for traversing ditch for agricultural irrigation should avoid agricultural irrigation season. It is prohibitive to stack construction waste in ditch during the construction process, and construction site should be recovered timely after construction without effect on the function of ditch. While traversing natural drainage ditch, it is prohibitive to stack construction waste in ditch during the construction process, and construction site should be recovered timely after construction without effect on the function of ditch.

5.2.3 Pollution control measures during construction period

5.2.3.1 Measures for noise reduction

The environmental impact analysis during previous construction period reveals that the residents near the construction sites of gas pipelines are the main noise sensitive receptors. Thus, measures for noise reduction, as shown in the following table, are proposed corresponding to the locations and features of each sensitive receptor.

Table 5.2-8 Measures for noise reduction in sensitive receptors

No.	Subproject name		Sensitive receptor	Measures for noise reduction
1	Anping subproject	Construction period	——	——
		Operation period	——	——
2	Yutian subproject	Construction period	Huangjiashan Village	Mainly carrying out pipeline construction during the daytime, excluding the rest time of the surrounding residents, and prohibiting any operation during 22:00PM~06:00AM without the permission of the residents.
			Xingshuyu Village	
			Shangzhuang Village	
			Xiaolizhuang Village	
			Ruanzhuangzi Village	
			Xingjiawu Village	
			Sijiaoshang Village	
			Guangongling Village	
		Operation period	——	——
3	Zunhua subproject	Construction period	Wangjiapu Village	Mainly carrying out pipeline construction during the daytime, excluding the rest time of the surrounding residents, and forbidding any operation during 22:00PM~06:00AM without the permission of the residents.
			Qujiapu Village	
			Xiaocaogezhai Village	
		Operation period	Huangjiapu Village	——
4	Linzhang subproject	Construction period	Jia Village	Mainly carrying out pipeline construction during the daytime, excluding the rest time of the surrounding residents, and forbidding any operation during 22:00PM~06:00AM without the permission of the residents.
			Xidiqiu Village	
			Beizhang Village	
			Shuangmiao Village	
		Operation period	——	——
5	Chengde subproject	Construction period	——	——
		Operation period	——	——
6	Laoting subproject	Construction period	Dongdazhuang Village	Mainly carrying out pipeline construction during the daytime, excluding the rest time of the surrounding residents, and forbidding any operation during
			Wantuo Village	
			Shao Village	
			Donggaoge Village	
			Dongzhuang Village	
			Laomumiao Village	
			Xigong Village	

			Donggong Village	22:00PM~06:00AM without the permission of the residents.
			Yucai primary school (Shaozhuang Village)	Taking manual excavation at the construction spots near schools and forbidding operations during the school hours without the permission of the schools, suggested in the summer or winter vocations.
		Operation period	——	——

(1) To comply with the relevant provisions of PRC on the construction noise and to avoid the adverse environmental effects of noise, any construction activity is forbidden at the spots near the residential area within 300 meters during 22:00PM~06:00AM and 12:00PM~14:00PM. Construction builders should comply with this provision.

(2) Passing roads should be far away from some sensitive receptors, such as schools, residential area and hospitals and Traffic should be shopped at night when the roads are near the residential area within 50 meters.

(3) The mechanical equipment producing large noise should be prohibited for use during the school hours when construction sites are near the schools, or at night when near the intensive residential area.

5.2.3.2 Measures for dust reduction:

(1) Regular watering at the dust-producing road sections is done to reduce dust.

(2) The storage and processing areas for materials, as well as storage areas for big template should be flat and solid.

(3) Easy-flying and fine particle-made up materials should be sealed storage and covering measures should be taken during installation, dismantle and transportation.

(4) Suitable watering should be done at the bare ground of construction sites to reduce dust.

(5) Vehicles should slow down when enter the construction sites.

(6) Covering measures should be taken for the vehicles carrying earthwork, muck and construction waste.

5.2.3.3 Measures for wastewater treatment

(1) Wastewater from excavation and mortar mixing should be precipitated and recycled for the construction usage or dust-reducing watering.

(2) Discharge of construction wastewater randomly is banned and cleaning water of mechanical equipment should be reused.

(3) Drainage channels are dredged regularly.

(4) Mechanical equipment and vehicles should be repaired at the professional repairing spots to avoid producing oil-containing wastewater at the construction sites.

(5) The oil and water leakage for the mechanical equipment should be checked before use.

(6) Sewage tank should be made of impermeable cement and reservoir tank should adopts geomemberane to prevent leakage.

(7) Underground and semi-underground structures should prevent the inflow of surface water. Anti-float measures should be taken when groundwater level is high.

(8) Water-proof measures should be taken when pipelines pass through the main body of volume pool, such as using pre-embedded casing.

(9) Flexible gaps and water-proof sheets should be installed when volume pool is too big according to standard requirement.

5.2.3.4 Measures for solid waste treatment

(1) Construction waste should be carried by enclosed vehicle and random throwing is prohibited. Construction waste should be reused as much as possible and be removed as soon as possible in accordance with the relevant provisions for waste classification management.

(2) Domestic waste should be collected from the dustbins at the construction sites with garbage bags and then be transported to the domestic waste landfill site in corresponding towns for treatment.

(3) Waste earth and muck can be reused for backfill and road embankment. No dumping site will be set up to reduce land occupation.

(4) Toxic and hazardous substances should not be burn out and should be processed in accordance with the relevant provisions.

5.2.3.5 Measures for soil and water conservation:

(1) Excavated area should be processes with backfill and corresponding vegetation restoration after construction. Vegetation restoration should be finished one month before the arrival of the rainy season in order to achieve the best effects.

(2) Excavation should be avoided during the rainy days. Laying sandbags, sand bar or straws is adopted to reduce soil erosion and sediment load of rivers.

(3) Vegetation restoration should be implemented to all the bare ground generated by construction activities as soon as possible to prevent soil erosion caused by wind, water or surface runoff during the rainy season.

(4) Unrecyclable waste earthworks and stone materials should be piled up or moved into the designated sites, followed by hierarchical compaction and vegetation planting.

(5) Excavated topsoil should be piled up separately for the usage as embankment materials of ditch or restoring earth of arable land.

5.2.3.6 Measures for traversing construction

(1) Traversing programs should be reserved according to the grade-I road and leave enough room for road widening.

(2) Perpendicular crossing of pipelines and roads is preferred and the angle should not be less than 60 °when skews.

(3) The protective casing should be embedded when pipeline traverse highway, and casing strength needs to satisfy the demand of grade-I road.

(4) The distance between the top surface of protective casing and subbase of roads should be more than 1.5 m.

(5) When being in parallel with roads, the distance between pipeline centerline and sideline of road occupation land should be more than 20m.

(6) Disturbance of safe and unblocked traffic, damage or even potential threat on the road and the corresponding infrastructures are prohibited in pipeline construction and operation periods.

(7) The relevant required materials, including drawings, plans, quality of construction should be reported and relevant formalities should be conducted according to *Provision for Road Administration*.

5.2.3.7 Measures for historical relic protection

(1) The construction builders are trained to identify underground cultural heritage and the protection awareness for the relic are improved.

(2) Any found historical relic should be reported immediately during the construction period.

(3) Construction contractors should stop the construction activities immediately and take appropriate measures for the in situ conservation.

(4) The finding should be reported to the local cultural heritage protection authority.

(5) Construction activities should not be restored until the investigation is finished without any disagreement by local cultural heritage protection authority.

5.3 Environment impacts and mitigation measures in operation period

5.3.1 Positive environmental impacts in operation period

Hebei province is a big agricultural province. Its main crops are cotton, wheat and corn, and the planting area is large. Therefore, it has a rich resource of all kinds of straw. However, because of lacking of suitable utilization methods, about 15% of the straw is used as domestic fuel, and the remaining are discarded. Not only huge energy is wasted, but also individual farmers burn straw in field, which cause serious atmospheric pollution and harm the heath of urban and rural residents. The implementation of this project can avoid environmental pollution that caused by field burning and straw as fuel, at the same time the biogas produced can be used as domestic fuel for rural residents and replace the rural non-point source pollution caused by burning coal or firewood.

Therefore, on the one hand, the implementation of this project reduces straw and coal combustion and biogas is used as a clean fuel to achieve air pollutant emission reduction. On the other hand, after collection of livestock and poultry manure to produce biogas, the by-product can be used as organic fertilizer reducing the discharge of water pollutants. In addition, this project has good social benefits and environmental benefits.

5.3.1.1 Emission reduction prediction in operation stage

In order to predict environmental benefits achieved by the project implementation and put forward the phased goal for the project scheme, the pollution reduction of subprojects are predicted in construction period, and the specific process of calculation is shown as follows:

(1) The amount of straw and manure utilization

The annual consumption of straw is 19.14×10^4 tons and livestock manure is 23.31×10^4 tons by the project. The raw material demanded in each subproject is shown in the table 5.3-1.

Table 5.3-1 The consumption of crop straw and livestock manure for each subproject

No.	Subproject name	Materials	Annual demand of straw (10^4 tons)	Annual demand of the manure (10^4 tons)
1	Anping subproject	Livestock manure is used as the main raw materials and ensilage straw is supplemented.	1.46	8.69
2	Yutian subproject	Livestock manure is used as the main raw materials and straw is used as the raw material for organic fertilizer.	0	11.62
3	Zunhua subproject	Chicken manure and straw are mainly used as raw material.	3.8	3
4	Linzhang subproject	Straw is used as the fermentation raw material and manure is used as the material of the biogas residue organic fertilizer.	2.1167	0
5	Chengde subproject	Dry corn straw is used as raw materials.	4.27	0
6	Laoting subproject	Straw	7.49	0
Total	--	--	19.1367	23.31

(2) Biogas and biofertilizer supply capability

The annual output of biogas is 4282.97×10^4 cubic meters，the solid organic fertilizer produced is 7.91×10^4 tons and the liquid organic fertilizer is 4.79×10^4 tons through the project implementation. The condition of biogas and biofertilizer in each subproject is listed in table 5.3-2.

Table 5.3-2 The product supply capability in each subproject

No.	Subproject name	Main product and output					
		The total output of biogas (10^4 m^3)	The quantity used by enterprise itself (10^4 m^3)	The quantity of biogas used by household (10^4 m^3)	Vehicle CNG (10^4 m^3)	Solid organic fertilizer (10^4 tons)	Liquid organic fertilizer (10^4 tons)
1	Anping subproject	1052.56	0	531.44	286.6	1.29	3.32
2	Yutian subproject	699.3	159.84	299.7	0	0.53	1.13
3	Zunhua subproject	802	0	400	226	2.55	0
4	Linzhang subproject	283.84	130.54	153.3	0	1.31	2.0
5	Chengde subproject	541.23	155.64	211.95		0.623	1.14
6	Laoting subproject	904	0	438	265.47	1.55	1.1
Total		4282.97	446.02	2034.39	778.07	7.91	4.79

5.3.1.2 The impacts of biogas plants on the environment

(1) The effect on soil environmental quality

At present, the soil and surrounding waters are polluted due to the direct discharge of manure and sewage without treatment. The implementation of the project directly cut down 24.16×10^4 tons livestock manure which may be discharged directly to the environment, and at the same time, 7.6×10^4 tons solid organic fertilizer and 15.83×10^4 tons liquid organic fertilizer are produced. The organic fertilizer used on the soil can remove the harmful germs and eggs, increase the content of soil organic and improve the quality of soil environment. In addition, the biogas liquid and residue can partially replace of fertilizer and pesticide, thus decreasing the nitrate pollution and pesticide residue in soil.

(2) The effect on crop quality

The crop quality is improved due to reduction of soil contamination, increase of organic matter, decrease of utilization of chemical fertilizer and pesticide and enhancement of the disease resistance of crops after the usage of biogas liquid and residue. All of these improvements of crop quality create advantages for developing pollution-free or green food and promoting agricultural sustainable development.

(3) The effect on human health

Because of the reduction of pollution, it's beneficial to the heath of workers and surrounding farmers. Replacing the coal by biogas can decrease the emission of smoke and sulfur dioxide. The biogas liquid and residue are used as fertilizer and bait material to develop green food, which is beneficial to the consumer health.

(4) The effect on atmospheric environment

Biogas is used as energy. On the one hand, the treated manure can greatly reduce the odors in air, and on the other hand, the biogas substitute partially coal, which can decrease the CO_2, NOx, PM and SO_2 releasing into the atmosphere and make a contribution to reducing greenhouse gas emission.

After the implementation of the project, six large and medium-sized biogas subprojects will be constructed. The annual output of biogas is 4282.97×10^4 cubic meters. The annual consumption of straws is 22.94×10^4 tons and livestock manure is 24.16×10^4 tons. The annual output of solid organic fertilizer is 7.6×10^4 tons and liquid organic fertilizer is 15.83×10^4 tons.

The reference coefficient of standard coal is converted on the basis of *China Rural Energy Statistical Yearbook* and the *Standard of National Bureau of Statistics*: the energy of $1m^3$ biogas =0.75kg standard coal=0.68kg gasoline=1.63kg dry firewood. After the implementation of the project, the biogas produced annually will replace

1.9×10^4 tons coal-based fuel or 4.2×10^4 tons firewood for residents in the service area. 0.55×10^4 tons of vehicle gasoline in gas station can be replaced annually by the project. The index change of each pollutant emission before or after project implementation is shown in table 5.3-3.

Table 5.3-3 The reduction of pollutants emissions after project implementation unit t/a

Pollutant index	Pollutant reduction
SO_2	165.6
NOx	254.6
PM	103.0
CO_2	496.9

The quantity of discharged pollutant is calculated through the relevant discharged pollutant material balance method which stemmed from the *Notice of Checking Imposing Discharge Fee* (EPA [2003] NO.64) issued by NEPA. Suppose that the household in the service area of biogas supply all use the coal-fired stoves and the biogas completely replace coal after the construction implementation. As shown in table 5.2-3, the quantity of reduction is SO_2 165.6tons/year, NOx 254.6 tons/year, PM 103.0 tons/year, CO_2 496.9 tons/year on the present basement.

(5) The effect on water environment

The implementation of the project directly cut down 24.16×10^4 ton/year of livestock manure which may be discharged directly to the environment. The manure and wastewater discharged from the pig-farm is treated and concentration of all pollutants in wastewater has been reduced to a certain range. The wastewater discharged from livestock farm is avoided to flow in the surrounding irrigation ditch and the quality of water environment is greatly improved. The implementation of the project plays a better role in water environment treatment and water quality improvement for surrounding waters.

5.3.1.3 Analysis of the environment benefit by applying organic fertilizers

In recent years, people begins to pay more attention on quality of life. The demand for pollution-free, safe, and green food is increasing. Since fertilizer is the foundation of green food, the aim can be achieved only by preparing green fertilizer. A series of pollution-free, green and ecological fertilizer, including biofertilizer, active organic fertilizer and bio-chemcomplex fertilizer, is the most advanced fertilizer product in this field.

Organic fertilizer that can replace chemical fertilizer can avoid water pollution, soil pollution and atmospheric pollution caused by intensive application of chemical

fertilizers to farm. Meanwhile, organic fertilizer plays a role in soil improvement. Organic fertilizer is rich in organic matter. The long term use of organic fertilizer will enhance the content of organic matter in soil, improve the soil texture and promote soil microbes breeding. Then the soil become loose and air permeability for drainage and cultivation.

The application amount of fertilizer including organic fertilizer, N, P, K and trace element is put forward scientifically according to the fertilizer consumption rule of crops, the soil nutrient-supplying and fertilizer effect, and the basic method is soil test and field test. The calculation method for biogas manure market demand in the project area is introduced as follows: firstly, the demand for local biogas manure market is calculated according to the methods in *Wastewater Engineering: Treatment and Reuse* (the fourth edition, Chemical Industrial Press), the application of fertilizer can meet the need of plant growth and no pollution of the soil by heavy metals causing phytotoxicity.

According to this calculation, the proper amount of biofertilizer is 0.475 t/hm ²a for liquid fertilizer, 0.789 t/hm ²a for solid fertilizer. Statistics show that the demand for good quality organic fertilizers of Hebei province is about 300 million tons per year. In this project, all subprojects fertilizer products are mainly based on local markets (within 20km around the project). There are totally 399.08×10^4 mu arable land, 114.2×10^4 mu orchard land, and 92.6×10^4 mu vegetable land, that is a total biogas fertilizer demand of 106.2×10^4 tons. The six subprojects in this project can produce 7.91×10^4 tons solid organic fertilizer and 12.02×10^4 tons liquid organic fertilizer. 18.77% of the demand of inorganic fertilizer can be substituted in the project area, which will bring great environmental and social benefits.

5.3.2 Negative environmental impacts in operation period

The main pollutants in operation period consist of the wastewater generated from pig farm flushing, the waste gas produced by the gas-fired boiler and generators, the wastewater produced by the process and operation staff, the waste desulfurizer produced by desulfurizing tower and the environmental risk existed in the operation period of biogas project, etc.

5.3.2.1 Analysis of atmospheric environmental impact

The air pollutants produced by the project in operation period are mainly as follows:

(1) Dust produced by the straw chopping and organic fertilizer processing.

(2) odour (H_2S, NH_3) produced by the pretreatment of fermentation raw material, the fermentation tank discharging, aerobic composting, the organic fertilizer drying, etc.

(3) Dust, SO_2 and NOx produced by boiler in the biogas plants (biomass briquetting, self-produced biogas, or the other energy) and torch.

The analysis and prediction for air pollution source strength in these subprojects is shown as follows: (air environment assessment adopts estimation model SCREEN3: single pattern that recommended by *Technical Guide for EIA: Atmospheric Environment* (HJ2.2-2008)).

According to the analysis and prediction of air pollution source strength in the subprojects, the amount of air pollution emission is small in each subproject and the predicted maximum of ground concentration is small; percentage of the standard limit and the field scope concentration all don't exceed the local environmental quality requirements. Air pollutants are controlled effectively and the effect on surrounding air environment is small.

Table 5.3-4 The report of analysis and prediction of atmosphere pollution source strength in the subprojects

Subproject name	No.	Pollutant	Pollution source	Height of emitting source (m)	Inner diameter of exhaust stack (m)	Waste gas (m^3/h)	Temperature of smoke outlet (K)	Source strength (kg/h)	Impacts prediction	Concentration (g/m^3)	Occupancy ratio %	Apparent distance (m)
Linzhang	1	particles	Straw chopping	15	0.4	5000	423	0.15	Pmax	0.002708	0.60	269
	2	Particles, SO_2 NO_X	Gas-fired boiler	15	0.4	2139	423	0.045 0.0038 0.29	Pmax	0.00208 0.000176 0.0134	0.46 0.04 6.7	289
	3	Particles, SO_2 NO_X	Hot air furnace	15	0.4	817.56	423	0.017 0.0015 0.112	Pmax	0.00136 0.00012 0.00898	0.3 0.02 4.49	216
	4	Particles	Biogas residue crushing	15	0.4	8000	423	0.48	Pmax	0.00147	3.26	290
	5	Particles, SO_2 NO_X	Power generator	15	0.4	817.56	423	0.017 0.0015 0.112	Pmax	0.00136 0.00012 0.00898	0.3 0.02 4.49	216
		Unorganized	Pollution source	Non-point source length (m)	Non-point source width (m)	Initial emitting height of on-point source (m)	Source strength (kg/h)	Concentration (g/m^3)	Occupancy ratio (%)	Distance (m)	Maxima contribution value of boundary concentration (mg/m^3)	Health protection zone (m)
	6	particles	Straw chopping	50	30	5	0.04	2.2	6.5	100	0.007	100
	7	H_2S NH_3	Biogas liquid and residue pool	140	50	5	0.0015 0.032	0.000689 0.009397	1.26 1.35	162 162	0.00078 0.0167	100 100
Chengde	No.	Pollutant	Pollution source	Height of emitting source (m)	Inner diameter of exhaust stack (m)	Waste gas (m^3/h)	Temperature of smoke outlet (K)	Source strength (kg/h)	Impacts prediction	Concentration (g/m^3)	Occupancy ratio %	Apparent distance (m)
	1	Particles	Straw chopping dust	15	0.5	4110	298	0.269	Pmax	0.009827	2.18	1164
	2	Particles SO_2 NO_X	Gas-fired boiler	15	0.5	1887	383	0.131 0.01 0.859	Pmax	0.001736 0.00014 0.011484	0.39 0.03 5.74	238

	3	particles SO_2 NO_X	Gas-firing hot blast stove	15	0.5	2377	383	0.165 0.013 1.082	Pmax	0.002148 0.000172 0.014129	0.48 0.03 7.06	284
	4	Particles	Biogas residue chopping	15	0.5	2876	298	0.084	Pmax	0.002515	0.56	229
		Unorganized	Pollution source	Non-point source length (m)	Non-point source width (m)	Initial emitting height of on-point source (m)	Source strength (kg/h)	Concentration (g/m^3)	Occupancy ratio %	Distance (m)	Maxima contribution value of boundary concentration (mg/m^3)	Health protection zone (m)
	5	H_2S NH_3	Organic fertilizer workshop, biogas liquid pool	120	25	6	0.0007 0.009	0.000608 0.000473	6.08 0.24	250	0.00348 0.01136	0
Laoting	No.	Pollutant	Pollution source	Height of emitting source (m)	Inner diameter of exhaust stack (m)	Waste gas (m^3/h)	Temperature of smoke outlet (K)	Source strength (kg/h)	Impacts prediction	Concentration (g/m^3)	Occupancy ratio %	Apparent distance (m)
	1	particles SO_2 NO_X	Biomass boiler	20	0.5		523	6.24 1.07 0.169	P_{max}	0.03597 0.006168 0.0009742	7.99 1.23 0.49	415 415 415
		Unorganized	Pollution source	Non-point source length (m)	Non-point source width (m)	Initial emitting height of on-point source (m)	Source strength (kg/h)	Concentration (g/m^3)	Occupancy ratio %	Distance (m)	Maxima contribution value of boundary concentration (mg/m^3)	Health protection zone (m)
	2	Particles	Straw chopping	40	35	5	0.04	2.0	6.0	100	0.007	100
	No.	Pollutant	pollution source	Height of emitting source (m)	Inner diameter of exhaust stack (m)	Waste gas (m^3/h)	Temperature of smoke outlet (K)	Source strength (kg/h)	Impacts prediction	Concentration (g/m^3)	Occupancy ratio %	Apparent distance (m)
	1	Particles, SO_2 NO_X	Biogas coal boiler	15	0.3	11000	373	0.11 0.0297 1.39	P_{max}	0.001348 0.000364 0.01703	0.3 0.07 7.1	300 300 300
Yutian	2	H_2S NH_3	Biogas liquid pool,	15	0.3	1000	353	0.012 0.087	P_{max}	0.000895 0.006489	8.95 3.24	225 225

			fermentation tank, biofilter											
		Unorganized	Pollution source	Non-point source length (m)	Non-point source width (m)	Initial emitting height of on-point source (m)	Source strength (kg/h)		Impacts prediction	Concentration (g/m^3)		Occupancy ratio %		Distance (m)		Maxima contribution value of boundary concentration (mg/m^3)
	3	H_2S NH_3	Fermentation workshop, room for screening and product storage	95 35	62 22	10 10	Fermentation workshop 0.0011 0.0053	Room for screening and product storage 0.0001 6 0.0008 9	P_{max}	Fermentation workshop 0.0001918 0.0009573	Room for screening and product storage 5.366×10^{-5} 0.00029 85	Fermentation workshop 1.92 0.48	Room for screening and product storage 0.54 0.15	Fermentation workshop 400 400	Room for screening and product 100 100	0.000244 0.001256
	4	particles	Room for auxiliary material crushing and storage	47	20	10	5.00×10^{-7}		Room for auxiliary material crushing and storage	0.005736		0.64		100		0.005736
Anping	No.	Pollutant	pollution source	Height of emitting source (m)	Inner diameter of exhaust stack (m)	Waste gas (m^3/h)	Temperature of smoke outlet (K)		Source strength (kg/h)	Impacts prediction		Concentration (g/m^3)		Occupancy ratio %		Apparent distance (m)
	1	Particles, SO_2 NO_X H_2S NH_3	Gas-firing drying stove	15	15	0.3	1000		0.133 0.0068 0.072 0.57 0.276	P_{max}		0.002344 0.000187 0.015329 0.000895 0.006489		0.52 0.04 6.13 8.95 3.24		200
	Unorganized	Pollutant	Pollution source	Non-point source length (m)	Non-point source width (m)	Initial emitting height of on-point source (m)	Source strength (kg/h)		Concentration (g/m^3)	Occupancy ratio %		Distance (m)		Maxima contribution value of boundary concentration (mg/m^3)		Health protection zone (m)
	2	H_2S NH_3	Cesspool, biogas liquid pool	95 35	62 22	10	0.525 1.3		0.0001918 0.0009573	1.92 0.48		400 400		0.000244 0.001256		100

	3	H_2S NH_3	Air-drying filed of biogas residue, production workshop of solid/liquid organic fertilizer	95 35	62 22	10	0.400 1.0	5.366×10^{-5} 0.0002985	0.54 0.15	100 100		
Zunhua	No.	Pollutant	Pollution source	Height of emitting source (m)	Inner diameter of exhaust stack (m)	Waste gas (m^3/h)	Temperature of smoke outlet (K)	Source strength (kg/h)	Impacts prediction	Concentration (g/m^3)	Occupancy ratio %	Apparent distance (m)
	1	particles SO_2 NO_X	Biomass boiler	20	0.5	10685	523	1.7 2.6 1.7	Pmax	16 24 163	7.99 1.23 0.49	415 415 415
	2	H_2S NH_3	Biofilter	15	0.3	1000	353	0.27 0.5	Pmax	53.3 100	8.95 3.24	225 225
	Unorganized	Pollutant	Pollution source	Non-point source length (m)	Non-point source width (m)	Initial emitting height of on-point source (m)	Source strength (kg/h)	Concentration (g/m^3)	Occupancy ratio %	Distance (m)	Maxima contribution value of boundary concentration (mg/m^3)	Health protection zone (m)
	3	H_2S NH_3	Raw mix, organic fertilizer drying	35	10	10	0.07 0.3	0.012 0.087	8.95 3.24	225 225	0.000895 0.006489	100 100
	4	Particles	Dry straw chopping	47	20	10	5.00×10^{-7}	0.005736	0.64	100	0.005736	100

According to above table, the calculated protection zone can serve as the reference scope for subproject sensitive areas. Residents, schools and hospitals within this range can be determined as sensitive points. Refer to “5.1 screening environmental sensitive receptors” for finally determined sensitive receptors.

5.3.2.2 Analysis of water environment impact

According to the *Technical Policy for the Pollution Control from Livestock* and the *Technical Specifications for the Pollution Control for Livestocks*, the biogas liquid can be directly applied to farmland as liquid fertilizer. However, improper application or direct discharge of the biogas liquid into surface waters will cause severe pollution. Water balance, the emission source, quantity, treatment measure and emission amount of wastewater and main water pollutants, and the storage volume of biogas residue and wastewater, the disposal of the wastewater are all considered on the basis of EIA reports (Table 5.3-5 to Table 5.3-6). According to the statistical analysis, the wastewater produced in each subproject is mainly the biogas liquid from fermentation. The subprojects of Anping, Yutian, and Zunhua subprojects need to use manure and their concentration of main pollutants in biogas liquid is high. Pure-straw fermentation technology is adopted in the other subprojects.

Several subprojects adopt the mixed fermentation of manure and straw. For Anping subproject, the wastewater is discharged into the local municipal wastewater treatment plant after pretreatment by its own sewage treatment station. Dry fermentation process is adopted in Zunhua subproject with no biogas liquid produced. The wastewater in Yutian subproject is firstly discharged into the on-site wastewater treatment station, the treated wastewater will be discharged into the storage pool and then used for irrigation. There are 300000 m^3 of storage pool in the filed.

The operation period of fermentation pool may lead to two main conditions of water body pollution. The first，if overflow event happens or the substance in fermentation pool was discharged into the surface water system, the receiving water will be polluted. The second, if the designing of dike for fermentation pool is improper, especially when fermentation pool is above the ground, the break-up of dike also lead to the pollution incident. The two conditions above both lead to the receiving water pollution and bring serious negative effects to the residents who used the surface water and underground water as water resourse. The contaminant in the surface water pollute underground water by infiltration, especially when the soil texture is coarse, the infiltration is much severe. Besides, the fermentation pool may pollute underground water by two other ways: the infiltration and side-stream of contaminant. When the soil texture of the pool bottom is coarse and lots of macrospores conjoin together, the pollutants will infiltrate through the pool bottom. When the soil texture of the pool bottom is watertight, the pollutants will infiltrate along two side of the pool.

Several subprojects adopt the straw fermentation. One part of the biogas liquid in Linzhang, Laoting and Chengde subprojects is recycled for fermentation; the other part is

used for the production of liquid organic fertilizer. There are storage pools for biogas liquid in Linzhang, Chengde, Laoting subprojects and the storage pool can store the biogas liquid at least three days.

In order to prevent from the odour pollution of the biogas liquid pool and overflow caused by the high-intensity rainfall, the biogas liquid pool adopts gland sealing design in each subproject. To ensure that the biogas liquid be disposed reasonably and not exceed the volume of the storage pool, agreement about the supply and transportation of biogas liquid and liquid organic fertilizer must be signed with the person involved. So that the biogas liquid produced is carried away timely.

The fermentation pool and the biogas liquid pool in each subproject must adopt seepage prevention measures in order to prevent the biogas liquid infiltration caused by the break-up of the fermentation pool. Each subproject has little effect on the local water environment after doing the above measures.

Because the breeding wastewater and biogas liquid quantity is relatively large, and no municipal sewage treatment plant nearby, its wastewater treatment and biogas utilization measures was further analyzed, refer to Figure 5.3-1 for Yutian water balance, refer to Figure 5.3-2 for Yutian wastewater treatment station process.

Table 5.3-5 Analysis of the water balance in each subproject unit: t/d

a Pure straw	Total biogas liquid production	Biogas residue carried away	Reflux	Canned liquid fertilizer	Storing capacity of biogas liquid pool (seven days)	Storing capacity of non-fertilizing season (Nov., Dec., Jan., Feb.)
Chengde	543.8	72.5	320	116	809	——
Linzhang	209.8	18.5	168.19	41.61	292	——
Laoting	445.33	85.4	340.91	19.02	——	——

b Manure and straw	Livestock wastewater production	Livestock wastewater emission	Amount of livestock wastewater for fermentation	Reflux	Total biogas liquid production	Efflux	Biogas residue carried away	Canned liquid fertilizer	Storing capacity of biogas liquid pool (seven days)	Storing capacity of non-fertilizing season
Anping	902.41	249.01	653.4	50	946.25	753.65 (flowing into the sewage processing station)	60.13	82.47	577.29	——
Zunhua	0	0	0	Partial residue recycled, Residue containing water 112.19 (172.6 water content 0.65)	Residue containing water 98.68 (151.83 water content 0.65)	0	210.88 (324.4 water content 0.65)	0	0	——

c Pure manure	Amount of livestock wastewater for fermentation	Manure brought to fermentation	Amount of livestock wastewater For irrigation	Total biogas liquid production	Biogas liquid used for direct irrigation	Biogas liquid used for irrigation after fermentation	Concentrated supernatant of biogas liquid	Biogas liquid concentrate	Organic solid waste	Storing capacity of biogas liquid pool (non-fertilizing season）
Yutian	350	322	650 (treated by wastewater station, discharging into storage pool and finally used for surrounding farmland)	672	200 (discharging into storage pool and finally used for surrounding farmland)	222 (discharging into storage pool in non-fertilizing season)	160 (treated by wastewater station, discharging into storage pool and finally used for surrounding farmland)	40	50 （TS31.5%）	9.72×10^4 m^3

Table 5.3-6 Lists of water pollutant source intensity and treatment, the temporary measures for each subproject

No.	**Subproject name**	**Emission source**	**Pollutant name**	**Production and concentration before treatment**	**Treatment measures / discharge whereabouts**	**Discharge concentration and quantity**	**Storage pool volume**
1	**Linzhang subproject**	Biogas liquid	Wastewater production	7.6×10^4 t/a,209.8 t/d	47% biogas liquid is reused for fermentation; 53% biogas liquid is processed into liquid fertilizer.	——	Biogas liquid pool 1000 m^3
			COD	3000 mg/l			
			BOD_5	800 mg/l			
			SS	500 mg/l			
			NH_4-N	1000 mg/l			
		Sewage	Wastewater production	0.146×10^4 t/a	Sewage is reused for biogas fermentation after pretreatment by septic tanks.	——	——
			COD	350 mg/L			
			BOD_5	250 mg/L			
			SS	300 mg/L			
			NH_4-N	35 mg/L			

		Wastewater form water softening station	Wastewater	0.0365×10^4 t/a	Sprinkle for dust suppression	____	____
			COD	60 mg/L			
			SS	10 mg/L			
2	**Anping subproject**	Biogas liquid	Wastewater production	34.53×10^4 t/a，946.25 t/d	Biogas liquid is discharged into Anping sewage treatment plant after pouring to sewage treatment station in Yufengjingan breed farm.	26.85×10^4 t/a	Biogas liquid pool 3000 m^3
			COD	3000 mg/l		252 mg/l, 67.7 t/a	
			BOD_5	600 mg/l		58 mg/l, 15.6 t/a	
			SS	500 mg/l		70 mg/l, 18.8 t/a	
			NH_4-N	500 mg/l		27 mg/l, 7.2 t/a	
		Sewage from CNG	COD NH_3	200mg/L，0.139 t/a 30mg/L，0.002t/a	Sprinkle for dust suppression; Installing the water-tight pit latrines	____	____
3	**Chengde subproject**	Biogas liquid	Wastewater production	3.18×10^4 t/a, 87 t/d	43% biogas liquid is reused for fermentation； 57% biogas liquid is processed into liquid fertilizer.	____	Biogas liquid pool 1300 m^3
			COD	3000mg/l			
			BOD_5	800mg/l			
			SS	500mg/l			
			NH_4-N	1000mg/l			
		Demineralized water preparation	Wastewater production	0.073×10^4 t/a	Sprinkle for dust suppression	____	____
			COD	60mg/L			
			SS	10 mg/L			
		Sewage	Wastewater production	0.069×10^4 t/a	After pretreatment by septic tanks, all sewage is reused to fermentation.	____	____
			COD	350 mg/L			
			BOD_5	250 mg/L,			
			SS	300 mg/L			
			NH_4-N	35 mg/L			
4	**Zunhua subproject**	Softening wastewater	Wastewater production	1460 t/a	Sprinkle for dust suppression	____	____
			pH	6~9			

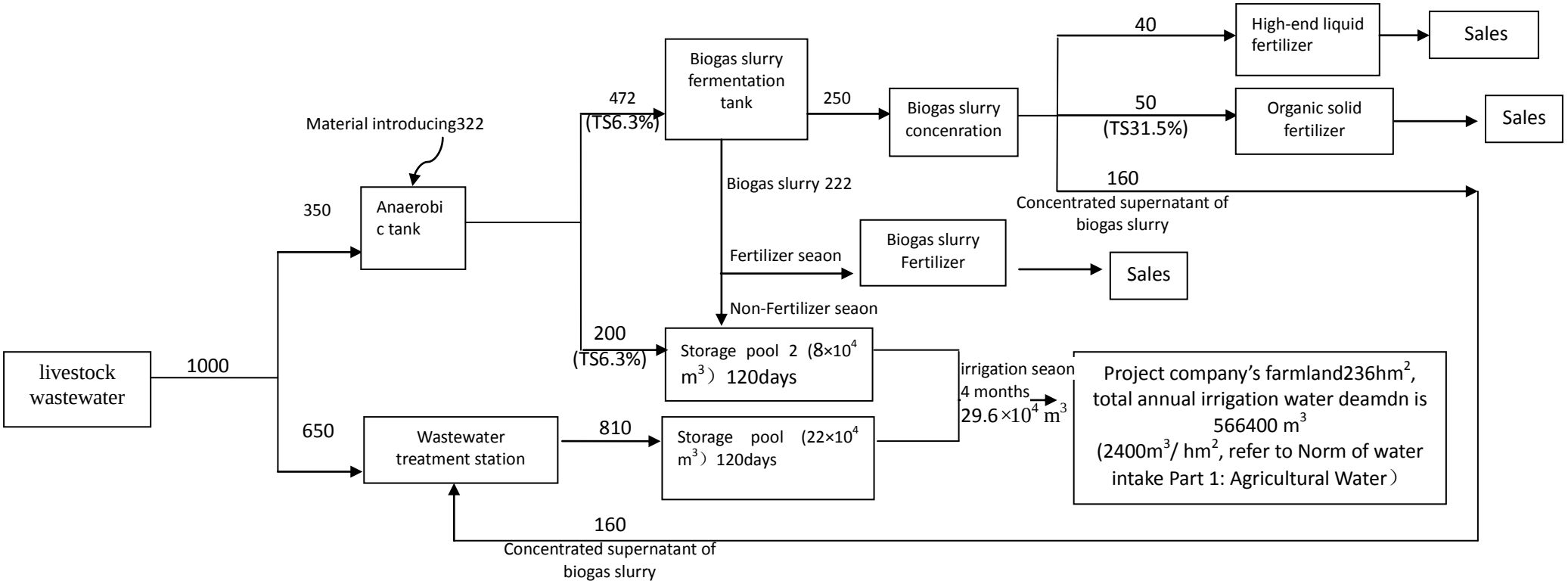
		Sewage	Wastewater production	777.45 t/a	After pretreatment by septic tanks, all sewage is reused to fermentation.	——	——
			COD	200 mg/L			
			NH_4-N	30 mg/L			
5	**Yutian subproject**	Biogas liquid	Wastewater production	7.3×10^4 t/a,2000 t/d	Biogas liquid firstly is discharged into storage pool. Then it is reused for irrigation after dilution.	——	Biogas liquid pool 17000m ^{3}
			COD	3000mg/l			
			BOD_5	800mg/l			
			SS	500mg/l			
			NH_4-N	1300mg/l			
		Piggery washing water	Wastewater production	23.72×10^4 t/a, 650t/d	discharged into wastewater treatment station (achieve agricultural irrigation water quality standards), then into storage pool. reused for irrigation	——	2 storage tanks and total area is 300000 m ^{3}
			COD	2640mg/l			
			BOD_5	1400mg/l			
			SS	1300mg/l			
			NH_4-N	260mg/l			
		Concentrated supernatant of biogas slurry	Wastewater production	5.84×10^4 t/a	discharged into wastewater treatment station (achieve agricultural irrigation water quality standards), then into storage pool. reused for irrigation	——	——
			COD	800 mg/L			
			BOD_5	300 mg/L			
			SS	150 mg/L			
			NH_4-N	200 mg/L			
			COD	100 mg/L			
			BOD_5	30 mg/L			
			SS	70 mg/L			
			NH_4-N	15 mg/L			
		Sewage	Wastewater production	0.054×10^4 t/a	Sprinkle for dust suppression	——	——
			COD	350 mg/L			
			BOD_5	210 mg/L			
			SS	200 mg/L			
			NH_4-N	25 mg/L			
6	**Laoting**	Biogas liquid	Wastewater	13.14×10^4 t/a	Most of the biogas	——	Biogas liquid 6000m ^{3}

	subproject		production		liquid is reused in the digester, the remaining biogas liquid is used for the production of liquid fertilizer		
			COD	3000 mg/l			
			BOD_5	800 mg/l			
			SS	500 mg/l			
			NH_4-N	1000 mg/l			
		Sewage	Wastewater production	0.1365×10^4 t/a	After pretreatment by septic tanks, sewage is reused to fermentation.	____	____
			COD	350 mg/L			
			BOD_5	210 mg/L			
			SS	200 mg/L			
			NH_4-N	25 mg/L			

Table 5.3-7 Analysis of the wastewater treatment measures and treatment effect for each subproject

No.	Subproject	Treatment object	Facility name	Treatment effect
1	Linzhang subproject	Biogas liquid	——	47% biogas liquid is reused for fermentation; 53% biogas liquid is processed into liquid fertilizer (Humic acid＞3%, NPK≥20%)
		Sewage	Septic tank	All wastewater is reused for biogas fermentation
		Sewage from water softening station	—	Sprinkle for dust suppression
2	Anping subproject	Aquaculture wastewater	Sewage treatment station Anping sewage treatment plant	3-grade standard in table 4 from Integrated Wastewater Discharge Standard (GB8978-1996), standard from Livestock and Poultry breeding Industry Pollutant Discharge Standards (GB18596-2001) and water intrusion indicators for Anping Municipal sewage treatment plant
		Office worker, the life (CNG)	Sprinkle for dust suppression the water-tight pit latrines	——
3	Chengde subproject	Production wastewater	—	After soft water preparation, the surplus water is used for dust suppression
		Sewage	Septic tank	Reusing for biogas fermentation, all waste water can't effluent.
4	Zunhua subproject	Sewage	Septic tank	Reusing for biogas fermentation, all waste water can't effluent.
		Softening the wastewater	Sprinkle for dust suppression	——
5	Yutian subproject	Biogas liquid	Coagulation+hydrolytic acidification+3-grade aeration, the storage tank+stabilization pond	discharged into wastewater treatment station (achieve agricultural irrigation water quality standards), then into storage pool. reused for irrigation
		Sewage	Septic tank	Reusing for biogas fermentation, all waste water can't effluent.
6	Laoting subproject	Sewage	Septic tank	Reusing for biogas fermentation, all waste water can't effluent.
		Sewage water softening station	--	Sprinkle for dust suppression

Figure 5.3-1 Water balance in Yutian subproject



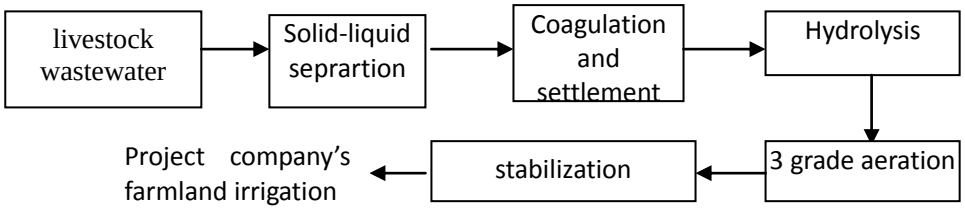


Figure 5.3-2 Yutian wastewater treatment process

Yutian wastewater treatment process use "coagulation+ hydrolytic acidification+3 grade aeration+ stabilization+disinfection (ClO_2)", the treated water quality meet the *Standards for Irrigation Water Quality* (GB5084-2005). According to the site survey, Yutian subproject relys on existing farm, the surrounding terrain can arrange adequate aeration tank, stabilization ponds and storage pool. The breeding farm keep strict implementation of manure separation, rain-sewage separation, solid-liquid separation, etc.

The breeding wastewater is firstly solid-liquid separated, then pass "coagulation+ Hydrolysis+3 grade aeration+ stabilization". The hydrolysis tank volume is 1500m^3, equipped with biological filler, HRT 24hours, COD removal efficiency 30%; 3 grade aeration+ stabilization volume is 3000m^3(each),each aeration tank is divided into three cells, the bottom is distributed with aeration tubes, each of the tube is installed four aerators, which have strong stirring and mixing capabilities, HRT 48hours, COD removal efficency50%; stabilization tank volume is 10000 m^3, water depth 0.5m, HRT 6days, COD removal efficency50%, BOD_5 removal efficency80%.

After the treatment, the wastewater can meet the *Standards for Irrigation Water Quality* (GB5084-2005), and is used for irrigation. According to the non-irrigation season (120 days), irrigation season (245 days), the wastewater discharged into storage pool during non-irrigation season will include: breeding wastewater 650 m^3/d, concentrated slurry supernatant 160 m^3/d, totally 810 m^3/d, 29.6×104m^3/y. yutian project presently has storage pool capacity 30×$10^4$$m^3$, all the wastewater discharged into the storage pool during non-irrigation season will be used for the irrigation of project company's farmland(3540mu), refer to "norm of water intake part 1: agricultural water(DB13)", the irrigation quantity in yutian area is 160 m^3/mu, 56.6×$10^4$$m^3$/y, the project farmland can exhaust all the water generated by the project. Besides, there is small amount of sludge produced by the wastewater treatment process, after drying, it will be taken away by local sanitation department.

Refer to table 5.3-8 for The influent and effluent water quality of water treatment facilities at all levels of Yutian project.

Table 5.3-8 The influent and effluent water quality of water treatment facilities at all levels of Yutian project unit：mg/L

item		COD	BOD_5	SS
wastewater	Influent water quality	2640	1400	1300
coagulation	Influent water quality	2640	1400	1300
	Influent water quality	1900	1120	260
Hydrolytic acidification	Influent water quality	1900	1120	260
	Effluent water quality	1330	780	280
3 grade aeration	Influent water quality	1330	780	280
	Effluent water quality	170	200	130
stabilization	Influent water quality	170	200	130
	Effluent water quality	90	40	60
Final effluent(after storage pool)	Effluent water quality	≤90	≤40	≤60
“standards for irrigation water quality (GB5084-2005)	Standards value	200	100	100
Standard analysis	--	√	√	√

Through the analysis of the water balance, biogas liquid producing, output and storage, the biogas liquid pool in each subproject can completely accommodate biogas liquid quantity for at least 7 days. Each subproject has reasonable wastewater measures and the wastewater is all used fully with small effect on the environment.

5.3.2.3 Analysis of acoustic environment impact

Grinder, mixer, pumps, other machinery and transport vehicles can cause noise during operation period in the project.

In addition, the regulator cabinet will also produce some noise and the sound pressure level is low (analogy with existing regulator cabinet, less than 55 dB). The noise level at three meters from regulator cabinet can reach the 1-grade standard of residential area according to prediction. The regulator cabinets in the project are all located in the region outside 200 meters of residential area, so there is no effect on the residents.

Linzhang subproject has direct-fired biogas engine for power generation, and the rated power is 100kW with no transformer. All electricity is used by the biogas plant and power generation process will produce noise.

The analysis for noise source intensity and prediction is shown as follows:
(Adopting the prediction models of factory noise from the *Technical Guidelines for EIA of the Acoustic Environment* (HJ2.4-2009))

Table 5.3-7 List of plant boundary noise prediction in each subproject dB(A)

Subproject	Prediction spot	Monitoring values for status		Contribution value	Superimposition values of prediction		Standard values	
		Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime
Linzhang subproject (power generation)	Eastern plant boundary	52.1	42.9	51.78	54.95	52.31	65	55
	Southern plant boundary	51.1	41.6	38.9	51.35	43.47	65	55
	Western plant boundary	50.9	41.0	51.9	54.44	52.24	65	55
	Northern plant boundary	50.9	40.3	33.53	50.98	41.13	65	55
Chengde subproject	Eastern plant boundary	39.3	37.4	41.5	43.6	42.9	60	50
	Southern plant boundary	43	39.2	46.2	47.9	47	60	50

	Western plant boundary	33.7	33.5	45.5	45.8	45.7	60	50
	Northern plant boundary	34.7	34.2	43.4	44	43.9	60	50
Yutian subproject	Eastern plant boundary	42.5	39.9	45.9	47.53	46.87	60	50
	Southern plant boundary	48.5	43.1	47.2	50.91	48.63	60	50
	Western plant boundary	43.4	40.9	36.3	44.17	42.19	60	50
	Northern plant boundary	42.5	39.9	45.9	47.53	46.87	60	50
Laoting subproject	Eastern plant boundary	48.9	43.8	45.0	40.2	40.2	60	50
	Southern plant boundary	48.2	42.4	29.5	46.2	46.2	60	50
	Western plant boundary	47.8	41.8	41.2	42.5	42.5	60	50
	Northern plant boundary	48.5	42.4	24.8	45.1	45.1	60	50
Anping subproject	Eastern plant boundary	52.8	46.3	45.9	47.53	46.87	60	50
	Southern plant boundary	55.9	48.7	47.2	50.91	48.63	60	50
	Western plant boundary	57.9	45.2	36.3	44.17	42.19	60	50
	Northern plant boundary	57.8	47.6	45.9	47.53	46.87	60	50
Zunhua subproject	Eastern plant boundary	50.6	35.9	45.0	40.2	40.2	60	50
	Southern plant boundary	48.8	37.1	29.5	46.2	46.2	60	50

	Western plant boundary	50.7	38.7	41.2	42.5	42.5	60	50
	Northern plant boundary	52.6	40.2	24.8	45.1	45.1	60	50

The local acoustic environment in each subproject is good, and noise prediction values of plant boundary all satisfy requirements for local acoustic environment quality with small effect on acoustic environment according to the acoustic environment status and noise prediction analysis in each subproject.

5.3.2.4 Analysis of solid waste impact

The amount of biogas residue and organic fertilizer production in each subproject is shown in table 5.3-8.

Table 5.3-8 The amount of biogas residue and organic fertilizer production in each subproject Unit (t/d)

Fermentation materials	Subproject	Biogas residue	Storage location and storing time for biogas residue	Adding yeast	Organic Fertilizer product
Pure straw	Chengde subproject	96.7 (Moisture content 65%)	Fully enclosed drying field 1500 m², 5-7 days	Additives (humus acid) 0.006	38.4 (Moisture content 15%)
	Linzhang subproject	73.7 (Moisture content 65%)	Fully enclosed drying field 1000 m², 5-7 days	Additives (humus acid) 0.006	30 (Moisture content 14%)
	Laoting subproject	97.83 (Moisture content 65%)	Aerobic compost bins 1500 m², 5-7 days	Extra nutrients 2	40 (Moisture content 14%)
Mixing straw and manure	Anping subproject	80.169 (Moisture content 75%)	Biogas residue drying field 1500 m², 5-7 days	Processing auxiliary material 40	80 (Moisture content 14%)
	Zunhua subproject	151.83 (Moisture content 65%)	Aerobic compost bins 8400 m³ Anaerobic digestion 12 days; Windrow compost bins 6000 m² Material aging 15-20 days	Mushroom fungus residue and chicken manure 49 (Moisture content 40%)	76.47 (Moisture content 15%)
Pure manure	Yutian subproject	205.80 (Moisture content 80%)	Biogas residue storage bin 60m³, Composting	Straw 14.8 (Moisture content	61.9 (Moisture content 15%)

			fermentation workshop 5890 m^2 5-7 days	10%)	

Table 5.3-9 Other solid waste production and storage spaces or disposal mode in each subproject unit: t/a

Subproject name	Solid waste name	Production	Disposal measures
Chengde subproject	Packaging of organic fertilizer waste gas	2	Recycled by materials sector
	Waste desulfurizer	10	Recycled by manufacturers
	Garbage	9	Regular removal by sanitation sector
Linzhang subproject	Waste desulfurizer	10	Recycled by manufacturers
	Discarded packaging	1	For sales
	Garbage	18.25	Regular removal to landfill
Laoting subproject	Waste desulfurizer	10	Recycled by manufacturers
	Discarded packaging	1	Delivered to landfill
	Garbage	16.06	Regular removal to landfill
Anping subproject	Biogas liquid filtration and sludge sedimentation	901.55	Temporarily stored in the sink filtration tower sump (design volume: 47 m^3), used for 3×10^4 mu circulation land of surrounding countryside
	Garbage	0.99	Collected and processed by local sanitation department
Zunhua subproject	Waste activated carbon	2	Recycled by manufacturers
	Garbage	5.11	Collected and processed by local sanitation department
Yutian subproject	Waste desulfurizer	120	Collected for sales
	Garbage and sludge	8.4	Removed by the sanitation department

5.3.2.5 Soil pollution

There is a certain environment risk of soil pollution in the project, such as collection process for manure, leakage of manure transportation pipeline and vehicles. All these are potential threat to soil contamination. Another pollution source for soil is the leakage of effluent biogas liquid from fermentation pond.

In addition, the biogas liquid and residue in the project are used for making organic fertilizer. If fertilizer application is excessive or the fertilizer is applied on saturated soil, the crop cannot utilize the nitrogen and phosphorus, causing excess nitrogen and phosphorus filtration. Weed of the field will use the residue nitrogen, which will lead to the faster growth of weed than crops, crop lodging, seed growth

retardation or developmental problems, etc. Heavy metal contamination on soil is another issue of concern. The specific mitigation measures refer to Section 5.3.3.4.

5.3.2.6 Manure collection, transportation and storage

Anping, Yutian and Zunhua subproject involve in the collection, transportation and storage of manure.

Table 5.3-10 The consumption of livestock manure for subproject

No.	Subproject name	Materials	Annual demand of the manure (manure+pig urine+washing water） (10^4 tons)
1	Anping subproject	Livestock manure is used as the main raw materials and ensilage straw is supplemented.	9.54
2	Yutian subproject	Livestock manure is used as the main raw materials and straw is used as the raw material for organic fertilizer.	11.62
3	Zunhua subproject	Chicken manure and straw are mainly used as raw material.	3

(1) Anping project

There are 5 pig farms affiliated to Hebei Yufengjingan farm Co., Ltd. Jingan pig farm has 114, 394 pigs, and the manure production is 228.8 t/d. The pig manures of the farm are treated in the way: 1. Drained and send into the composting site for the composting; the treated manures are sold to the farmers for application as the base fertilizer; after treated by the intra-plant sewage water treatment plan, the waste water is discharged to Anping municipal sewage treatment plant. Liangwagesi pig farm has 16, 282 pigs, and the daily manure and waste water production is 32, 560 t and 81.4 t, respectively. The manures and waste water will be all discharged into the existing biogas plant and the generated biogas is used for heating of biogas works and other purposes within the plant. The biogas residues that sold to the farmers around as the base fertilizer are stored in the biogas liquid tank.

After the completion of Anping biogas project, the manures of Jingan pig farm and Liangwasige pig farm as the raw materials of fermentation will be transported to the plant by the pipelines in this biogas subproject. According to the design, the requirement of manures for the project operation is 261.36 t/d, which can handle 653.4 t wastewater. Therefore, the manures generated by Jingan pig farm and Liangwasige pig could meet the requirement of the project, and it is not need to expand the farming scale or purchase the external manures.

The total pigs of Langren pig farm, Zhaotuan pig farm and Nanwangzhuang pig farm is 41, 550. The pigpens of Langren farm sweeps up the dungs by dry method, and pigpens in Zhaotuan and Nanwangzhuang farms sweep up the dungs using manure-soaking method, which will produce large amount of fecal water. The manure production is about 407.75 t/a. The manures and waste water produced by these pig farms will be all discharged into the internal buffer pools, and then sold to the farmers around as the fertilizer. Available information shows the impervious layers have not been set for these buffer pools in the early stage of construction, which will affect the groundwater around in some extend. The manure of the 3 pig farms will be piped to the plant for biogas power generation until the biogas power generation project of Hebei Yufengjingan breeding Co., Ltd is completed, the existing tanks without lining layers will be cancelled.

(2) Yutian project

Yutian Yiheyuan ecological agriculture Co., Ltd plans to breed 30, 000 hogs and 100, 000 chickens. The annual production of chicken manure is 4, 380 t, pig manure is 21, 900 t and breeding wastewater is 79, 935 m^3. The livestock and poultry manure and pig urine are discharged into the biogas plants. After the solid-liquid separation, the biogas liquid and biogas residues could all be applied to farmland of the company. The breeding wastewater is firstly solid-liquid separated, then pass the process of "coagulation+ hydrolytic acidification+3 grade aeration+ stabilization+disinfection" to meet the water quality for agricultural irrigation .

After the treatment, the wastewater can meet the *Standards for Agricultural Irrigation Water Quality* (GB5084-2005), and is discharged into storage pool before used for irrigation. There is impermeable layer under the storage pool, which can effectively prevent the impact on regional groundwater.

(3) Zunhua project

Hebei Meikeduo Food Co., Ltd have 8 chicken farms that is within the distance of 5 km of Zunhua subproject, and the total amount of chickens is about 1330, 000. The annual manure production is 43, 200 t, most of which is applied as base fertilizer to the private farmland or used by the farmers at free of charge. The rest of the fertilizer is sold out as the raw materials for generation of biogas.

Depending on the design, the biogas project of Zunhua could handle 25, 000 t of chicken manure and the processing of organic fertilizer could handle 5, 000 t, annually. Therefore, this subproject could handle most of the manure.

5.3.3 Analysis for environmental impact of environmental sensitive receptors in operation period

5.3.3.1Analysis of the atmospheric environmental impact

The major air pollutants in operation period of biogas plants are air-borne dust from straw chopping and organic fertilizer process, odor (H_2S, NH_3) produced during fermentation materials pretreatment, fermentation tank discharge and aerobic composting for organic fertilizer and flue dust, SO_2 and NOx generated by boiler (biomass briquetting, self-produced biogas, or other energy) in biogas plants and torch. The main air pollutants in operation period of gas filling stations are exhaust gas discharged by vehicles coming and going and present risk of biogas leakage. The possible risk of biogas leakage exists without other atmospheric pollutants in operation period of gas pipeline.

The sensitive receptors around the biogas plants are few in each subproject. After adopting some measures such as dust elimination, odor elimination and desulfurization, the analysis for pollutant source strength and emission prediction indicates that atmospheric pollutants in biogas plants all can reach the limit requirements from *Integrated Emission Standard of Air Pollutants* (GB16297-1996) or *Health Design Standard of Industrial Enterprises* (TJ36-79) and requirements for the maximum allowable concentration of atmospheric harmful substances in residential district. Moreover, emergency plan for the biogas plants, gas filling station and gas pipeline have been compiled to prevent the biogas leakage. The risk of biogas leakage can be minimized through regular inspection, equipment maintenance and security operations, etc, and the effect on surrounding sensitive receptors is small after the implementation of the project.

5.3.3.2 Analysis of water environmental impact

The major wastewater is sewage and biogas liquid produced by fermentation in the project. A part of production wastewater is discharged into the local sewage treatment plant in Anping subproject and all production wastewater is reused for fermentation without being discharged. However, other environmental risks may exist, such as leakage from fermentation pond.

There is no surface water body near each subproject. Anti-seepage measures is made for the structures containing liquid, such as fermentation pond, biogas liquid pool and straw ensilage pools, without causing pollution to local groundwater.

Moreover, manure used for fermentation in the project is transported by water-tight tanker or sewage pipelines to prevent manure leakage in the process of transport/delivery.

Drinking water surrounding the project all comes from the deep groundwater or central water supply by local water plant. The wastewater will cause no impact on surrounding water environment in operation period after taking the above measures.

5.3.3.3 Analysis of acoustic environmental impact

The machinery in operation period such as grinder, mixer, water pumps and regulator cabinets can cause noise, as well as transport vehicles. This project adopts soundproof and noise reducing, base-isolation and regular maintenance for equipment, etc. After taking the above measures, plant boundary noise will meet the *Emission Standard for Industrial Enterprises Noise at Boundary* (GB12348-2008) through analysis of source intensity prediction. Noise in gas filling station mainly comes from vehicle and filling equipment and no noise exist during operation of gas pipelines.

5.3.3.4 Analysis of soil environmental impact

There is a certain environment risk for soil pollution in the project, such as from the collection process of manure, leakage of manure transportation pipeline and leakage during biogas liquid outflow from fermentation pond and so on. In addition, the biogas liquid and residue is used for making organic fertilizer. Thus, there is a risk of soil contamination caused by excessive application of organic fertilizer.

For the leakage risk of manure transport/delivery process and fermentation pond overflow, the EIA for each subproject includes the corresponding emergency plan for environmental risks. The risk can be minimized through safety training, equipment maintenance, setting up signage, etc.

In addition, the application rate of liquid and solid organic fertilizer, application timing and frequency of sampling and testing should be considered on basis of soil properties (soil texture, cation exchange capacity, soil minerals, etc.) and climate conditions in order to ensure that the total application amount of fertilizer is not excessive that would cause soil nutrient overload. The status of soil quality, organic fertilizer component and raw material component on the farm land are investigated in the project. The suitable application rate of organic fertilizer is calculated. The specific information is shown in 5.3.4.5 soil pollution prevention.

The biogas liquid from fermentation pond must be monitored strictly (sampling and analysis of the nutrient content, periodic testing of heavy metal content) to ensure

obtain optimum application rate to meet the needs of crop growth before application.

5.3.4 Pollution prevention and control measures in operation period

5.3.4.1 Waste gas treatment

(1) Boiler waste gas treatment

The processes of fermentation and organic fertilizers drying in each subproject need boiler and oven to provide heat source. The primary energy used is generally self-produced biogas, and biomass briquetting, etc. Boiler exhaust gas will be generated in the heat production process and the main air pollutants are PM, SO_2, NOx. Subprojects of Linzhang, Anping and Chengde use biogas as energy for boiler, hot air stove or oven. Yutian subproject adopts dual purpose biogas- coal boiler. Zunhua and Laoting subprojects use biomass briquetting boilers. Each subproject adopts measures, such as exhaust stack (>10 m), dust collector and catalytic combustion, in order to ensure that emissions of boiler waste gas meet the standard.

(2) Some steps in each subproject are likely to produce odor, such as manure material collection, premixing and feeding, fermentation tank discharge, biogas liquid and residue transportation, aerobic composting, organic fertilizers drying and so on. Thus, the project should take management measures to reduce the emission of odour. For example, each subproject uses enclosed fermentation tank and biogas liquid pool and installs biofiltration deodorization system and exhaust stack in organic fertilizer production workshop to enhance ventilation; Transportation of manure material and biogas liquid and residue adopts enclosed tankers to reduce odor emissions.

(3) The operation process of fermentation tank is controlled strictly to prevent or minimize toxic gases emissions. The maximum allowable concentration of harmful substances in ambient air is CO_2 0.04 mg/m^3; H_2S 0.01 mg/m^3; NH_3 0.2 mg/m^3. Other contaminants concentration should meet the Health Design Standard of Industrial Enterprises (TJ36-79)

(4) The collection and transportation for manure should be managed strictly to prevent leakage of pipeline or truck.

(5) Trees are planted in critical and surrounding area to absorb or reduce

volatile gases, toxic gases, dust and odor.

(6) Good management practices must be carried out strictly in biogas digester design and operation.

(7) The staff in the project should accept training and education to understand the environmental risk caused by improper operation of digesters.

(8) Air quality monitoring program in the project area should be developed, especially for the area around the digesters. Ambient Air Quality Standards (GB3095-2012) and Health Design Standard of Industrial Enterprises (TJ36-79) must be complied with strictly.

Table 5.3-9 Treatment measures for waste gas in each subproject

Subproject	No.	Treatment objects	Facility name	Exhaust stack height (m)	Quantity (units / sets)	Acceptance criteria
Linzhang subproject	1	Dust from straw chopping	Simple dust removal facilities	15	1	Dust emissions meet the 2-grade requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996); Unorganized dust emissions meet the relevant limit requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996)
	2	Dust from organic fertilizer production workshop	Exhaust fan	—	20	
	3	Flue gas from gas-fired boiler	10 m Exhaust stack	10	1	Flue gas emission meet the Ⅱ period requirement of table 1 and table 2 from Emission Standard of Air Pollutants for Coal-burning Oil-burning Gas-fired Boiler (GB13271-2001)
Anping subproject	1	Manure receiving tank, liquid tank	Biofilter +15 m Exhaust stack	15	1	Meeting the corresponding requirement of table 2 from Emission Standards for Odor Pollutants (GB14554-93)
	2	Gas-firing	Cyclone	15	1	Meeting the corresponding

		drying stove	dust collector + catalytic combustion system +15 m exhaust stack			requirement of table 2 from Emission Standards for Odor Pollutants (GB14554-93)
	3	Air-drying filed of biogas residue and production workshop of solid/liquid organic fertilizer	Exhaust fan	—	—	Meeting the 2-grade requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996)
	4	Storage tank in CNG	Station area is open, natural diffusion	—	—	Meeting the corresponding requirement of table 2 from Emission Standards for Odor Pollutants (GB14554-93)
Chengde subproject	1	Dust from straw chopping	Simple dust removal facilities	15	1	Meeting the 2-grade requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996)
	2	Dust from straw chopping	Simple dust removal facilities , emission by a 15 m exhaust stack	15	1	Meeting the requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996)
	3	Flue gas from gas-fired boiler	Using clean energy of biogas and direct emission by 15 m exhaust stack	15	1	Meeting the Ⅱ period requirement from Emission Standard of Air Pollutants for Coal-burning Oil-burning Gas-fired Boiler (GB13271-2001)
	4	Flue gas from gas-firing hot blast stove	Direct by 15 m exhaust stack	15	1	Meeting the Ⅱ period requirement from Emission Standard of Air Pollutants for Coal-burning Oil-burning Gas-fired Boiler (GB13271-2001)
	5	Odor	Air-drying	——	1	Meeting the plant boundary

			filed for biogas residue is totally enclosed type of heated board. The top of biogas liquid is set up with cover plate. Workshop ventilation is strengthen.			requirement of table 1 from Emission Standards for Odor Pollutants (GB14554-93)
Zunhua subproject	1	Anaerobic fermentation, the material discharge, aerobic composting closed bin	Biofilter +15 m Exhaust stack	15		Meeting the corresponding requirement of table 2 from Emission Standards for Odor Pollutants (GB14554-93)
	2	Biomass boiler	Cyclone dust collector + catalytic combustion system +30 m exhaust stack	30		Meeting the II period requirement in table 1 and table 2 from Emission Standard of Air Pollutants for Coal-burning Oil-burning Gas-fired Boiler (GB13271-2001)
	3	Raw material mixing zone, production workshop of organic fertilizer	Exhaust fan			Meeting the plant boundary requirement of table 1 from Emission Standards for Odor Pollutants (GB14554-93)
	4	Dry raw grinder	Thimbleful unorganized dust emissions			Meeting the requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996)
Laoting subproject	1	Dust from straw chopping	Simple dust removal facilities	3	1	Dust emission meets the 2-grade requirement in table 2 from Integrated

	2	Dust from liquid organic fertilizer production workshop	Exhaust fan		20	Emission Standard of Air Pollutants (GB16297-1996); Unorganized dust emission meets the unorganized emission limit in table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996).
	3	Boiler dust	Simple dust removal facilities +20 m exhaust stack	20		Meeting the requirement from Emission Standard of Air Pollutants for Coal-burning Oil-burning Gas-fired Boiler (GB13271-2001)
Yutian subproject	1	Biogas pool and fermentation tank	Biofilter system +15 m exhaust stack	15	a set	Meeting the standard of new reconstruction and extension in table1 and table 2 from Emission Standards for Odor Pollutants (GB14554-93).
	2	Gas-fired boiler	Direct emission by 15 m exhaust stack	5	a set	Meeting the Ⅱ period emission standard of gas-fired boiler pollutants in table 1 and table 2 from Emission Standard of Air Pollutants for Coal-burning Oil-burning Gas-fired Boiler (DB13/841-2007) (GB13271-2001)
	3	Fermentation workshop, room for screening and product storage	Strengthening the ventilation in workshop		——	Meeting the 2-grade standard of new reconstruction and extension in table1 from Emission Standards for Odor Pollutants (GB14554-93).
	4	Room for auxiliary material crushing and storage	Strengthening the ventilation in workshop		——	Meeting the requirement of table 2 from Integrated Emission Standard of Air Pollutants (GB16297-1996)

5.3.4.2 Sewage treatment

The project needs to fully consider the various technical and management plan, reasonable planning in order to meet the environmental requirements.

The fermentation pond must be designed strictly in accordance with corresponding technical specifications. The determination of important parameters, such as the soil permeability coefficient of construction site for fermentation pond, needs to be obtained by measuring the permeability rate of each soil layers.

When fermentation pond must discharge wastewater, the effluent wastewater needs to meet the 3-grade requirement of table 4 from *Integrated Wastewater Discharge Standard* (GB8978-1996).

The bank protection of fermentation pond should be constructed strictly in accordance with the relevant design standard to ensure that dike protection will not collapse even in the worst weather condition.

The design, operation technology and management practices for biogas digester must be implemented.

The environmental and health education program should be carried out in the area, which uses organic fertilizer as crop fertilizer, to make the public understand the harm of direct biogas liquid discharge into water bodies. Biogas liquid from digesters should be stored in the storage pond and used as irrigation water.

Table 5.3-10 Treatment measures of wastewater in each subproject

Subproject	No.	Treatment objects	Facility name	Quantity (units / sets)	Acceptance Criteria
Linzhang subproject		Sewage	Septic tank	2	Reused for biogas fermentation, all waste water can't effluent.
		Wastewater from water softening station	—	—	Sprinkled for dust suppression
Anping subproject	1	Breeding wastewater	Biogas liquid is discharged into Anping sewage treatment plant after pouring to sewage treatment station in Yufengjingan breed farm.	/	3-grade standard in table 4 from *Integrated Wastewater Discharge Standard* (GB8978-1996), standard in table 5 from *Livestock and Poultry breeding Industry Pollutant Discharge Standards* (GB18596-2001) and water intrusion indicators for Anpingxian sewage treatment plant

	2	sewage	Sprinkle for dust suppression; Installing the water-tight pit latrines	1	——
Chengde subproject	1	Biogas liquid	Circulating water system	1	Surplus water from water softening is used for dust suppression
	2	sewage	Septic tank	2	Reused for biogas fermentation, all wastewater can't effluent.
Zunhua subproject	1	sewage	Septic tank	1	Reused for biogas fermentation, all wastewater can't effluent.
Yutian subproject	1	sewage	Septic tank	1	Reused for biogas fermentation, all wastewater can't effluent.
	2	Wastewater treatment station	Aeration tank, storage tank	2	Discharged into wastewater station, meet the *Standards for irrigation water quality*(GB5084-2005), be used for irrigation
Laoting subproject	1	Sewage	Septic tank	2	Reused for biogas fermentation, all wastewater can't be discharged into waters out of the plant.
	2	Wastewater from water softening station	--	--	Sprinkled for dust suppression

For subprojects using straw for fermentation, a part of biogas liquid in Linzhang and Chengde subprojects is reused for fermentation and the other part is used for production of liquid organic fertilizer. A part of biogas liquid in Laoting subproject is reused for fermentation, and the other part will be taken away regularly by farmers and used as fertilizer for crops. Subprojects of Linzhang, Chengde and Laoting are equipped with biogas liquid pool which can store the liquid for the at least 3 days of biogas liquid productivity.

In order to prevent from the odour pollution of the biogas liquid pool and overflow caused by the high-intensity rainfall, the biogas liquid pool adopts gland sealing design in each subproject. To ensure that the biogas liquid should be disposed reasonably and not exceed the volume of the storage pool, agreement about the supply and transportation of biogas liquid and liquid organic fertilizer must be signed with the users. So that the biogas liquid produced can be carried away timely.

The fermentation pool and the biogas liquid pool in each subproject must adopt leakage prevention measures in order to prevent the biogas liquid infiltration caused by the break-up of the fermentation pool. Each subproject has little effect on the local water environment after executing the above measures.

5.3.4.3 Noise treatment

The main noise in operation period comes from the pumping station and other machinery. The main pollution control measures for acoustic environmental are shown as follows:

(1) The operation of equipment causing noise must be placed in the closed room

(2) Some measures should be adopted for machinery causing larger noise, such as base-isolation, setting up damper hold and using insulation materials.

(3) The production equipment should be maintained regularly in order to ensure them in the best working state and the lowest noise level as possible.

(4) Idle facilities must be in the state of power off or sleeping.

The noise should follow the *Emission Standard for Industrial Enterprises Noise at Boundary* (GB12348-2008). Table 5.3-13 lists the details for the standard.

Table 5.3-11 Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008) dB(A)

Scope of application	Grade	Daytime	Nighttime
Area of living, and education and hospital areas	1	55	45
Mixed area of residential, business and industrial, the central area of business district	2	60	50
Industrial area	3	65	55
Two sides area of traffic trunk road	4	70	55

Table 5.3-12 Treatment measures for noise in each subproject

Subproject name	No.	Treatment objects	Facility name	Quantity (units/ sets)	Acceptance criteria
Linzhang subproject	1	Crusher, screening machine, draught fan, dryers, solid-liquid separator, rotor pump	Muffler, vibration damping pads, closed maintenance structure of workshop	Several	GB12348-08 Class 3 standards

		and generator, etc			
Anping subproject	1	Solid-liquid separator, pipeline pump, dryers, mixer, granulator, screening machine, crusher, etc	Installing base-isolation, workshop doors and windows and sound-absorbing materials for wall	Several	GB12348-08 Class 2 standards
Chengde subproject	1	Crusher, screening machine, dryer	Base-isolation+ sound-proofing of workshop	Several	GB12348-08 Class 2 standards
	2	Fan	Muffler + sound-proofing of workshop		
	3	Pumps, sludge pumps	Sound-proofing of workshop		
Zunhua subproject	1	Dryers, mixer, granulator, screening machine, crusher, etc	Choosing low-noise equipment, installing base-isolation, mufflers and acoustic enclosures	Several	GB12348-08 Class 2 standards
Yutian subproject	1	Fan, blender, belt conveyor, pipeline pump, crusher, etc	Choosing low-noise equipment, installing base-isolation, mufflers and acoustic enclosures	Several	GB12348-08 Class 2 standards
Laoting subproject	1	Fan	Muffler, vibration damping pads	Several	GB12348-08 Class 3 standards
	2	Crusher, screening machine, draught fan, dryers, solid-liquid separator, rotor pump and generator, etc	Vibration damping pads, closed maintenance structure of workshop	Several	GB12348-08 Class 3 standards

As shown in table 5.3-7 Analysis of the noise level prediction and mitigation measures for each subproject, the local acoustic environment in each subproject is good. Through the above measures for noise reduction, the noise prediction values of plant boundary all satisfy requirements for local acoustic environment quality.

5.3.4.4 Disposal measures for solid waste

Table 5.3-13 Disposal measures for solid waste in each subproject Unit t/a

Subproject name	Treatment objects	Amount	Facility name	Acceptance criteria
Linzhang subproject	Biogas residue	2.69×10^4	Using for organic fertilizer production	Proper disposal for solid
	Waste	10	Recycled by manufacturers	

	desulfurizer			waste
	Waste packaging	1	Regular removal to landfill	
	Garbage	18.25		
Anping subproject	Biogas residue	2.93×10^4	Using for organic fertilizer production	Proper disposal for solid waste
	Biogas liquid filtration, Sediment sludge	901.55	Temporarily stored in the sink filtration tower sump (design volume: 47 m^3), used for 3×10^4 mu circulation land of surrounding countryside	
	Garbage	0.99	Regular removal by sanitation sector	
Chengde subproject	Biogas residue	3.5×10^4	Using for organic fertilizer production	Proper disposal for solid waste
	Waste desulfurizer	2	Recycled by manufacturers	
	Waste packaging	10	Recycled by materials sector	
	Garbage	9	Regular removal to landfill	
Zunhua subproject	Biogas residue	11.84×10^4	6.3×10^4 t of biogas residue is reused for fermentation and 5.54 $\times10^4$ t is used for organic fertilizer production.	Proper disposal for solid waste
	Waste activated carbon	2	Recycled by manufacturers	
	Garbage	5.11	Collected and processed by local sanitation department	
Laoting subproject	Biogas residue	3.57	Using for organic fertilizer production	Proper disposal for solid waste
	Waste desulfurizer	10	Recycled by manufacturers	
	Waste packaging	1	Regular removal to landfill	
	Garbage	16.06	Regular removal to landfill	
Yutian subproject	Biogas residue	7.48	Using for organic fertilizer production	Proper disposal for solid waste
	Waste desulfurizer	120	Collected for sales	
	Garbage and sludge	8.4	Regular removal by sanitation sector	

Analysis from the above table indicates that the solid waste in each subproject is used as much as possible and disposed reasonably with small impact on environment,

solid waste disposal measures are reasonable.

5.3.4.5 Soil pollution control

The possible soil pollution in the project is caused by excessive application of biogas liquid, biogas residue and organic fertilizer, especially nitrogen pollution and heavy metal contamination causing phytotoxicity.

(1) Application rate of organic fertilizer

The application rate of liquid and solid organic fertilizer, application timing and frequency of sampling and testing should be considered on basis of soil properties (soil texture, cation exchange capacity, soil minerals, etc.) and climate conditions in order to ensure that the total application amount of fertilizer is not excessive without causing soil nutrient overload.

Refereeing to calculation method about land application rate for digested sludge from *Wastewater Engineering-Treatment and Reuse* (Fourth Edition, Chemical Industry Press), the most suitable application rate of chemical fertilizer and organic fertilizer is determined. The application amount of fertilizer should not only meet the need of plant growth, but also ensure that the leaching loss of soluble nutrients through plant root is the minimum. The biogas liquid from fermentation pond must be monitored strictly (sampling and analysis of the nutrient content, periodic determination heavy metal content) to ensure obtain optimum application amount to meet the needs of crop growth before application.

The application amount of organic fertilizer for soil is calculated as follows:

$$L_N = [NO_3 + k_v(NH_4) + f_n(N_o)]F$$

Where Ln is the annual quantity of Nitrogen available for plants, gN/kg(lbN/t(US));

NO_3 is the percentage of Nitrate Nitrogen in Bio-solids;

k_v is the volatile coefficient of ammonia loss, counted by decimal;

0.5 for surface applying liquid sludge;

0.75 for surface applying dewatered sludge;

1.0 for injected liquid sludge or dewatered sludge;

NH_3 is the percentage of Ammonia nitrogen, counted by decimal;

f_n is the mineralization coefficient of the organic nitrogen;

0.5 for digested sludge in warm weather;

0.4 for digested sludge in cold weather;

0.3 for composting sludge or cold weather;

N_o is the percentage of organic nitrogen in sludge, counted by decimal;

F is the conversion coefficient, 1000g/kg dry solid (lb/t(US))

Taking the wheat, a northern common crop, for example, the northern common soil is brown soil with 1.34 t/m ^{3} soil bulk density and 0.15 m of topsoil depth. The surface fertilization, a common fertilization pattern for northern area, is adopted. The recommended application amount is 9 t/hm ^{2}a of liquid organic fertilizer and 11 t/hm ^{2}a of solid organic fertilizer.

(2) Heavy metal pollution control

Some subprojects uses livestock manure as raw materials for fermentation and the biogas liquid and residue generated is used for production of organic fertilizer. In the process of livestock and poultry breeding, the feed and additive containing heavy metal would cause the heavy metal enrichment in livestock manure. Thus, the organic fertilizers produced also contain a certain amount of heavy metals. Take the test results of organic fertilizer (Hebei Runze Zhimin agricultural science and Technology Co., Ltd, Table 4.4-1) for example, long-term application of organic fertilizer containing heavy metals can lead to heavy metal pollution in soil.

Here refereeing to calculation method about land application loading rate for pollutants from Wastewater Engineering-Treatment and Reuse (Fourth Edition, Chemical Industry Press), the heavy metal loading and land area requirements are calculated as follow:

$$L_s = \frac{L_c}{CF} \qquad (14\text{-}38)$$

Where Ls is the max quantity of annual biosolids application, mg/hm^2 a (t (US)/ac a)

Lc is the max quantity of annual component application, mg/hm^2 a (t (US)/ac a)

C is the concentration of pollutants in the biosolids, counted by decimal(mg/kg);

F is the conversion coefficient, 0.001kg/mg (0.002 lb/t(US))

Metal concentration and loading rate of Biosolids land

pollutants	Upper limit concentration		Cumulative pollutant loading		High quality pollutant concentration		Annual pollutant loading rate	
	lb/t(US)	mg/kg	lb/t	mg/kg	lb/t	mg/kg	lb/t	mg/kg
Arsenic	0.15	75	37	41	0.08	41	1.78	2.0
Cadmium	0.17	85	35	39	0.08	39	1.70	1.9
Chrome	--	--	--	--	--	--	--	--
Copper	8.60	4300	1338	1500	3.00	1500	66.91	75

Take Linzhang subproject for example, the basic heavy metal load factor is calculated according to heavy metal concentration in solid organic fertilizer and liquid organic fertilizer (table4.4-1)

Table 4.4-1 The heavy metal load factor in organic fertilizer from Hebei Runze Zhimin agricultural science and Technology Co., Ltd

	Test item	Pollutant concentration	Annual pollutant load factor kg/hm a	Load factor on the basis of the monitoring project Mg/hm a	Limit rate Mg/hm a	Suitable application amount t/hm ²a
Solid organic fertilizer	Total Cd, mg/kg	1	1.9	1900	789	0.789
	Total Pb, mg/kg	19	15	789		
	Total Cr, mg/kg	5	——	——		
	Total As, mg/kg	1	2.0	2000		
Liquid organic fertilizer	Total Cd, mg/ L	4	1.9	475	475	0.475
	Total Pb, mg/L	16	15	938		
	Total Cr, mg/L	8	——	——		
	Total As, mg/L	2	2.0	1000		

Through the above analysis combining the calculation result of organic fertilizer

application amount and soil heavy metal pollution load, the recommended application amount is 0.475 t/hm ²a of liquid fertilizer and 0.789 t/hm ²a of solid organic fertilizer, which meet the need of crop growth necessary without causing toxicity to crops.

Table 5.2-14 The anti-seepage treatment and prevention measures in each subproject

Subproject name	Treatment objects and /Facility name	Acceptance criteria
Linzhang subproject	The floor of the workshop puts 15 cm of concrete bedding on the bottom and 10~15 cm of cement concert on the upper layer.	Permeability coefficient of each unit $\leq 10^{-7}$ cm/s
	The rainproof, anti-seepage for ground and drainage ditches should be carried out for open storage area. The ground of storage area puts 15 cm of concrete bedding on the bottom and 10~15 cm of cement concert on the upper layer.	
	Biogas liquid pool and ensilage pool adopt over ground steel and concrete structure and the bottom of the pool is treated anti-seepage.	Permeability coefficient $<10^{-10}$ cm/s
Anping subproject	The cell bodies of sewage receiving pool, deodorization pool, biogas liquid pool and air-drying filed for biogas residue are treated with anti-seepage. The bottom of these cell bodies is paved fully with 300 mm of claypan (protective layer, also as auxiliary impermeable layer). Then HDPE-GCL complex anti-seepage system (2 mm of high-density polyethylene film, 300 g/m ²of geosynthetic clay liner) is paved on the claypan. Finally the upper part plus 15 cm of anti-corrosion concrete to enable that the permeability coefficient is not larger than 10^{-10} cm/s.	Permeability coefficient $<10^{-10}$ cm/s
Chengde subproject	The ground of biogas residue storage yard, production workshop and warehouse is paved with 15 cm of concrete bedding on the bottom and 10~15 cm of cement concert on the upper layer. to enable that the permeability coefficient is smaller than 10^{-7} cm/s. Biogas liquid pool and ensilage pool adopt over ground steel and concrete structure with anti-seepage and anticorrosion treatment, in order to enable that the permeability coefficient is not larger than 10^{-10} cm/s. The other region in the plant area all adopt anti-seepage treatment by concrete hardening, in order to enable that the permeability coefficient is smaller than 10^{-7} cm/s.	Permeability coefficient for structure $K<1\times10^{-7}$ cm/s
Zunhua subproject	(1) The cell bodies of anaerobic fermentation tank, composting pool and raw materials mixing zone are treated with anti-seepage. The bottom of these cell bodies is paved fully with 300 mm of claypan (protective layer, also as auxiliary impermeable layer). Then HDPE-GCL complex anti-seepage system (2 mm of high-density polyethylene film, 300 g/m ² of geosynthetic clay liner) is paved on the claypan. Finally the upper	Permeability coefficient for structure $K<1\times10^{-12}$ cm/s

	part plus 15 cm of anti-corrosion concrete to enable that the permeability coefficient is not larger than 10^{-10} cm/s. (2) The sewage pipelines adopt PVC impervious material to ensure that the permeability coefficient is not larger than 10^{-10} cm/s.	
	(3) The ground of workshops for organic fertilizer production and warehouse firstly adopt concrete treatment in anti-seepage structure. Then cement is used for hardening treatment to ensure that the permeability coefficient is not larger than 10^{-7} cm/s.	Permeability coefficient for structure $K<1\times10^{-7}$cm/s
Laoting subproject	The ground of the workshop is paved with 15 cm of concrete bedding on the bottom and 10~15 cm of cement concert on the upper layer.	Permeability coefficient of each unit $\leq10^{-7}$ cm/s
	The rainproof, anti-seepage for ground and drainage ditches should be carried out for open storage area. The ground of storage area is paved with 15 cm of concrete bedding on the bottom and 10~15 cm of cement concert on the upper layer.	
	Biogas liquid pool and ensilage pool adopt over ground steel and concrete structure and the bottom of the pool is treated anti-seepage.	Permeability coefficient < 10^{-10} cm/s
Yutian subproject	The ground of workshops for martial mixing, fermentation, screening, product storage and auxiliary material crushing is all treated with anti-seepage. The ground is paved with 15 cm of concrete bedding on the bottom and 10~15 cm of cement concert on the upper layer to ensure that the permeability coefficient is smaller than 10^{-7} cm/s.	Permeability coefficient of each unit $\leq10^{-7}$ cm/s
	The cell bodies of mixing pool, regulating reservoir and biogas liquid pool are treated with anti-seepage .The bottom of these cell bodies is paved fully with 300 mm of claypan (protective layer, also as auxiliary impermeable layer). Then HDPE-GCL complex anti-seepage system (2 mm of high-density polyethylene film, 300 g/m ^{2}of geosynthetic clay liner) is paved on the claypan. Finally the upper part plus 15 cm of anti-corrosion concrete.	Permeability coefficient of each unit $\leq10^{-10}$ cm/s

5.3.4.6 Pollution control of the manure collection, transportation and storage

Because the breeding farm is close to the biogas plants, Anping project use underground pipeline for the transportation of manure. The pipeline is short and watertight, the depth of the pipe laying and the pipe materials have taken into account the impact of the external environment by the pipeline, so as to reduce the risk of pipeline break and pollution to the soil and groundwater; the manure collection pond is also lined with a volume for storing the amount of one-month productivity of the

liquid. There are gate valves on both ends of the pipeline, once a fault occurs, the manure transportation can be immediately stopped, to avoid the manure collection pond overflow. The above facilities are all lined and under ground, no odor impact would happen.

Zunhua subproject need to add a certain amount of chicken manure in biogas and organic fertilizer production. Closed tankers are to be used for the transportation, the manure transportation quantity is determined by the production needs, thus no need to set the manure storage pool at the biogas plant. There is only a small amount of odor produced during the raw material mixing and organic fertilizer drying process, after taking biofilter measures, the impact on surrounding environment would be very small.

Yutian project uses pig manure and chicken manure from its own breeding farm to produce biogas. The project use underground pipeline for the transportation of manure. The pipeline is short and lined, the depth of the pipe laying, pipe materials have taken into account the impact of the external environment by the pipeline, to reduce the risk of pipeline break and pollution to the soil and groundwater; the manure collection pond is also impervious, with a volume capable of accommodating the liquid of one moth productivity. There are gate valves on both ends of the pipeline, once a fault occurs, the manure transportation can be immediately stopped, to avoid the manure collection pond overflow. The above facilities are all impervious, and located under ground, no odor impact would happen.

5.4 Social Impact Analysis

5.4.1 Positive impacts

After the implementation of this project, 19.1367×10^4 tons of straw and 23.31×10^4 tons of animal manure are consumed per year, producing 4282.97×10^4 m^3 /a of biogas, 7.91×10^4 tons/a of solid organic fertilizer and 4.79×10^4 tons/a of liquid fertilizer and offering cooking energy and heating for 20.46×10^4 households. The environmental quality of project area can improve obviously, benefiting significantly

for the protection of the local water and the improvement of the agricultural production conditions and the living environment. In addition, the project can reduce emission of methane caused by random pile up of excrement and liquid manure. Chemical fertilizer can be replaced by organic fertilizer and all kinds of compost. Besides, the utilization of liquid fertilizer can replace 18.77% of chemical fertilizer per mu, reducing the wastage rate of nutrients and the mining of mineral, keeping ecological balance and improving soil quality.

The implementation of the project is good for enhancing the environmental awareness of governments at all levels in Hebei province and the breeding industry, guiding local government and farming enterprise to become environment friendly. The project can also improve the life quality of local people by providing rural residents with clean and beautiful environment and reducing the odour. Constructions of the project will expand the domestic demand and drive the development of building materials industry, not only stimulate the demand side on the local building materials market, but also developing the local rural economy and the related industries.

(1) Promoting the local sustainable economic development and providing good rural environment. The project of biogas exploitation and utilization not only can help improve and protect environment, but also can develop regional economy by using the bio-gas produced from the project. Moreover, biogas liquid and residue produced from the process of biogas production can be used as organic fertilizer to produce the organic, green and pollution-free agricultural products, benefiting the good cycle of agro-ecological system and creating a good living environment for the local ethnic minorities.

(2) Increasing the utilizing efficiency of straw and improving the environmental quality. According to the investigation, local peasants need to hire straw-crushing machines with the price of 100 yuan per mu, which brings high economy pressures and labor cost for local people. Some peasants burn straw directly in order to save money, which causes serious environmental pollution. The implementation of the Hebei Rural New energy development project will contribute to the straw recycling in local area, decreasing the peasants' economic burden, and optimizing the rural

environment at the same time.

(3) Increasing the job opportunities for the local ethnic minorities and the income of peasants. Although Hebei province is located in North China Plain region, the rural land area per capita is declining due to the accelerating urbanization. An investigation for the influence on project construction, which was conducted by the social team, shows that the revenue gained from farming for a family has gradually reduced to 30%, while the income ratio from the migrant workers has accounted for a larger proportion, even as high as 70%, while the migrant population proportion is more than 50%. The implementation of Hebei Rural New energy development project will increase the employment opportunities and income for the local peasants, making it possible for them to take care of their families while working. At the same time, a large number of non-technical jobs will be provided during the project construction and the service/maintenance after the completion of the project, increasing non-agricultural employment opportunities in the short term, and the local poor people and women will be preferential to the employment.

(4) Improving the population quality via training and education. The results of social and economic survey indicate that environmental awareness of labor force in the project area is low and a lot of rural youth and better educated people switch into non-agricultural industry. The three major characteristics of labor force in agriculture and aquaculture are poor educated, feminization and aging. Therefore, it is difficult to adopt advanced technology and adjust the agricultural structure. With the implementation of this project, the related training and education will be provided to promote the quality of the population and the local economic development.

(5) The implementation of the subprojects will help promote infrastructure upgrading and perfection in the project area. Building a batch of pilot project for rural waste comprehensive utilization, will help enhance the environmental facilities in husbandry and agriculture, and improve the environmental management level. The successful experience and the demonstration role of the subprojects will help transfer the capital of farming enterprises and private enterprises into the industry of comprehensive utilization of rural waste, promoting the sustainable development of

agriculture and animal husbandry.

5.4.2 Negative Effects

In the process of the project construction，the earthwork excavation and construction can bring certain impacts to the local environment, such as construction noise, construction waste and wastewater from construction. Pipeline laying will also cause negative influence on the surrounding atmosphere and acoustical environment and cause traffic jams to the local traffic. The residents along the construction sites would suffer from noise and dust pollution. The clearing of the construction land and engineering construction activities will also bring negative effects to surrounding resident's life to a certain extent. The EP measures will minimize these negative effects, and these effects will disappear eventually after the end of construction.

After the implementation of the project, noise and dust from straw collection and pretreatment, odour from manure collection, transportation and fermentation, noise from biogas purification and electric power generation, as well as the production of organic fertilizer, may induce some certain effects on workers' health, especially the influence of the noise and the fire and explosion risk. In addition, the emission of waste gas, waste water, and solid wastes during the operation period will have a negative effect on the surrounding landscape and the quality of living conditions.

Besides, the project can induce a series of environmental risks, such as gas leakage, leakage from digesters, ensilage pool, storage pool, fermentation tank and biogas liquid tanks, and the risk of excessive application of organic fertilizer.

This project adopts a series of mitigation and prevention measures to mitigate negative environment impact and environmental risks.

5.4.3 Impact on the minority policy

This project involves four areas of Hebei province, Handan, Tangshan, Chengde, and Hengshui, including 6 counties/districts such as Linzhang county, Laoting county, Chengde county, Yutian county, Zunhua county and Anping county. The minority population is less and limited only in Chengde, Tangshan and Yutian, involving 11 villages with dispersed population of Manchu, Mongolian, Zhuang, Hui nationalities,

affecting a total population of 1856 people. This project does not involve oncentrated settlement of the minorities.

Table 5.4-1 The statistical table of minorities in the project area

No.	City	County/ district	Town	Administrative village	Households	Total population	Minority village	Minority population	Minority types	Whether gathering district or not
1	Chengde City	Chengde County	Sangou Town	Beigushan Village	394	1443	No	188	Manchu	No
2	Chengde City	Chengde County	Sangou Town	Sancha Village	879	2950	No	442	Manchu	No
3	Chengde City	Chengde County	Sangou Town	Beizhangzi Village	584	1999	No	300	Manchu	No
4	Tangshan City	Yutian County	Guojiatun Town	Yuanzhuangzi Village	210	850	No	1	Zhuang	No
5	Tangshan City	Yutian County	Guojiatun Town	Shangzhuang Village	653	2016	No	3	Hui and Manchu	No
6	Tangshan City	Yutian County	Guojiatun Town	Guangonglin g Village	343	1323	No	1	Manchu	no

5.4.4 The ability and willingness of people to pay in the project area

5.4.4.1 Ability to pay

The average cost of residential electricity consumption is 52.31 yuan monthly, with a total of 627.72 yuan per year in the project area. The average amount of liquefied gas is 4 cylinders a year, adding up to 400.56 yuan per year. Other cooking energy, including coal briquettes, costs 198.23 yuan a year on average. The sum expenditures of the above household energy are 1226.51 yuan per year for each household. The per capita net income of rural households is 8486.9 yuan in 6 counties/districts of the project area. The family members in each household averages 4.09 people , the total annual income of a household is 34,711.42 yuan Thus, the ratio of the expenditure for household energy is 3.53% of household income.

After completion of the project, pipelined biogas is expected to charge 1.5-2.5 yuan/m³, with the average price of 1.9 yuan/m³. According to the survey of the social team on the areas using the pipelined biogas, pipelined gas with 100 yuan cost can support cooking of a 4-member family for three and a half months, and the average cost is about 350 yuan a year. In addition, biogas can replace liquefied gas and other cooking energy. Thus, the ratio of the expenditure for household energy would be 2.82% of household income.

According to the market research, the price of residential natural gas is 2-3 yuan/m³ in the past five years. The price less than 1.9 yuan/m³ has a strong market competitiveness based on the analysis of the acceptable price range of centralized gas supply for the township residents and the domestic gas market price.

Besides, about the prices of various types of household energy, 77% of people consider that the price of electricity consumption is reasonable. 66% of people think that the price of canned liquefied gas is on high side while 19.8% of people consider that the price is reasonable. However, most people were not sure for other fuel prices.

5.4.4.2 Willingness to pay

(1) Willingness to pay for pipeline installation fee

According to the survey, the number of people willing to pay for installation cost of branch pipeline is 605, accounting for 75.9%，while 21.5% without the willing and the remaining 2.3% of the people is not sure about it.

(2) Willingness to pay for biogas using fee

The results of questionnaire survey from the social team indicate that the proportion of people have the willingness to pay biogas fee at 10 RMB/ month is 97.3% versus that rejecting the price is 2.7%; 93.3% of the people have the willingness to pay for 20 yuan per month; 85.2% are willing to pay at 30 yuan; 66.1% versus 33.9% at 40 yuan, 45.9% at 50 yuan, 32.1% at 80 yuan and 23.8% at 100 yuan per month, indicating that the proportion of people willing to pay decline with the increase of biogas fees.

5.5 Occupation health analysis (EHS)

5.5.1 Occupation health analysis for electro-meganetic impact

This project involves power generation components, which apply the General Guidelines of Environment, Health and Safety for Thermal Power Plant (EHS Guidelines for thermal power plant), and the specific provisions for the power generation components is shown in the following table.

Table 5.5-1 Identification of occupation health impacts in electro-magnetic subprojects

No.	Subproject name	Processes of electricity generation	Specifications	Parameters	Number	Location	Labor quota	Occupation health Influence
1	Linzhang subproject	Biogas combustion generator	100GFT	Gas consumption: 60 m³/h, rated power: 100KW, 380/220V phase 5-wire system transformer: 1500KW	2	Generator room 144 m²	30	Noise

The main occupational health impacts in operation of the project may include electro-magnetic radiation, magnetic field, and noise and radio interference. Considering that the project only involves small-sized power generator device of internal-combustion engines, which is less than minimum size of 3MW, and the effects of electromagnetic field and radio are small for this kind of device, it is not necessary to analyze the electromagnetic impact on occupational health.

The noise influence scope is shown as follows:

Operation noise: the generator is the center, within a radius of 200 m.

5.5.1.1 Analysis of noise impact

Table 5.5-2 The main noise source and control measure in the project

Subproject name	Noise source	Noise level	Treatment measure	Noise reduction effect

Linzhang subproject	Generator	95dB(A)	Base-isolation +muffler +sound-proofing of workshop	Noise reduction of 25dB (A)

(1) Analysis of noise prediction

Noise of power generator: Noise source of generator is smaller than 70 dB (A) when prediction and transformer is set up outdoor. Linzhang subproject plans to set up generator room from the 69.75 m of eastern plant boundary, 62.5 m of southern plant boundary, 108 m of western plant boundary, 57.4 m of northern plant boundary. The predicted noise from plant boundary is shown in table 5.5-3.

Table 5.5-3 The predicted noise result for plant boundary in operation period of Linzhang subproject unit: Leq dB(A)

Measuring point	Period of time	Environmental background value	Contribution value of this project	Predicted values	Standard	Super scalar
East side	Daytime	44.8	＜39.1	45.8	60	——
	Nightti me	42.9	＜39.1	44.4	50	——
South side	Daytime	45.1	＜40.1	46.3	60	——
	Nightti me	41.7	＜40.1	44.0	50	——
West side	Daytime	45.1	＜35.4	45.5	60	——
	Nightti me	41.7	＜35.4	42.6	50	——
North side	Daytime	44.9	＜40.8	46.3	60	——
	Nightti me	42.2	＜40.8	44.6	50	——

By the analysis of the above table, The plant boundary noise all meet the 2-class standard from the Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008) without disturbing the residents.

5.5.1.2 Occupational health measures

The main consideration in here is acoustical environment impact caused by noise source in construction period and operation period, as well as occupation health effect on employee caused by high temperature and electromagnetic radiation.

Referring to the General Guidelines of Environment, Health and Safety for Thermal Power Plant (EHS Guidelines for thermal power plant) and combined with

the requirements of the occupation health programs, we should take the following measures:

(1) Noise control

Power substation and electric transmission line use low noise construction machinery and high noise construction machinery should avoid construction at night.

Power substation should use low noise construction machinery and the noise caused by main transformer should be smaller than 70 dB (A). Green tree-planting should be carried out near the wall of no-incoming and outgoing feeder to reduce the noise effect on the surrounding environment.

With the economic development, the project should contact with the local planning authority and land departments to ask residents not to build residential building near the power substation near residential near, in order to avoid disturbing the residents by factory boundary noise, and once the disturbing the residents exist, treatment measures should be immediately taken.

(2) Other measures

Centralized facility for large acoustical power equipment should be set up with favorable sound control room.

The operation personnel exposure to high noise for long-term should wear earplugs and regularly check the hearing.

The employee activities should be organized regularly to reduce stress of staff and make them enjoyable.

The management methods should reasonably be taken to reduce the noise effect on human body, such as shift schedules, labor turnover and so on.

Regular inspection and maintenance of the pressure vessel and high pressure piping

Sufficient ventilation measures should be taken in the work area to decrease temperature and humidity.

Surface of metal modules should be smooth without burr, such as suspension clamp, protection ring, protection angle, pad, connector, bolt, blade of knife switch, etc.

5.5.2 Occupation health analysis of biogas production and transportation management

The biogas manufacture and transportation management are suitable for Environment, Health, Safety Guidelines-Atmospheric Emissions and Atmospheric

Environment Quality from WB. The analysis of occupation health risks involved in the project is shown as follows:

Table 5.5-4 The distribution list for dangerous and harmful factors in the project of biogas development and resources utilization

No.	Hazardous factors	Hazard places
1	Fire, explosion, leakage	Gas pipeline, gas cabinets, skid car, valve pit, etc.
2	Boiler explosion	Biogas boiler
5	Physical explosion	Gas pipeline
6	Poisoning and asphyxia	Leakage of pipeline and valve, nitrogen purging in maintenance process

Table 5.5-5 Occupation health analysis of biogas production and transportation management

No.	Subproject name	Digesters	Gas cabinets	CNG gas filling station	Middle-pressure gas tank	Middle-pressure gas pipeline	Effect of occupation health
1	Anping subproject	CSTR fermentation tank 4700 m ³×6	Double-layer film 750 m ³×2	One 8629.14 m ³ (included EMF)	50 m ³×8	DN20, 1000 m	Fire, explosion
2	Yutian subproject	CSTR fermentation tank 3000 m ³×6	Double-layer film 6000 m ³×2			107.9 km	Fire, explosion
3	Zunhua subproject	Fermentation bin of garage dry 1100 m ³×16	Double-layer film 2000 m ³×2		100 m ³×2	PE110，60 km	Fire, explosion
4	Linzhang subproject	Anaerobic fermentation tank of step-vertical plug flow 2500m ³×4	2000 m ³×2			De110PE，30km，De50PE,21km	Fire, explosion, high pressure and electromagnetic radiation noise
5	Chengde subproject	CSTR fermentation tank 2500m ³×12	Double-layer film 5000 m ³×2			53341m	Fire, explosion
6	Laoting subproject	Vertical plug flow 2500m ³×8	Double-layer film 1000 m ³×2	2 (included in EMF)		PE100，SBR17.6，11.5km	Fire, explosion

Referring to the General Guidelines of Environment, Health and Safety for Thermal Power Plant (EHS Guidelines for thermal power plant) and combined with

the requirements of the occupation health programs, we should take the following measures:

Gas storage cabinet must be provided with safety device for preventing excessive inflation and exhaust, and vent pipe should be set up with flame arrester.

Digestive needs to outage, and harmful gases should be detected firstly before emptying, cleaning and maintenance.

Staff engaged in special occupation must pass the safety technology training and occupation skill and work with the certificate.

The operator must wear appropriate labour protection appliance and do safety and health work well.

The operator should pay attention to anti-skidding and prevent high falling when patrolling or operating in rainy or snowy days.

Regular inspection and replacement safeguards of safety and fire protection should be carried out in accordance with the requirements of equipment.

Lightning-protection for buildings and maintenance of explosion proof equipment should meet the provisions of meteorological and fire departments.

Emergency plan should be made for unexpected events, such as fire, flammable, Explosion, natural disasters and so on.

Some special places having harmful gas, flammable gas, odor and dust should be ventilated, as well as place of moist environment.

The facilities for production, transport and storage of biogas should carry out gas leak protection, fire prohibition and anti-negative pressure.

When cleaning electromechanical equipment in operation, wiping operating part of equipment is forbidden and the washing water must not splash onto the cable head and motor.

Gas storage cabinet should keep the fire safety distance.

The summary table for environment management plan in the project is seen in appendix 3.

6. Land expropriation and relocation

The Project consists of two batches construction, and the first batch includes 6 subprojects in Tangshan, Hengshui, Handan and Chengde Cities, or two components:

Component 1: Large-scale biogas facilities development and sustainable management. The proposed project activities are expected to demonstrate sustainable large-scale biogas facilities management and biogas supply to mainly meet local cooking and heating energy needs of rural communities/residents.

Component 2: Technical support, project management, and monitoring, including technical services, training and extension, policy advice, monitoring and evaluation, and project management.

Among the 6 subprojects, available state-owned land has been acquired for the 3 subprojects of Yutian County, Zunhua city and Anping County, and 215 mu of collective land will be acquired for the 3 subprojects of Linzhang, Chengde and LaotingLaoting Counties, affecting 45 households with 203 persons in 3 villages in 3 towns in 3 counties.

The resettlement impact analysis in this RAP is focused on the 3 subprojects for which land has not been acquired. The Hebei Technology promotion office has been assigned to an existing office.

The project composition and the immigrant impact are shown in the table 6-1:

Table 6-1 Sub-Projects' migration influence

No.	City	County	subproject	Project owner	Construction content	Area (mu)	Permanent acquisition of collective land			Temporary area (mu)	illustration
							Area (mu)	Affected households	Affected population		
1	Handan	Linzhang	Linzhang	Runze Zhimin Agro-technology Co., Ltd	Biogas works: 4 2,500m^3 fermentation tanks, 2,000m^3, gas storage tanks, 60m^3 feed bunker and so on	70	70	13	81	/	LA has not been conducted; the RAP of the Linzhang Subproject has been prepared
					Pipeline works: gas delivery pipeline	/	/	/	/	/	The occupied land area cannot be fixed; an RPF has been prepared.
2	Chengde	Chengde	Chengde	Chengde Luneng Organic Fertilizer Co., Ltd.	Biogas works: 8 2,500 m^3 fermentation tanks, 42,000 m 3gas storage tanks, 10,200 m^3 stalk silage tank, 2 120 m3feed bunkers, 845 m^3 solid-liquid separation tank, 800 m^3 biogas fluid tank, 180 m^2 boiler room	45	45	9	36	/	LA has not been conducted; the RAP of the Chengde Subproject has been prepared.
					Pipeline works: gas delivery pipeline	/	/	/	/	/	50 mu of land will be occupied temporarily; an RPF has been prepared
3	Hengshui	Anping	Anping	Yufeng Jing'an Stockbreeding Co., Ltd	Biogas works: 23,000 m^3 silage tank, mixed feed system, 6 4,700 m^3 CSTR fermentation tanks, 2 1,500 m^3 storage tanks, organic fertilizer production shop	35.66	/	/	/	/	Land for this subproject was acquired in June 2001; resettlement has been completed.
					Pipeline works: gas delivery pipeline	/	/	/	/	/	The occupied land area cannot be fixed; an RPF has been prepared.
					CNG station	40	/	/	/	/	Land for this subproject was acquired in 2007; resettlement has been completed
					Silages storage room	10	/	/	/	/	Land for this subproject was acquired

											in 2002; resettlement has been completed
4	Tangshan	Laoting	Laoting	Hebei Jointo Energy Investment Co., Ltd.	Biogas works: construction of 8 anaerobic fermentation tanks with a total volume of 25,408 m^3, 3 dry double-film gas storage tanks of 2,500 m^3 each, a purification and compression device, and an organic fertilizer production device with a capacity of 13,690 m^3/d; production of 16,000 tons of biogas slag organic fertilizers and 11,500 biogas liquid fertilizers annually	100	100	23	86	/	LA has not been conducted; the RAP of the Laoting Subproject has been prepared.
					Pipeline works: gas delivery pipeline	/	/	/	/	/	The occupied land area cannot be fixed; an RPF has been prepared
					CNG station	10	/	/	/	/	2 CNG stations will be constructed, one within the subproject, and the other not determined; an RPF has been prepared.
					Second phase	/	/	/	/	/	The occupied land area cannot be fixed; an RPF has been prepared
5		Yutian	Yutian	Yutian Yiheyuan Eco-agriculture Co., Ltd.	Two sets of homogenates with effective volume of 350 m^3, Six medium temperature anaerobic fermentation tanks: effective volume 3,200 m^3,650 m^2 gross area of the building, 220 m^2 section area	70	/	/	/	/	Land for this subproject was acquired in 2011; resettlement has been completed
					Pipeline works: gas delivery pipeline	/	/	/	/	/	The occupied land area cannot be fixed; an RPF has been prepared
6		Zunhua	Zunhua	Hebei Meikeduo Foods Group Co., Ltd.	Biogas works: construction of 16 anaerobic fermentation tanks with a total volume of 17,600 m^3, two inoculation solution storage towers with a volume of 796 m^3 each, 8 aerobic fertilizer tanks with a volume of 1,050 m^3 each, and a 6,000 m2 fully enclosed organic fertilizer	170	/	/	/	/	Land for this subproject was acquired in June 2008; resettlement has been completed.

					workshop						
					Pipeline project: biogas pipeline	/	/	/	/	/	The occupied land area cannot be fixed; an RPF has been prepared.

6.1 Collective land of permanent expropriation and the impact analysis

6.1.1 Collective land of permanent expropriation

Hebei Rural New energy development project using the WB loan involves 215 mu collective land of permanent expropriation (dry land), and involves three counties, three towns and three villages with 45 households and 203 people. The details are seen in table 6.1-1.

Table 6.1-1 subproject permanent land acquisition

No.	Subproject name	Town	Village	permanent land acquisition	Affected population	
					Households	population
1	Construction of Joint-household Straw Biogas Project and Biogas Liquid and Residues Utilization Project Using IBRD Loan	Linzhang town	Luo village	70	13	81
2	Green Energy Straw Biogas Project in Beigushan Village, Sangou Town, Chengde County	Sangou Town	Beigushan village	45	9	36
3	Hebei Laoting Large straw biogas development and biogas residue,biogas liquid comprehensive utilization project	Laoting Town	Hantuo village	100	23	86
total				215	45	203

6.1.2 Impact analysis for collective land of permanent expropriation

Generally, the Project's LA impacts are minor, with land loss rates of 3.07-5.76%, and per capita cultivated areas of 1.16-1.87 mu before LA and 0.29-0.62 mu after LA.

Among the 45 households with 203 persons affected by LA, two households with 13 persons have land loss rates of 10-30%, 3 households with 17 persons 31-40%, two households with 8 persons 41-50%, 21 households with 80 persons 50-70%, 17 households with 85 persons 71-100%, and 9 households with 52 persons 100%.

Since there are industrial parks or private enterprises in the 3 towns affected by

LA, the laborers of the 45 AHs with 203 persons work in county towns, industrial parks or private enterprises mainly, and some of them deal with stockbreeding and would get employed in the slack season. Employment and stockbreeding income accounts for about 70% of household income, so cultivation is not a main household income source and the AHs will be affected slightly by LA.

The income loss analysis of households influenced in subprojects is shown as follow:

Linzhang Subproject: This subproject will affect 13 households with 81 persons, where men deal with construction and manufacture in Handan City and Linzhang County, while women deal with crop cultivation and stockbreeding at home mainly, and would do odd jobs nearby in the slack season; employment is their main income source: 1) 7 households with 41 persons deal with decoration, catering and apparel making in Handan City and Linzhang County mainly, and are highly paid at an average of 3,000; 2) 3 households with 19 persons deal with stockbreeding mainly, with average annual household income of about 35,000 yuan; 3) two households with 13 persons deal with crop cultivation mainly, and would do odd jobs in Linzhang Town and Linzhang County in the slack season, paid 80-120 yuan/day, and their employment income accounts for about 70% of household income; 4) One household with 8 persons does business, with annual income of about 55,000 yuan.

Chengde Subproject: This subproject will affect 9 households with 36 persons, including 15 laborers. 1) 5 households with 21 persons deal with decoration, machinery, food processing and apparel making in Beijing City, Chengde City and Chengde County mainly, and are highly paid at 4,000 yuan/month (in Beijing City) or 2,500-3,000 yuan/month (in Chengde City and Chengde County); 2) Two households with 7 persons deal with stockbreeding mainly, with average annual household income of about 40,000-50,000 yuan; 3) Two households with 8 persons deal with crop cultivation mainly, and would do odd jobs in Chengde County and Sangou Town in the slack season, paid 80-120 yuan/day, and their employment income accounts for about 65% of household income.

Laoting Subproject: This subproject will affect 23 households with 86 persons. Although their land loss rates are high, their income loss rates are low because their main income sources are stockbreeding and employment:

1. 3 households with 13 persons have land loss rates of below 50%, with a per capita cultivated area of 0.98 mu after LA, including 9 laborers, in which 6 deal with

construction, machinery, food processing and apparel making in Beijing, Tianjin and Tangshan Cities all the year round, and are highly paid at over 3,500 yuan/month, while the other 3 deal with fruit tree cultivation and stockbreeding locally, and stockbreeding income accounts for over 70% of household income.

2. 15 households with 56 persons have land loss rates of 50-70%, with a per capita cultivated area of 0.62 mu after LA, including 43 laborers, where 21 deal with construction, machinery and container handling (males mainly), or small commodity processing and marketing (females mainly) in Beijing, Tianjin and Tangshan Cities, and earn 2,800-4,000; 5 deal with automobile repair and decoration, and fertilizer marketing in the Laoting county town, and earn over 150,000 yuan per annum; the other 17 deal with fruit tree cultivation and stockbreeding locally, and would work in the county town in the slack season (150 yuan-200 yuan/day), and employment and stockbreeding income accounts for about 75% of household income.

3. 5 households with 17 persons have land loss rates of 70% or more (two households with 6 persons will lose all land), with a per capita cultivated area of 0.24 mu after LA, including 12 laborers, in which 6 deal with construction, machinery, welding and hotel operation in Beijing, Tianjin and Tangshan Cities, and earn over 4,000; two run stores (apparel and bread) in the Laoting county town, and earn 100,000 yuan per annum; and the other 4 deal with fruit tree cultivation and stockbreeding locally, and their cultivation income accounts for about 15.7-21.3% of household income.

6.2 The population influenced in the project

6.2.1 The summary of the influenced population

Hebei Rural New energy development project that using the WB loan influence 45 households with 203 people whose land have been levied.

6.2.2 Vulnerable groups

For the purpose of the Project, vulnerable groups include the disabled, five-guarantee households, MLS households and women-headed households. Two households affected by the Project fall into vulnerable groups, including an MLS household and one affected by disability. Details are shown in table 6.2-1.

Table 6.2-1 Vulnerable groups affected

Subproject name	village	Vulnerable categories	Vulnerable population	Household size	Where: females	Labor force	Notes
Chengde	Group 5 of Beigushan Village	disability	1	2	1	1	Unable to do farm work
		MLS	1	1	0	1	

6.2.3 Minorities influenced

In the Project, only the Chengde Subproject involves one minority household with 5 persons, accounting for 2.46% of the population affected by the Project, all being Manchu people, including two minority women. It is found that there is no minority village in the project area, and minority population is similar to Han population in language and lifestyle without any significant difference.

7 Environmental risk analysis and mitigation measures

Hebei Rural Renewable Energy Development Project has six subprojects, which are all the projects of biogas development and comprehensive utilization of resources. Each subproject has made a safety pre-evaluation report compiled by the Hebei Anke Engineering Technology Co., Ltd. and Hebei Zuntai Safety Evaluation Co., Ltd. for domestic approval separately. This chapter primarily quotes to the main conclusion and recommendation of safety pre-evaluation report.

7.1 Environmental risk identification

7.1.1 Environmental risk identification in the construction period

7.1.1.1 Building construction

Hazardous factors that exist in the construction process are fire, heating, vehicle injuries, lifting injuries, mechanical injuries, electric shock, falls, collapses and other accidents, and these incidents are likely to cause some economic losses and casualties. Such as electrical equipment, cables and other facilities may cause electrical fires accident due to the improper operation and use; Pressure vessels of oxygen, acetylene and others used during welding easily explode; Transport vehicles may cause harm to pedestrians; There may be occur objects striking, mechanical injury and other accidents in the process of crossover operation and construction machinery running. May be occur collapses, falls and other accidents in the process of earthwork excavation and plant construction; May be occur crane accidents, mechanical injury, falls and so on in the process of important equipment and machinery installation

7.1.1.2 Construction defect

Construction defect mainly refers to the unqualified interface of biogas pipeline in the construction process, or biogas pipeline being destroyed after the construction completion to lead pipeline leak, and the pipe handling freely and not carefully to produce fatigue crack for pipe.

7.1.2 Environmental risk identification in operation period

7.1.2.1 Substances risk identification

The dangerous and harmful substances involved by the process of biogas production, storage and transport on the biogas development and resources comprehensive utilization project after identification can be found in table 7-1.

Table 7-1 Dangerous and harmful substance of the biogas development and resources comprehensive utilization project

No.	Substance name	Dangerous goods number	Hazard categories	Classification of fire hazards	Remarks
1	Biogas（main component is CH_4）	21007	Inflammable gas	Class A	It is the main product of project, using pipeline to transport, mainly exist in pipelines, gas tank, tanker and the combustion chamber, which is mainly hazardous substances.
2	H_2S	21006/1053	Inflammable gas	Class A	It is an associated product of biogas, produced in anaerobic digestion tank system and purification system, in which biogas content is not high, not the main hazards of the project.
3	CO_2	22019/1013	——	Class E	It is an associated product of biogas, produced in anaerobic digestion tank system and cleaning system, purification system.
4	Straw	——	——	Class C	Raw material. There may be spontaneous combustion during storage. It is not the main hazards of the project.
5	Livestock manure	——	——	——	Raw material
6	Mushroom residue	——	——	——	Raw material. 97% of the ingredients are sawdust.
7	Biogas liquid	——	——	——	Producing liquid organic fertilizer
8	Biogas residue	——	——	——	Producing solid organic fertilizer
9	Organic fertilizer	——	——	——	product
10	Activated Carbon	42521/1362	——	——	Biogas purification system(active carbon filter), not the main

No.	Substance name	Dangerous goods number	Hazard categories	Classification of fire hazards	Remarks
					hazards of the project.
11	NaOH	82001	Corrosives presenting alkalinous properties	——	It is mainly used for boiler make-up water treatment, and exists in the chemical water treatment systems. The substance is not the main hazards of the project.
12	Hydrochloric acid (HCl solution)	81013	Corrosives presenting acidic properties	——	It is mainly used for boiler make-up water treatment, and exists in the chemical water treatment systems. The substance is not the main hazards of the project.
13	High-temperature flue gas（contain the gas of SO_X, CO_X, NO_X, N_2, etc.）	——	Non-combustible, harmful gas	Class E	Gas combustion products, mainly exists in the combustion system, the flue gas duct. Boiler chimney is higher than 15 meters, people can not touch it, not the main hazards of the project.
14	Freon 22	22039/1018	——	——	Used for dehydrofrozen devices, not the main hazards of the project.
15	Thiobacillus thiooxidans and acidithiobacillus ferrooxidans	——	——	——	Used for biological desulfurization device, not the main hazards of the project.

Each subproject all involves biogas and its associated products, straw, livestock manure or mushroom residue, biogas residues, biogas liquid and organic fertilizer. In addition to the Anping subproject without boiler, the other six subprojects have a biogas boiler, which relate to sodium hydroxide, hydrochloric acid and high temperature flue gas. Zunhua subproject adopts activated carbon to absorb and purify biogas, involves the use of activated carbon. Other subprojects use biological desulfurization, involves thiobacillus thiooxidans and acidithiobacillus ferrooxidans.

Linzhang subproject involves the use of freon 22 on dehydrofrozen process.

7.1.2.2 The main production facility identification

Mainly dangerous and harmful factors distribution can be found in table 7-2.

Table 7-2 Dangerous and harmful factors distribution for the biogas development and resources comprehensive utilization project

No.	Hazard factors	Hazard places	Property
1	Fire, explosion	Gas tank, anaerobic digestion tank, purification system, etc	Chief
2	Boiler explosion	Biogas boiler	Chief
3	Electrical fault	Transformer	Minor
4	Poisoning and suffocation	Biogas leakage from pipeline, valves, and etc. Nitrogen purging in the process of maintenance and repair	Minor
5	Physical explosion	Boilers, pipeline, etc.	Minor
6	Natural disaster	Biogas storage and pipeline	Minor
7	Social environmental factors	Areas around the plant may be affected by fire and explosion.	Minor

7.1.2.3 Major hazard source identification

According to dangerous chemicals major hazard source identification (GB18218-2009) and guidance on carrying out the supervision and management of major hazard source (State Bureau of Safe Production Supervision and Administration [2004] No. 56), major hazard source is carried on the identification, identification results can be found in table 7-3.

Table 7-3 Major hazard source identification

Item	No.	Determine conditions to constitute major hazard source	Constitute t major hazard source or not	Remarks
Flammable gases	1	Critical mass for flammable gas storage ≥ 10T	No	The largest reserves of methane and hydrogen sulfide in gas storage and production systems of each subproject＜ 10T, which does not constitute a major hazard source.

Item	No.		Determine conditions to constitute major hazard source	Constitute t major hazard source or not	Remarks
Pressure vessel	1		Three types of pressure vessels: Medium toxicity level is extreme, high or moderate.	No	There are not the 3 types of pressure vessels in each subproject plant.
	2		Flammable medium, the maximum working pressure ≥ 0.1MPa, PV ≥ 100MPa/m ^{3} of pressure vessel.	No	The gas pressure of gas tank in each subproject plant is less than 0.1MPa, which does not constitute a major hazard source.
Pressure pipeline	Long-distance pipeline	1	Transport toxic, flammable, explosive gaseous medium, and design pressure greater than 1.6Mpa	No	There is not this type of long-distance pipeline in each subproject plant.
		2	Transport toxic, flammable, explosive liquid medium, conveying distance is equal or larger than 200km, and its nominal diameter ≥ 300mm.	No	There is not this type of long-distance pipeline in each subproject plant.
	Public pipeline	3	Medium and high pressure pipeline, which nominal diameter ≥ 200 mm	No	There is not this type of public pipeline in each subproject plant.
				No	There is not this type of public pipeline in each subproject plant.
	Industrial pipeline	4	The pipeline that transmission medium is gas with extreme-toxicity or high- toxicity, liquefied gas medium, and the nominal diameter ≥ 100mm	No	There is not this type of technical pipeline in each subproject plant.
		5	Fire risk is A and B types of flammable gas, and the nominal diameter ≥ 100mm, design pressure ≥ 4MPa	No	Nominal diameter of gas pipeline in each subproject is 200 mm and 100mm, design pressure＜4MPa
		6	The pipeline that transport other flammable, toxic fluid medium, and its nominal diameter ≥ 100mm, design pressure ≥ 4MPa,	No	There is not this type of technical pipeline in each subproject plant.

Item	No.		Determine conditions to constitute major hazard source	Constitute t major hazard source or not	Remarks
			design temperature ≥ 400℃		
Boiler	Biogas boiler	1	The hot-water boiler which nominal water temperature ≥ 120℃, nominal power ≥ 14MW	No	Outlet water temperature of other projects hot-water boiler is 80-90℃, power < 14MW, so biogas hot water boiler in each subproject does not constitute a major hazard source.

All subprojects are involved gas storage whose pressure is < 0.1MPa, and gas pipeline whose nominal diameter is 200~50mm. Each subproject has biogas boiler, except for Anping subproject.

It can be seen from table 7-3, all the facilities in each subproject plant does not constitute a major hazard source.

7.2 Source item analysis

7.2.1 Factors that lead to accidents

Factors likely to cause accidents in each subproject are shown in Table 7-4.

Table 7-4 List of accident factors

Potential accidents	Causes of the accidents
Pipeline leakage and explosion	1. External interference: mainly refers to earthquakes, landslides, mudslides, collapsible loess, collapse, floods, etc., or leak and explosion caused by a third party vandalism. 2. Pipes and construction defects lead to the leakage and explosion.
Leak and explosion of gas tank and anaerobic digestion tank	1. External interference: mainly refers to earthquakes, landslides, mudslides, collapsible loess, collapse, floods, etc., or leak and explosion caused by a third party vandalism. 2. Because design and installation defects or filling equipment and pipeline failure, leak and explosion is occurred.

Potential accidents	Causes of the accidents
High-temperature burns	1. Leakage of high temperature steam, hot water splash to human bodies; 2. Human body unintentionally touches the surface of high-temperature facilities during work. 3. Personal protective measures are not adopted. 4. Inappropriate insulation treatment for high-temperature parts of the boiler; 5. Steam pipe occur perforation and leakage due to corrosion or other causes of accidents. Pipe without insulation treatment. insulation layer breakage.
Boiler Explosion	1. Boiler design, manufacturing have defects; 2. Shortage of water and abnormal pressure; 3. Inflammable and explosive materials leakage to meet open fire.
Poisoning, suffocation	1. Toxic materials (such as biogas contains hydrogen sulfide) leakage. 2. Asphyxiating gas leak (such as biogas contains carbon dioxide). 3. Exposure to toxic or asphyxiating material when maintenance or emergency repair.
Transformer electrical fault	1. Short-circuit fault; 2. Discharge fault; 3. Insulation failure; 4. Core failure; 5. Tap switch failure.

7.2.2 Probability of an accident occurring and the protective radius

1. Biogas boiler explosion

Calculation based on a quantitative model of boiler explosion:

$$Eg = 7400PV[1-\left(\frac{0.1013}{P}\right)^{0.119}]$$

$$Ew = [(H_1 - H_2) - (s_1 - s_2)T_1]W$$

$$q = (Eg + Ew)/4500$$

$$R = 13.6\ (〚q/1000〛\ ^{\wedge}0.37$$

Eg: Steam blasting energy, kj;

Ew: High-temperature saturated water blasting energy, kj;

q: TNT equivalent of boiler explosion energy, kg;

R: Fatal radius of boiler explosion, m;

P: Rated steam pressure, MPa; 6.98

V: Drum volume, m^3; 50

H_1: Enthalpy of saturated water under pressure and temperature before the

explosion, kj/kg; 1273

H_2: Enthalpy of saturated water at atmospheric pressure, kj/kg; 419

S_1: Entropy of saturated water under pressure and temperature before the explosion, kj/kg ℃; 3.16

S_2: Entropy of saturated water at atmospheric pressure and temperature, kj/kg ℃; 1.3

T_1: Boiling point of water at atmospheric pressure, ℃; 100

W: Saturated water quality, kg. 12300

In the case of routine inspection and normal operation, probability of the boiler explosion accident is extremely low. Biogas boiler lethal radius calculated by the above formula is 15.1m.

2. Pipeline leakage and explosion

To reflect the probability of a gas pipeline accident occurring, the accidents number per unit length of gas pipeline is seen as accident of analogy analysis. According to domestic and abroad pipeline accident statistics, the overall level of gas pipeline accident is calculated, namely:

（1）American after 1990s: 1.5×10^{-4} times/(km a)

（2）The former Soviet Union: 4×10^{-4} times/(km a)

（3）Europe: 5.7×10^{-4} times/(km a)

（4）China in 1990s: 4.9×10^{-4} times/(km a)

Although design, technology, pipe, construction and management of each subproject are superior to the 1990s' level of pipeline construction, from the conservative point of view, pipeline accident rate according is still 4.9×10^{-4} times/(km a) according to that of China in 1990s.

According to subproject gas pipe materials and pressure conditions, the low-pressure gas pipeline protection radius is about 12.4m.

3. Gas tank leakage and explosion

Gas tank specifications and quantities of each subproject are shown in table 7-5. Select the largest design reserve of single gas tank, methane content of 60% in biogas, and storage capacity of 80%, the largest reserves of methane is calculated. Gas tank rupture and leak, according to the vapor cloud explosions after serial blast to predict and analyze.

(1) TNT equivalent of explosion calculated by the following formula：

$$W_{TNT}=1.8aW_fQ_f/Q_{TNT}$$

W_{TNT}—TNT equivalent of vapor cloud, kg;

1.8—Ground explosion coefficient;

a—TNT equivalent coefficient of vapor cloud, 4%;

W_f—Total mass of fuel in vapor cloud, kg;

Q_f—Heat of fuel combustion, kJ/m ³;

Q_{TNT}—Explosion heat of TNT, it's kJ/kg;

TNT equivalents of explosion are estimated by above formula when the methane explosion accident occurred. The results are shown in table 7-5.

Table 7-5 Gas tank specifications and quantities of each subproject, maximum capacity of methane storage and TNT equivalent

Project Name / Content	Anping subproject	Yutian subproject	Zunhua subproject	Linzhang subproject	Chengde subproject	Laoting subproject
Specifications and quantity of double membrane gas tank	750m ³×2	6000m ³×2	2000m ³×2	2000m ³×2	2500m ³×2	1000m ³×2
Maximum methane reserves (kg)	1028.2	4112.8	1370.9	1370.9	1713.6	2056.4
TNT equivalent (kg)	272.5	1089.9	363.3	525	454.1	787.6

(2)Death radius R_1

Death radius R1 is calculated as follows:

$R_1=13.6(W_{TNT}/1000)^{0.37}$

(3)Injury radius R_2

Injury radius R_2 is calculated as follows:

$\Delta P_s=0.137Z^{-3}+0.119Z^{-2}+0.269Z^{-1}-0.019$

$Z=R_2/(E/p_0)^{1/3}=0.00722R_2$

$\Delta P_s=44000/p_0=0.4344$

(4)Minor injury radius R_3

Minor injury radius R_3 is calculated as follows:

$\Delta P_s=0.137Z^{-3}+0.119Z^{-2}+0.269Z^{-1}-0.019$

$Z=R_3/(E/p_0)^{1/3}=0.00722R_3$

$\Delta P_s=17000/p_0\approx0.1678$

(5)Property damage radius $R_{property}$

For explosive damage, property damage radius $R_{property}$ (destruction radius) is calculated as follows :

$R_{property}=K_1W_{TNT}^{1/3}(1+(3175/W_{TNT})^2)^{1/6}$

K_1——Secondary damage coefficient, K_1=5.6.

According to the above formula to calculate, each radius is shown in table 7-6.

Table 7-6 Hazard range of vapor cloud explosion of gas tank

Radius / Project name	Death radius (m)	Injury radius (m)	Minor injury radius (m)	Property damage radius (m)
Anping subproject	8.4	25.2	46	62.1
Yutian subproject	14.1	40.2	73	81.4
Zunhua subproject t	9.3	27.8	50.6	70.8
Linzhang subproject t	9.3	27.8	50.6	70.8
Chengde subproject	10.1	30	54.5	72
Laoting subproject	10.8	31.8	58	78.5

Refer to the relevant materials of accident situation from the national chemical industry in 1949-1988 counted by *Analysis and Prevention of Chemical Equipment Accident* (published by Chemical Industry Press in 1994), combined with the relevant norms of the chemical industry, biogas leakage and explosion occurring rate Pa of subproject is 1.2×10^{-6}.

4. Transformer failure

Transformer failure mostly is electrical fault, including short-circuit fault, discharge failure, insulation failure, core failure and tap switch failure. Based on equipment failure calculating formula counted from IEC in 2007, it is impossible that failure rate of using a transformer for 30 years reached 2.5%. Oil-immersed transformers rated life is generally 30 years at most, therefore transformer failure rate select 2.5%.

5. High-temperature burns

Subprojects use biogas boiler to supply heat. It easily lead to high-temperature burn accidents for no insulation layer or insulation layer breakage of steam pipes, heat exchangers, and other high-temperature devices, lack of security isolation measures, human body unintentionally touching the surface of high-temperature facilities. Steam leakage and the high-speed spills due to accident also easily lead to high-temperature

burn accident. High-temperature burns rarely occur in the case of taking security measures. In case of boiler explosion accidents, burns to nearby personnel may be caused.

6. Suffocation and poisoning

Hydrogen sulfide content in the biogas is low. Plant ventilation is good. There is no confined workplace for toxic gases. Taking safety precautions into the tower or tank to operate, installing monitoring and alarm device for combustible gas, and taking other measures, it can avoid such accidents.

7.3 Consequences analysis of environmental risk

7.3.1 Consequences analysis of environmental risk in construction period

Construction defects mainly refer to the gas pipelines substandard interface in construction time or interface destroyed after construction is completed, leading to pipeline leakage. The PE pipe is used for pipeline. If imprudent and careless carrying, pipeline may appear fatigue crack and result in leakage in operation time. If the concentration of biogas leaking out reaches explosion limit, fire and explosion will break out with meeting fire source to cause probably serious casualties and property losses.

7.3.2 Environmental risk consequences analysis of main danger sources in operation period

7.3.2.1 Biogas boiler explosion

When the boiler design or manufacturing defects, lack of water, and abnormal pressure lead to the boiler running pressure exceeding the maximum allowable working pressure, it is prone to explosion with damage to the surrounding production workers. After calculation, the death radius of the gas boiler is 15.1 m. As can be seen from each subproject arrangement chart, boilers are laid in the boiler room, and the management buildings all far from the boiler room of above 20 m out of the death radius.

7.3.2.2 Pipeline leakage and explosion

In the gas transmission and distribution process, the largest accident hazard maybe caused by various potential accident factors is gas pipeline rupture, resulting in a large number of gas leaks. If meeting fire source, it will break out a fire or explosion, resulting in two kinds of hazard factors (the burning heat radiation and explosion shockwave) to cause injury or even death of surrounding crowd.

According to the materials and pressure conditions of subproject gas pipeline, maximum protective radius of the pipeline is 12.4 m. On the layout of each subproject, laying the gas pipeline is as far as possible away from the management, workshop, and other buildings with simultaneous setting the overpressure and low-limit automatic control valves. When the pressure in pipeline exceeds the control limits, it may automatically cut off the gas supply and reduce gas leak, fire and explosion possibly led by leakage. Therefore, after fire or explosion due to the gas pipeline leaks, the gas can be cut off in time, people can be protected by buildings with the vast majority of people unhurt, and the probability of death is almost zero.

Some pipelines of subprojects pass through villages, and a small number of pipelines are close to houses less than the protective radius. If the gas leakage and explosion break out, it might cause harm to people around the pipelines.

Table 7-7 The distance from each subproject pipeline to the nearest residential areas

Subproject	Anping subproject	Yutian subproject	Zunhua subproject	Linzhang subproject	Chengde subproject	Laoting subproject
Village name	Houpu Village	Ruanzhuangzi Village	Xixindian Village	20 households in Ganglingcheng Village; about 18 households in Luo Village; about 14 households in Hou Village; about 71 households in Beizhang Village; about 60 households in Shuangmiao Village; about 10 households in Houzhuang	Beishuiquan Village	Xiongzhuang Village
Households in the pipeline protective distance	None	10 households in Ruanzhuangzi Village; 5 households in Shangzhuang Village; 8 households in Xiaoli Village	None		None	None

Subproject	Anping subproject	Yutian subproject	Zunhua subproject	Linzhang subproject	Chengde subproject	Laoting subproject
				Village;		
Distance (m)	100	Pass through	50	Pass through	80	50

According to the materials and pressure conditions of subproject gas pipeline, maximum protective radius of the pipeline is 12.4 m. Combining with table 7-7 (conditions of each subproject passing through the villages), laying the gas pipeline is as far as possible away from residential areas with simultaneous setting the overpressure and low-limit automatic control valves. When the pressure in pipeline exceeds the control limits, it may automatically cut off the gas supply and reduce gas leak, fire and explosion led possibly by leakage. Therefore, after fire or explosion due to the gas pipeline leaks, the gas can be cut off in time, people can be protected by buildings with the vast majority of people unhurt, and the probability of death is almost zero.

7.3.2.3 Gas tank leakage and explosion

For biogas storage, each subproject has two or more double membrane gas tank. The largest accident hazard maybe caused by various potential accident factors is gas tank or gas pipeline rupture, resulting in a large number of gas leaks. If meeting fire source, it will break out a fire or explosion, resulting in two kinds of hazard factors (the burning heat radiation and explosion shockwave) to cause injury or even death of surrounding crowd.

The distance from each subproject site to the nearest residential areas is shown in table 7-8.

Table 7-8 The distance from each subproject site to the nearest residential areas

Subproject / Nearest sensitive point	Anping subproject	Yutian subproject	Zunhua subproject	Linzhang subproject	Chengde subproject	Laoting subproject
Village name	Houpu Village	Ruanzhuangzi Village	Xixindian Village	Beizhang Village	Beigushang Village	Xiongzhuang Village
Distance (m）	1000	520	360	550	280	350

When designing subproject layout, it is considered that the safe distance from hazardous substance storage site to management buildings and workshops. There are not regular personnel activities in the death or injury radius, and personnel are

generally in workshop or management buildings with protection by the buildings to usually cause people unhurt.

It can be seen form table 7-6, gas tank leakage encounter an ignition source to make an explosion, then the vast majority of people will not be injured with zero death probability without protection out of the region with center at vapor cloud heart and with radius equal to 80 m. Combining with table 7-8 (the distance from each subproject site to the nearest residential areas), there is not an impact on the surrounding villagers from gas tank leakage and explosion.

7.4 Environmental risk prevention and mitigation measures

Environmental risk prevention and mitigation measures of each subprojects is shown in table 7-9.

Table 7-9 Environmental risk prevention and mitigation measures

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
Construction period	Construction accident	1. Seriously implement the production safety guidelines of "safety first, giving priority to prevent, and comprehensive management". 2. Construction personnel must strictly observe three disciplines: wearing a helmet into scene, tying safety belt on high-altitude, and prohibiting high-altitude falling. 3. Must select construction machinery with acceptable quality during construction process. 4. Due to high transportation capacity and heavy traffic around roads in construction period, construction unit should fully consider the impact of transport to construction progress and security, set safety signs, and reasonably arrange for work time and tasks. 5. Construction should install lighting facilities when constructing at night or in poor light. 6. Machinery and equipments should	Construction unit	Project office, owner, administration of work safety, supervising unit, Environmental Protection Agency (EPA)

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		be regularly checked and found to solve the problem in a timely manner. Using machinery and equipment are in strict compliance with the operation rules to minimize misuse and prevent mechanical damage. In addition, the security protection devices of various machinery and equipments should be sensitive and effective. 7. Do well fire prevention work, and equip necessary fire-fighting equipment. 8. Strength safety education for construction workers, especially for new workers and peasant works with never participating in the construction. If different construction units at the construction site, it should be emphasized that improving construction safety work with mutual cooperation, exchange information, and keeping step. 9. Strengthen qualification check of the construction supervision and construction unit. 10. Strengthen construction design and organization, audit management, security management in commissioning phase. 11. Minimize interchange operations in construction time. 12. Construction units, reconnaissance units, design units, construction units, project supervision units and other units related to safe production of construction projects must comply with safety laws and regulations in construction process to ensure safe production and bear their own safety responsibility.		

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
	Construction quality	1. Strict control of raw material procurement chain, and never allow the purchase of substandard products. 2. Select the construction unit with extensive experience and excellent third-party to supervise forcefully its construction quality to reduce construction misoperation. 3. In strict accordance with the construction specifications, prohibit rude and barbaric construction. 4. Strengthen quality inspection of the pipeline. Carry out pressure test to remove more defects existing in interfaces and base materials, thereby increasing the pipeline safety. 5. Establish assurance system of construction quality, improve the level of construction inspectors, and strengthen inspection means. 6. Formulate strict rules and regulations, correctly repair defects and make a record in time.	Construction unit	Project office, owner, administration of work safety, supervising unit
Operation period	Biogas boiler explosion	1. In the course of the project running, strictly observe the relevant standards and regulations to better ensure the running safety. 2. Strengthen operation and maintenance management, continuously improve professional quality and responsibility of operating personnel with timely and accurate treating accidents to prevent accident spread. 3. Install gas concentration monitors. Quantity and pressure limiting facilities should be set up in pipeline. Empty pipe must be set up in pipeline system to ensure rapid venting of gas within the pipe. Inert gas blowing devices must be provided for gas pipeline system.	Owner, design unit	Project office, administration of work safety, supervising unit, EPA

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		4. Recommend to set lighting protection facilities in strict accordance with the lighting design criterion in project area, and set grounding facilities for lightningproof and anti-static electricity. 5. Insulated joints or insulating flanges should be used in intersections of gas main pipeline into plant. Manual isolation valves and emergency shut-off valves should be installed in gas main pipeline. Gas leakage detection alarm device and flame detection alarm device should be set above of open-arranged gas equipment, inside gas equipment, and pipeline. Their alarm signals should lead to the centralized control room. 6. Pressure gauge, safety valve, automatic fire alarm device, and combustible gas detection and alarm equipment are compulsory testing instruments, must ensure their testing in schedule to ensure their sensitivity and reliability. A complete archival records and testing records are established. 7. Water in system should comply with boiler water quality standards. Supplement water should comply with boiler water quality standards. Circulating water back into system for recycling after disposed and qualified. 8. Each pressure protection device should be safe and reliable with regular testing according to relevant regulations. Safety valves, pressure gauges, thermometers and etc. are required periodic calibration. 9. Strengthen whole process management from selection, ordering, acceptance to commissioning for		

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		transformers, and clear transformer full-time staffs and their responsibilities. 10. Keep clean of transformer enclosure. Maintain various electrical components, wires, and etc. inside transformer intact, and avoid short-circuiting and ignition caused by insulation damage. 11. Ensure reliable neutral grounding of transformer to prevent over-voltage breakdown accidents. 12. Boilers are set in boiler rooms. 13. Ensure that the water level alarm and low water-electric interlock protection device is sensitive and reliable. 14. Formulate contingency measures and personnel training for emergency. 15. Before boiler ignition, furnace should be purged and concentration of combustible gas is not in explosive scope. 16. Security measures should be provided for preventing too high or too low pressure in boiler furnace.		
	Toxicosis and asphyxiation	1. Strictly control equipment and its installation quality, prevent leakage of flammable and explosive materials, strengthen management and strict process, complete protection and intact of safety facilities. 2. Prevent vehicles from crashing pipelines, pipe bridges, and other equipments. 3. Take appropriate measures after leakage: to identify the leak points, cut off the corresponding valves, eliminate the leak sources, and report in time. If appearing large amount of leakage, relevant personnel should be evacuated to a safe place.	Construction unit	Owner, administration of work safety, supervising unit, EPA

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		4. Regular overhaul, maintenance, and keeping equipment in good condition. Thoroughly clear and detect the concentration of toxic and hazardous substances and oxygen content during overhauling, and operation after qualifying. Wearing labor protection products in operation with people monitoring and a back-up rescue measures. 5. Have contingency plans, and do not forget proper use of antitoxic filters, oxygen breathing apparatus and other labor protection products during rescuing. 6. Strengthen inspecting and testing whether does the toxic and hazardous substances drip and leak. Education and training workers about poison toxicity, prevention methods of poisoning and suffocation, and emergency treatment. Personnel are required strict compliance with various rules, regulations, and operating procedures. 7. Install dangerous, toxic, asphyxial signs. Establish first aid points equipped with the appropriate emergency medicine and equipment. Train medical personnel for emergency handling capabilities of poisoning, suffocation, burnings, and etc.		
	Burning people	1. For preventing leakage, firstly choose pipelines, containers, and others of quality, and carefully install them. 2. Rationally use anti-corrosion materials, and ensure weld quality and connection tightness. Regular inspect leakage and drip, and keep the towers, containers, pipes, and valves intact. Keep insulation layers intact. 3. Involving high-temperature materials	Owner, construction unit	Project office, owner, administration of work safety, EPA

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		or high-temperature equipment operation, the appropriate protective equipments must be worn. Equipments must be cleaned and insulated before inspected and maintained, and detected to be qualified. 4. Strengthen emergency treatment training and education for prevention knowledge of high-temperature materials burning. 5. Set warning signs.		
	Pipeline leakage and explosion	1. Regular clean pipeline and get rid of water and dirt inside the pipe. 2. Regular pressure tests for pipeline. If pressure discrepancies, timely inspect and maintain to avoid gas leaks. 3. Every six months to check pipeline safety protection system, so that pipes can get safe handling in overpressure or low pressure conditions to reduce to a minimum harmful range. 4. Increase the frequency of inspecting pipeline and improve the effectiveness of inspecting pipeline. Daily inspect pipeline construction zone, check surface conditions, and concern for staff activities in this zone. If finding behaviors to affect pipeline safety, timely stop, take appropriate measures, and report to the superiors. 5. Delimit pipeline protection scope, and prohibit construction within pipeline protection scope.	Owner	Project office, administration of work safety, EPA
	Gas tank and anaerobic digester leakage and explosion	1. Set solid enclosure wall outside gas tanks. 2. Plant set fire extinguishers, fire hydrants with quantity to meet fire safety requirement. Automatic fire alarm system and combustible and other gases detection and alarm equipment are set in gas tank, anaerobic digester, and biogas	Design unit, construction unit	Project office, owner, administration of work safety, EPA

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		purification system. Ensure their testing in schedule to ensure their sensitivity and reliability. A complete archival records and testing records are established. 3. Each pressure protection device should be safe and reliable with regular testing according to relevant regulations. Safety valves, pressure gauges, and etc. are required periodic calibration. 4. Production area and office area must be arranged separately, and fireproofing distance must comply with the requirements. 5. No smoking, fire, and wearing shoes with nails. Strictly prohibit vehicle without a flame arrester into explosive and inflammable areas. 6. Strict implement the flare permit system, and strengthen preventive measures. Explosion proof electrical equipments are always used in flammable and explosive places. Strictly prohibit knock and throw with rigid tools. Do not use the ignition tools. Install lightning protection facilities according to the standards, and regularly check. Strictly enforce static measures. 7. Make sure pumps, valves, machines, pipeline quality. Pressure vessels, pipes and their instrumentations should be regular inspected, tested, pressure-testing, defended, repaired. Equipments and electrical devices are installed according to the norms and standards with regular maintenance to ensure in good condition. 8. Volatile, flammable and explosive materials, high-temperature components scattered in site must take		

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		insulating and airtight measures. 9. Eliminate the "three violations" (illegal operations, illegal command, and violation of labor disciplines), comply with craft regulations to prevent the process parameters change. Insist tour inspection, timely treat the identifying problems, such as breathing valves, pressure gauges, nitrogen sealed, safety valves, pipeline anticorrosion, fire and ambulance facilities are intact or not, towers, containers, pipes, inlet valves, and others leak or not, fire exits are blocked or not, and etc. Do well isolation, empty, ventilation in overhaul, and hot work and other operations are carried out under monitoring. 10. Enhance training, education, assessment work, regular check whether there are violation of regulations and disciplines. Prevent leakage and drip of flammable and explosive materials. Strictly prevent vehicles crashing pipelines, pipe bridges, and other equipments. 11. Ensure fire safety facilities remain fully intact. 12. Develop emergency plans.		
	Tanker truck transport	1. Develop strict guidelines for tanker safety management workflow. 2. Develop safety procedures for tanker, and clearly require that drivers and supercargoes should work with certificates after trained. 3. Conduct tanker truck of off-site inspection, check before and after filling, inspection on the way, and stop inspection into station to ensure the tanker safety and exclude the possibility of hidden troubles existence. 4. Drivers and supercargoes are	Owner, design unit, tanker truck driver and supercargo	Project office, owner, administration of work safety, EPA

Period	Risk type	Prevention and mitigation measures	Implementing agency	Supervision agency
		responsible for truck safety inspections and routine safety checks of cylinder group, and fill check interchange receipt with signature confirmation. 5. Drivers and supercargoes should be familiar with the emergency measures to deal with an emergency situation.Specific safety procedures detailed in section 7.5.6.		

Anping subproject is not involved the use of biogas boiler and the risk of boiler explosion. The other six subprojects are all involved the risk of boiler explosion. Anping subproject, Zunhua subproject, Chengde subproject, and Laoting subproject involves risk of tanker transport. Other risk types are the common characteristics of six subprojects, no longer listed separately statements.

7.5 Contingency plans

Project unit should compile comprehensive contingency plans, special accident emergency plans, and on-site treatment schemes based on the project production characteristics, according to the requirements of *contingency plans compilation principles of work safety accident in production and management units* and *contingency plans management methods of work safety accident* (State Administration of Work Safety [2009] No. 17). When compiling contingency rescue plans, it should follow the principles of "*prevention first, unified command, graded responsibility, regional-based, combination with unit self-help and social rescues*", and also be in line with the requirements of relevant laws, regulations, rules and standards. The organizations, procedures, resources, measures regulated and cleared by contingency plans should be targeted, scientific and operability to meet emergency rescue needs of work safety accidents.

（1）Contingency plans compilation

Suggest the project contingency plans be classified and compiled according to the following system:

①Comprehensive contingency plans of work safety accidents

②Special accident emergency plans

Natural disaster emergency rescue plan;

Fire and explosion emergency rescue plan;

Poisoning and suffocation emergency rescue plan;

Personal injury emergency rescue plan；

Etc.

③On-site treatment schemes

Biogas leakage on-site treatment scheme;

Poisoning accident on-site treatment scheme;

Electric shock accident on-site treatment scheme;

Vehicle injury accident on-site treatment scheme;

Generators accident on-site treatment scheme;

Pipeline leakage and explosion accident on-site treatment scheme;

Etc.

（2）Assessment, release and record of contingency plans

Compiled contingency plans should be assessed or proofed by project unit, then signed and released by key official of project unit. Project owner will prepare an emergency preparedness plan after the project is completed.

7.5.1 Emergency organization and responsibilities

(1) Organization

Each subproject should set up emergency organization and emergency command group headed by each subproject director. Emergency command group obey the orders from the supervising emergency command institute and responsible for on-site command work.

Emergency command group timely adjust and revise contingency plans according to the successful experiences and existing problems in plans implementation, and regularly organize workers to exercise the accident plans. Meanwhile, all the emergency records, documents and other materials are collected

and collated by special person after the accident, and archived. Accident emergency organization system is shown in figure 7-1.

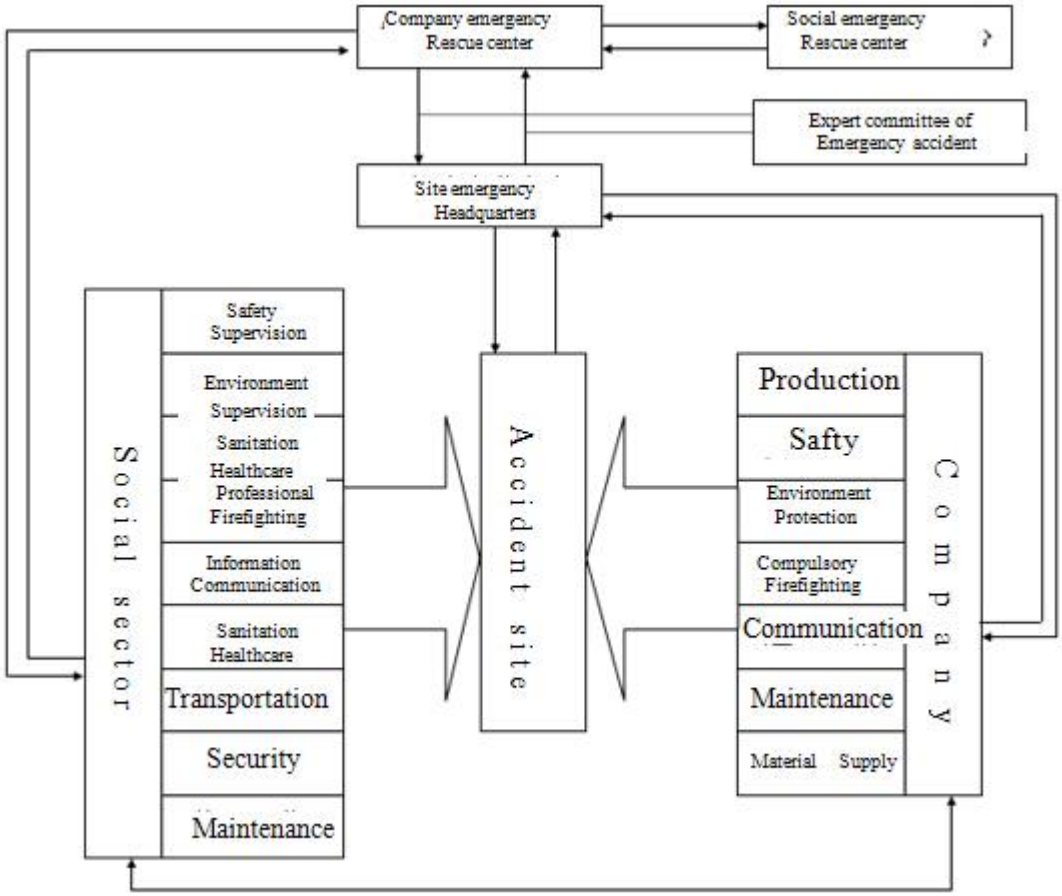


Figure 7-1 Emergency accident Organization System Block Diagram

(2) Division of responsibilities

Plans should clear responsibilities division of each member in emergency institution, and main contents need to clear are:

①Who issue alarm, how to issue alarm, and where to issue alarm;

② Time and ways of report the accident to their superior (personnel and of communication means);

③Who will organize rescue and controlling accidents;

④Use and distribution of emergency equipments;

⑤ Clear communication channels with the media and information released channels;

⑥When the accident scene and the surrounding environment reach unharmful conditions to human health approved by safety and environmental protection department (EPD), by whom announce that harm has been released and evacuation

personnel in accident hazard area can return.

⑦ Clearly stipulate under what circumstances and who announce contingency plans to close.

7.5.2 Ensure safety production

Project unit must ensure the necessary funding for safety production conditions. Safe production expenses mainly used in the following aspects: security technology and labor protection measures; anti-accident measures; emergency management; safety testing, safety assessment, inspection and treatment of hidden troubles, monitoring and rectification of major hazard sources, security, collection and identification of safety laws and regulations, implementation and maintenance of production safety standardization construction, operations training for production safety, safety supervision and inspection, security technology skills competition, safety culture construction, safety month activities, and etc.

7.5.3 Develop a safety management system

(1) Project unit should transmit the appropriate safety laws and regulations, standards and other requirements to the employees in a timely manner, comply with safety laws, regulations, standards, and rules, timely convert relevant requirements to regulations of unit, and convey to daily safety management works.

(2) Project unit should establish safety rules and regulations, distribute to related jobs, and regulate the production behaviors of operating employees. Safety regulations should contain at least the following elements: production safety responsibility, safety production inputs, documents and records management, inspection and treatment of hidden troubles, security education and training, special operations personnel management, safety management of equipments and facilities, construction projects safety facilities "three simultaneous" management, acceptance management of production equipments and facilities, abandonment management of production equipments and facilities, safety management of construction, and inspection and maintenance, dangerous goods and major hazard sources management, operation security management, stakeholders and external labor management, occupational health management, protective equipment management, emergency management, accident management, and etc.

(3) Project unit should compile safe operation rules, and distribute to related jobs.

(4) Project unit should annually inspect and evaluate at least once on the implementation of safety laws and regulations, standards, regulations, operation rules. Based on assessment results, the problems from security checks feedback, production safety accident cases, performance evaluation results and etc, production safety regulations and operation rules should be revised to ensure its validity and applicability and the latest valid version used by each job.

(5) Project unit should strictly enforce the document and file management system to ensure the effectiveness of compilation, use, evaluation, and revise of safety rules and operating procedures.

(6) Project unit should establish the safety record of main safe production processes, events, activities and check, and strengthen effective management of the safety record.

7.5.4 Education and Training

7.5.4.1 Staff training

(1) The main responsible person and safety management personnel of project unit should receive safety training, and must obtain qualification certificates of safety management.

(2) Project unit should give operations staff to deal with safety education and productive skills training to familiarize them with the relevant safety regulations and safety operation rules, and their ability should be confirmed to meet the job requirements.

(3) New staff must be educated and trained by factory, workshop, and team before on work position. Before using new processes, new technologies, new materials, new equipments and facilities, the relevant operation staff should receive specialized safety education and training. If operations staff is re-appointed after job transfer or leaving their post for more than one year, they should receive education and training from workshop and team, and take the post after passing the examination.

(4) The operation management personnel must be familiar with the operational requirements and technical indexes of biogas technology and equipment, equipment running. The operator must be familiar with his post operational requirements and

technical indexes of equipment and facilities, and aware of biogas technological process.

(5) Staff working on special (device) operation should obtain special (device) operation qualification certificate before they start to work.

(6) Construction unit should pay attention to safety culture, and develop corporate safety culture plan.

7.5.4.2 Gas user training

(1) Residents gas users

Before the building construction, company appoints special person to the villages along the pipeline with lecturing "popularize gas knowledge" in order to propagate safe gas use knowledge and educate villagers with safety knowledge. Meanwhile, distribute playing cards specially made by company, cards face detail knowledge about the safe use of gas, safety slogans and 24 hours emergency phone numbers.

After the pipeline built, photo, name, and telephone numbers of company security officer are hung in the bulletin boards of village committee along pipelines, and 24 hours emergency phone numbers is announced. Safety warning signs are hung on prominent places of the village walls every 200 meters.

After gas get into households, company personnel enter each user's home to distribute safe use manual and post gas safety knowledge and 24 hours emergency phone numbers in prominent place near stove.

After users normally use gas, the company personnel regularly enter into each user's home to carry out gas utility safety checks and on-site guide the user correct and safe use of gas. Meanwhile, professional teach user testing leakage methods by himself and provide emergency treatment training. The emergency treatment training contents are shown in (3) emergency treatment.

(2) Industrial and commercial gas users

Before the building construction, company appoints special person into commercial users centralized places and each industrial user with lecturing "popularize gas knowledge" in order to propagate safe gas use knowledge and security consideration of industrial and commercial facilities using gas. Meanwhile, inform users 24 hours emergency phone numbers.

After the pipeline built, photo, name, and telephone numbers of company security officer are hung in the commercial users centralized places and each industrial user inside. 24 hours emergency phone numbers is announced.

After gas get into users, company personnel enter each industrial and commercial users to distribute safe use manual and post gas safety knowledge, safety cautions and 24 hours emergency phone numbers in prominent place of gas utilization facilities.

After users normally use gas, the company personnel regularly enter into each user to carry out check and propagandize user internal safety management system. Meanwhile, professional teach user emergency treatment methods.

(3) Emergency treatment

When occurring gas leakage in resident users, first close the calves, immediately open the windows, avoid power on any electrical switches and using fire, and report by calling 24 hours emergency phone numbers.

After industrial and commercial gas users discover gas leakage or other possible happening security incidents, they should immediately cut off the gas source and away from the leak point, prohibit appearing fire in gas leaks place, at the same time report by calling 24 hours emergency phone number.

The public should immediately keep away from the ignition point after the fire, the crowd around the evacuation notification and call 24-hour emergency telephone report to the gas company, and dial "119" to report to the fire department.

7.5.5 Production facilities management

Project unit should provide production equipment and facilities with standardized management to ensure their safe operation. Project unit should set special person responsible for a variety of safety equipment and facilities, establish accounting, and provide regularly inspection and maintenance. Regular inspection and maintenance programs are compiled for safety equipment and facilities. Programs should be developed before the inspection and maintenance of equipment and facilities. Equipment design, manufacture, installation, use, testing, maintenance, renovation, demolition and abandonment should comply with the relevant requirements of laws, regulations, and standards.

Requirements of equipment running management are as follows:

①Anaerobic digester feed should be in accordance with relatively stable volume and cycle, and constantly sum up to get the best feed volume and feed cycle. For fermentation raw materials with high levels of suspended solids, total solids (TS) content in feed should be controlled at 6%-8% or less. Anaerobic digester should

remain relatively stable digestion temperature. Anaerobic digester should be stirred in intervals. Stirring should be stopped for 30 minutes before discharge, and stirring can not performed with removing sludge in the same time. Temperature, gas production, COD, pH, volatile acid, total alkalinity, biogas composition, and other indictors of anaerobic digester should be monitored. Overflow pipe of anaerobic digester must keep unblocked.

② Desulfurization devices should be regularly discharged. Desulfurizer in desulfurization devices should be regularly regenerated or replaced. Condensed water from gas-water separator, condensers and biogas pipeline should be regularly discharged. When discharging, prevent gas leakage. Gas tanks and gas pipeline should be regularly checked for leakage.

③ Sensors of various instrumentation, transmitters and converters should clean up the dirt in accordance with the technical documentation requirements. Controlling equipment components should be complete, clean, and no rust. Dial gauge scale should be clear. The nameplates, tags, and seals keep intact. Computer should be normal.

④ According to their technical documentation requirements of running solid-liquid separation devices, check and preparatory work should be prepared before power on, and observe sound and various instruments be normal or not.

⑤ When heat exchanger using a coil heating, inlet temperature should be controlled between 50-55℃, and inlet and outlet temperatures should be tested daily.

⑥ Water pump should be carefully checked before starting, do well preparation before starting work, and start according to operational requirements. When pumps in operation, mobile inspection system must be strictly enforced. Pumps' mechanical and electrical equipments should be kept in good condition.

7.5.6 Operation security guarantee

(1) Project unit should enhance control of safety management and production processes. Hidden problems of production process, materials, equipment, facilities, channels, operating environment and others should be analyzed and controlled. Higher risk operations of hot work, confined space operations, temporary power operation, high operating, and etc. implement operating license management with strict approval procedures.

(2) Based on the actual situation of the project unit workplace, clear warning signs should be set up in workplace, equipment and facilities with greater risk factor in accordance with the relevant regulations for danger remind and warning and informing the kinds, consequences and countermeasures of danger. Warning region and warning signs should be set up in equipment and facilities maintenance, construction, lifting and other operations. Fences and warning signs should be set up around pits, wells, ditches, steep slopes and others of inspection and maintenance places.

(3) Project unit should perform management system of contractors, suppliers and other stakeholders, to manage their pre-qualification, selection, service preparation, operation process, providing products, technical services, performance assessment, renewal, and etc.

(4) Project unit should execute change management system with planned control of agencies, personnel, processes, technology, equipment and facilities, operating processes, environment and other permanent or temporary change.

(5) Control measures of project material transfer

Use dedicated connectors, pipes and hoses (e.g., a type of connector used for all the acids, another type of connector used for all the basic substance) prepared for the materials in storage banks, and compile procedures to prevent dangerous substances into the wrong tank.

Use proper transfer compatible with the transferred material properties, designed in order to ensure safe transfer.

Regularly inspect, maintain and repair connectors, pipes and hoses.

At connection points or other possible overflow points, set the secondary containment measures, drain container of hazardous materials or its overflow and drip containment measures.

（6）Avoid filling the container and tank overfill protection

Overfilled containers and tanks are the most common cause of gas leaks and excessive pressure vessel, is also the most easy to prevent, and should be prevented. Proposed filling the container and tank overfill protection include:

Compile written transfer operating procedures, including the execution checklist required to enforce in filling operation, and the filling operator must be trained of these procedures.

Install measuring instruments on the storage tanks to measure tank volume.

Use drip-proof connection for tanker trucks, and use a fixed connection on the tank.

Install automatic shut-off valve on the filling tank to prevent overfilling.

Set collecting pools around the filling pipelines to collect spills;

Use connection fittings (float valve) with automatic overfill protection function.

Pumping amount into tank or vessel is less than the available volume of the tank or vessel. The method is ordered volume less than the available volume.

Set release port for overfilling or overpressure to release to capture points in a controlled state.

（7）Tanker transport safety rules

According to spirits of *safety technology supervision regulations of mobile pressure vessel*, *special requirements of tube trailer periodic inspection*, *hazardous and chemical goods transport regulations*, *road traffic safety law of People's Republic of China*, and other relevant regulations, combined with the actual situation of the project, the compilation of tanker safety transport rules as follows:

Part I: tanker transport workflow
The dispatching task of the tanker, off-site inspection, check before filling tanker, filling tanker, transportation midway check, transferring documents of gas volume, emergency treatment, truck inspection, maintenance and repair, maintenance and repair of cylinders. The operators are required strictly in accordance with the actual operation workflow and safety procedures, so as to ensure the safety and reliability of the work.
Part II: Safety operation regulations for tanker transport
A: The basic requirements for tanker drivers and supercargoes 1. Tanker driver and supercargo are responsible for inspection, maintenance and repair of tanker head and semi-trailer chassis below of pressure vessel carried. 2. Tanker driver and supercargo must understand the performance of the truck, must have a high degree of responsibility with skilled driving skills, and must understand the nature of biogas and safety knowledge related to biogas. 3. Tankers must be equipped with a dedicated maintenance tools uneasy to produce sparks, necessary spare parts, etc. Drivers and supercargoes must be familiar with using these maintenance tools. 4. Tankers must be equipped with fire-proof, fire-fighting equipments to meet the requirements. Drivers and supercargoes must master their use methods with skillfully use. 5. Tanker driver and supercargo must do well routine vehicle inspection, maintenance work and troubleshooting carefully in accordance with the requirements of the car using manual to ensure that vehicles are in good condition. Use and maintenance cylinders must be in strict accordance with the requirements of the cylinder use manual. The performance of safety

accessories must be always checked to maintain it in good condition. Ensure the safe and rational use of vehicle.

6. Tanker driver and supercargo must be onboard for all kinds of travel documents.

B: Tanker check

Tanker check include off-site check, check before and after filling, midway check, and stop check after entering station.

1. Tanker head and semi-trailer chassis check (by driver)

1.1 Before tanker departs form the station, the driver checks the tanker head and semi-trailer chassis. After making sure no faults, he fills in the “tanker head and semi-trailer chassis inspection record", and it is confirmed through signature by the check man.

1.2 Semi-trailer chassis inspection items and integrity requirements:

1.2.1 Traction pin and traction pin board

◆There is not injury, fracture, premature wear and other defects in traction pin.

◆Traction pin should be fasten without loosening, and its diameter is not less than 48mm or 86mm.

◆Traction pin board should be no scars, distortions and foreign matter.

1.2.2 Brake

◆ All pipes, joints should be no cracks, breakage, leakage phenomenon.

◆ Emergency brake valves without leakage and brake flexible.

◆ When brake release, the exhaust gas should be discharged from the exhaust port.

◆ The gap between brake drum and brake shoe lining should be 0.5mm-0.7mm.

◆ Brake lining should not be excessive wear with the rivet head height not less than 1mm of break lining.

1.2.3 Wheel and axle

◆ Vehicle wheels, Vehicle axles, tires should be free of cracks, damages and deformation.

◆ Vehicle wheel nuts should be tightened without loosening.

◆ Tire pressure should be maintained in specified tire pressure (740KPa±20kpa), and the lateral tire swing is not more than 5mm. Spare tire is securely mounted.

1.2.4 Suspension

◆ Leaf spring without broken and offset, and the deflection degree of the left and right springs is basically same.

◆ Each nut on suspension should be tightened without loosening.

1.2.5 Electrical system

◆ Connectors without slack, sagging and damage.

◆ Lights are intact without rupture.

1.2.6 Support device

◆ Support leg flexible movements, and transmission gear rotation flexibility without abnormal sound.

◆ Inside and outside tubes of support legs without cracks and damage.

◆ Nuts in installation position without loosening.

2． Check tanker before filling:

2.1 After tanker return to their home station, driver and supercargo fill tankers return records to confirm the trailer and skid-mounted cylinder group intact. Home station operators

check accessories of transport container to confirm normal, and fill.

2.2 Check items and requirement of tanker container, cylinder group and safety accessories of tanker (by supercargo)

2.2.1 Container（frame）

◆Container（frame）without damage, and weld no cracks, no significant deformation.

2.2.2 Cylinder group

◆Cylinder wall without mechanical scratches or bumps, surface paint intact, clear signs, cylinder group is fasten without loosening.

◆Cylinders valves and its connecting surface without leakage, and welded joints with cylinders valves without leakage.

2.2.3 Pipeline system

◆Each welding spots of pipelines without leakage, and connection point without leakage between pipeline and ball valves.

◆U-bolt is fastened to aggregate fix.

◆Connecting pipe connected with cylinder is not leakage.

2.2.4 Loading and unloading device

◆Each ball valves rotate flexibly without leakage.

◆Quick connectors are sealed and reliable with opening and closing well.

2.2.5 Safety accessories

◆ Rupture disc subassembly is intact, and subassembly pipes without damage and leaks.

◆ Joints with pressure gauges and thermometers is not leakage with meter body intact and no broken or damaged.

◆ Eliminating static devices: conductive copper and touchdown tape intact and no rupture.

◆ extinguishing device: cylinder group should be equipped with dry powder fire extinguisher, and within the validity period.

C: Tanker filling

1. Begin filling after checking various parts of the tanker without fault. (Note: tanker unchecked or untreated faulty is prohibited to fill tank);

2. New truck (or after maintenance) must replace the air in the cylinder before filling, is prohibited direct filling. Evacuated or nitrogen replacement method can be used, and oxygen concentration of cylinder is not more than 3% after the replacement.

3. Filling operation site is strictly prohibited fireworks, and can not use easily sparking tools and supplies. Lighting equipment must be explosion-proof lighting appliance.

4. When truck enters into filling area, touchdown tape must be raised.

5. Must park truck on the specified location of the gas source station (but should avoid excessive bending filling hose). Turn off the vehicle engine, open the release valve on the part reservoir pump of trailer when filling, and implement the trailer brake.

6. Must use wire to connect conductive copper in operation box and ground wire of filling station before filling operation.

7. Close attention to changes in pressure gauge and thermometer scale of cylinder group in filling process. Different temperatures should correspond to different filling pressures.

8. Close attention to changes in thermometer scale of cylinder group in filling process. The temperature must be between -20-60℃. If the temperature is out of this range, the filling

speed should be reduced.

9. After the filling is completed, put away the grounding line, close the valves, make sure the valves no leakage, lock transport container.

10. When filling operations, gas source station operator must not leave the site. Before filling is not completely done, not free to start the vehicle.

11. After filling, filling records should be filled in carefully. Include: vehicle number, filling volume, filling people, filling date, and etc.

12. Close the release valve on the trailer emission tube, lifting the trailer brake on, put down the touchdown tape.

D: Tanker entering station

1. After tanker enters station, the driver should obey the command from station operators to stop the vehicle in place.

2. After tanker park in place, the driver turn off the engine, the supercargo set triangular wooden block on both sides of the car wheels.

3. The operator checks whether the cylinder group is normal.

E: Tanker discharge

Under normal operating conditions, the sewage valve and the valve of aggregating cylinder is closed. In order to ensure the normal operation of tankers, tanker is required to discharge once every six months, and discharge should strictly follow these steps:

1. The residual pressure in the container should be 0.4-0.6Mpa.

2. Connect the discharging pipe to a safe place.

3. Open the sewage valve of each cylinder, open the valve of aggregating cylinder, and discharge.

4. When the pressure of cylinder drops to 0.3Mpa (pressure gauge only for inside the cylinder), close the sewage valve of each cylinder and the valve of aggregating cylinder.

Six tankers safe operation points

F: Tanker safe operation points

1. Tanker manager, driver, and supercargo are responsible for the safe operation of tanker.

2. Driver and supercargo must fully understand the performance of tanker and operation of each device accessories, and must master the basic characteristics of the transport medium, the road transport safety regulations, fire prevention and extinguishment knowledge, proper use methods of fire-fighting tools, and etc. Driver and supercargo strictly enforce *cylinders safety Supervision regulations* with decisively dealing with emergency situations and a variety of accidents. Drivers and operators must be trained and hold certification to mount guard after passing the examination.

3. Units of load and unload tanker should be registered by Boiler and Pressure Vessel Safety Supervision Agency of provincial quality and technical supervision administration.

4. Tankers must be dedicated without mixing with other media.

5. Units of load and unload tanker must attach warning labels and filling labels in compliance with national standard GB16804 *cylinder warning label*.

6. Tankers must be strictly prohibited to mix with the combustion gases.

7. Tankers must be strictly in accordance with the nominal pressure (20Mpa) of purchase vehicle to fill.

8. It is strictly prohibited percussion, collision cylinder pressure vessel.

9. It should be firstly treated, otherwise not allowed to carry out filling operations for one of the following conditions:

◆ Cylinder marks, color marks do not comply with the regulations without confirming media in the cylinder.

◆ Accessories is damaged, incomplete or non-compliant.

◆ No remaining pressure in the cylinder.

◆ Exceeding test period.

◆ After visual inspection, significant damage is existing, which requires further examination.

◆ First filling or the first filling after regular inspection, without replacement or vacuum process.

10. It is prohibited dig-mend, welding and repairing on the cylinder body with a flame, plasma.

11. The gas of cylinder pressure vessel can be not drained with residual pressure inside the container not less than 0.1 Mpa.

12. The filling staff should not leave the site, and the driver can not start the vehicle during the filling operation. It should stay at least one guard when stopping on the road.

13. Prohibit fire on load and unload site and near tanker, and not use easily sparking tools and supplies. When lighting, only allow to use lighting appliances with explosion proof rubber enclosure.

14. When the bundle is overhauled, it must be empty, and must park in the ventilated place without open flame. When necessary flare, residual media must completely removed and report to the security technology sector. After approval the action can proceed.

15. After Tanker filling with medium, it is not in the sun exposure, avoid excessive heat and pressure increases. if necessary, cool it with water.

16. Prohibit unload gas using direct heating the cylinder.

17. Tanker traveling speed is not exceed 50 km/h.

Part IV: Tanker safety inspection, maintenance and repair

Tanker driver and supercargo are responsible for tanker safety inspection and routine safety inspection of cylinder group, and fill check interchange receipt with signature confirmation.

A: routine inspection of cylinder group

1. Cylinder pressure vessel should periodic inspection by inspection station conforming to national standard *cylinder periodic inspection station technical conditions*, and its qualification is approved by Boiler and Pressure Vessel Safety Supervision Agency of provincial quality and technical supervision administration.

2. Cylinder pressure vessels should be inspected once every three years, and the expired container do not be used without inspection. Container should be inspected before enabling if its storage or disuse time is more than one inspection cycle.

3. Bursting disc devices should be changed regularly, and it should be replaced in two to three years as the case.

4. Pressure gauge is calibrated once half a year.

5. Thermometer is calibrated once a year.

B: Maintenance and repair of cylinder pressure vessel

In order to ensure the safe use of vehicles, filling staff, driver and supercargo must perform the following routine checks and maintenance:

1. Every day, the following should be checked:

◆ Observe the cylinder body and the cylinder body connecting pipe is abnormal or significant deformation or not.

◆ Ball valve joints with leaks or not.

◆ Pressure gauge joints with leaks or not, indicator for damage or not.

◆ load and unload hoses have cracks or not. The seal leaks or not. Function of joint self-locking device is normal or not.

2. Every month, the following should be checked:

◆ Ball valve joints for wear, handle function is normal or not.

◆ Rupture disc subassembly is intact without leakage.

◆ Extinguisher appearance for damage, and its performance is intact.

◆ Supercargo discharges the tanker.

Part V: Tanker emergency treatment

Tanker emergency type

1. Truck leaks before leaving the station;
2. Cylinder leak in transit, and fire and explosion hazard at any time.
3. Cylinder does not appear leakage when traffic accident occurs.
4. Cylinder appears leakage when traffic accident occurs.
5. Cylinder does not appear leakage when the truck off-road accident occurs.
6. Cylinder appears leakage when the truck off-road accident occurs.
7. Tanker fire and risk countermeasures.

Contingency plans for CNG emergency

When appearing above emergency types, drivers and supercargoes make an emergency response, and at the same time notify gas station chief and emergency leading team members.

A: Emergency plans for truck leaks before leaving the station

1. When driver and supercargo detect the cylinder leaks, they should immediately turn off the main valve of each cylinder group and the loop valve of upstream. Meanwhile, the engine is turned off, and present open flames and hidden dangers are eliminated.

2. Immediately and accurately report the accident to the gas station chief and related leaders, and help the station personnel to prepare work.

3. After receiving notification, the gas station chief informs that the accident rescue team and technical personnel rush to the accident scene to treat.

4. After the accident rescue team complete dealing with the accident and confirm no hidden dangers, driver and supercargo can continue driving according to the regulations.

B: Emergency plans for cylinder leak in transit

1. When a large number of CNG leakages from cylinder, the tanker must be stopped, but it can not be parked near offices, schools, factories, bridges, warehouses and some places with dense population. Parking spot should be well ventilated, and it can not have an open flame near the parking spot. Driver and supercargo (at least one person knows the process of truck and cylinder) seek the leakage point, and after finding it, close the main valve of each cylinder group and the loop valve of upstream to eliminate leakage.

2. If occurring to leakage, immediately stanch leaks. If not controlling in time the gas leak

points, the gas should be released in time from leak pipe sections. Be sure to extinguish the fire in the surrounding area (especially downwind area). Driver and supercargo guards in the safe range.

3. When cylinder breaks out a fire in transit, leaking cylinder mostly present spray burning with direct combustion of other cylinders, or even cause an explosion in a row, or ignition of the bottom box board, tires, fuel tank and others of transport vehicles, then the whole car on fire. Driver and supercargo should immediately call "119" for help. Firstly shoot water to cool, and quickly extinguish the burning of vehicle body, extinguish cylinder spray flame with dry powder or water-stream nozzle. In the fighting process, in order to avoid an explosion injury, the danger zone should be set aside to prohibit unrelated vehicles and person entering.

4. When not controlling cylinder leakage, released natural gas could cause a resurgence and explosion and will cause a major disaster, and burning cylinder can not be extinguished. In this case, driver and supercargo should quickly call "119" for help. Under conditions of strengthening cooling and controlling the spread of fire, it is allowed for stable combustion until burnout.

5. When the flame is found pale accompanied by "creak" sound, truck shaking, trembling and other conditions, extremely red flame, it may explode. Under the condition that can not effectively prevent an explosion, the personnel and vehicles participated in the fighting should be decidedly and rapidly evacuated from hazardous locations.

6. When safety guard, the situation should be accurately and timely reported to the superior, and the superior immediately notify the accident repair team and professionals to transport cylinder.

7. Only After the accident is completely treated processed with determining no hidden danger exists by professionals, the tanker can continue driving.

C: Cylinder does not appear leakage when traffic accident occurs

1. When a traffic accident, driver and supercargo should check cylinder leakage. If an open fire is in accident scene, extinguish fire first. Immediately call "122" for traffic accident survey.

2. When the cylinder did not find leakage, the situation should be accurately and timely reported to the superior, and the superior immediately notify the accident repair team.

3. After accident repair team arrive the scene and confirm the severity of the accident, considering whether to notify relevant personnel of the manufacturer to the scene.

4. Only if checked by technician to confirm the cylinder without hidden danger existing, the truck can be towed away with a trailer.

D: **Cylinder appears leakage when traffic accident occurs**

1. When a traffic accident, driver or supercargo should check cylinder leakage. If an open fire is in accident scene, extinguish fire first. Immediately call "122" for traffic accident survey.

2. When a leak is found in cylinder and the driver and supercargo can not control the leakage point, the upstream valve of the main pipeline should be closed and gas is diffused in leakage pipe segment. The diffusing location avoid in town or areas with dense population. If gas can only diffused where tanker is, set up cordon around it, evacuate nearby residents. When diffusing in highway, at least intercept the vehicles traveling in the same direction outside the safe range.

3. When diffusing gas, the existing situation should be accurately and timely reported to

the superior, and the superior immediately notify the accident repair team.

4. After accident repair team arrive the scene and confirm the severity of the accident, considering whether to notify relevant personnel of the manufacturer to the scene.

5. Only if checked by technician to confirm the cylinder without hidden danger existing, the truck can be towed away with a trailer.

E: Cylinder does not appear leakage when the truck off-road accident occurs.

When transport truck off-road accident occurs and cylinder does not appear leakage, the rescue program is similar to the rescue program C. The only difference is being sure to listen to the command of professional and technical personnel in the lifting without arbitrary lifting.

F: Cylinder appears leakage when the truck off-road accident occurs.

The rescue program is similar to the rescue program D. Only if diffusing completed, lifting can be operated. Listen to the command of professional and technical personnel in the lifting without arbitrary lifting.

G: Strategies for tanker fire and risk

Principles: first cut or plug the leak (close the main valve of each bottle group), then extinguish fire to prevent the fire from forming a large area danger zone with a lot of leakage. Only if the fire was fierce and difficult to cut or plug, the strategy can be used of first extinguishing fire, then cutting or plugging. Meanwhile, guard and extinguishing fire source is made for the possible dangerous areas to form.

1. Countermeasures for risk

◆ Prepare for all rescue and plugging tools, and set cordon.

◆ plug leakage and close the valves.

◆ Spray cooling, lay water tape for the danger zone, and cool tanker cylinder with some water guns to prevent the cylinder burst.

◆ Use some dry power extinguisher to extinguish fire simultaneously.

◆ Further examination and treatment of the leak.

2. Leakage countermeasure for cylinder rupture

◆ Stop truck immediately, extinguish all fires nearby, and simultaneously dial "119" to the police.

◆ alert immediately to stop all motor vehicles.

◆ Organize the masses to retreat upward wind direction.

◆ Immediately lay hydraulic gun, evacuate gas concentrations with flowering spray hydraulic gun.

◆ Organize emergency rescue preparations.

3. Countermeasure cylinder leakage fire

◆ When cylinder leak and fire, immediately stop, and dial "119" to the police.

◆ Alert immediately, extinguish all fires nearby, stop all motor vehicles.

◆ Lay water tape, use fire hydrant, cool cylinder with some hydraulic gun.

◆ Use some dry power extinguisher to extinguish fire simultaneously.

◆ Closely cooperate with public security and fireman to fight together.

Principles: No extinguish fire without scene command for fireman brigade and leader to prevent causing explosion and more casualties due to other flames.

7.5.7 Inspection and treatment of hidden dangers

(1) Project units should organize inspection of accident hidden dangers, analyze and assess the hidden dangers, determine the hazard level, register the hidden dangers, and take effective measures in a timely manner. According to the result of the hidden dangers, management plan to control the hidden danger is made hazard in time. Risk management plan should include the objectives and tasks, methods and measures, funds and materials, institutions and personnel, time limit and requirements. Before being treated, major accident hidden trouble should be taken temporary control measures and contingency plans are made.

(2) Based on the production and business operation condition and inspection and treatment condition of hidden dangers, project units should establish warning index system to reflect enterprise safety production situation and development trend, using the quantitative forecast and warning technology for safe production.

7.5.8 Major hazard source monitoring

According to relevant standards, project units should engage major hazard identification and safety evaluation to their own danger facilities or sites. Confirmed major hazard source should be registered and recorded in accordance with the regulations. Project units should establish safety management system for major hazard source, and make safety management technical measures for major hazard source.

In order to ensure safety and reliability of production and avoid major damage from fire and explosion, automatic fire alarm system is set in gas tank, anaerobic digestion tank area, biogas purification area. All of them access to the company fire alarm control system. At the same time constructing fire monitoring room and installment combustible gas alarming device to monitor the concentration of combustible gas in production area.

Anyone who finds biogas leakage should immediately report to the company leader and dispatching center. The fire location, burning materials, fire size, and the situation around should be cleared in report. Company leader should immediately organize on-site personnel on duty and post personnel to extinguish fire using fire extinguisher and fire hydrant. Cut off the link between the gas storage facilities and sales facilities by closing the valve, call "119" for police help quickly, and start the emergency plan.

7.5.9 Occupational health

(1) In accordance with the requirements of the laws and regulations, standards, and specifications, project units should provide practitioners with work environment and conditions to meet the requirements of the occupational health, and equip practitioners with facilities and tools appropriate to the occupational health protection.

(2) Project units should conduct a regular test on occupational hazard in the workplaces, and set signs in the testing point to inform. The test results are written in the occupational health record. For possible acute occupational hazards, toxic and harmful workplace, project units should set the alarm device, make contingency plans, equip on-site first aid supplies and devices, and set up the emergency exit and necessary risk-elimination area. All kinds of protective equipment should be stored in a safe place easy to access, and special personnel take care of them, regular check and maintain them. Project units should make regular maintenance and periodic testing their performance for the scene first aid supplies, equipment and protective equipment to making sure them in normal state.

(3) When conclude a labor contract with employees, project units should truthfully inform practitioners with occupational hazards, their consequences and protective measures produced possibly in the process of the work, and specify in the labor contract. Enterprises should conduct propaganda to employees and related parties adopting effective ways, and it should make them understand the occupational hazards in the process of production, prevention and emergency response measures to reduce or eliminate the harmful consequences.

(4) According to the regulations, enterprises should timely and truthfully declare to the local competent authorities about the occupational hazard factors in the production process, and accept their supervision according to the law.

7.5.10 Emergency rescue

(1) Enterprise should establish production safety emergency management agency or appoint someone who's in charge of production safety emergency management

according to the rules. Enterprises should establish full-time or part-time emergency rescue teams corresponding to their production safety features, or specify full-time or part-time emergency rescue personnel, and organize the training.

(2) Emergency plan should be reported to the local administrative departments to record according to the relevant regulations, and reported to relevant emergency cooperative unit. Emergency plans should be regularly assessed, and revised or perfected according to the assessment results or the actual circumstance changes.

7.5.11 Information submission and accident investigation

(1) Enterprise should establish the accident management system which clears investigation report, statistics and analysis, review, written report styles and table, etc. After the accident, principal or his agent should immediately go to the scene and organize rescue, take effective measures to prevent expanding the accidents.

(2) Enterprise should report to the superior departments timely in accordance with the regulations, and protect the accident scene and relevant evidence. In accordance with the requirements of the relevant laws, regulations, and management system, enterprise organizes the accident investigation team or cooperates with relevant government administrative department to investigate accidents and events, register the accident, and carry on the review and study relevant accident in their own units and other units.

7.5.12 Emergency facilities, equipment and devices

Equip with necessary supplies and equipment for emergency repair, emergency rescue and scene protection, cleaning, distinguishing fire. Especially near sensitive areas with high probability of fire and explosion, the emergency equipment is not only provided beforehand, but checked regularly to keep it in good conditions.

7.5.13 Emergency communications

Equip with smooth communications equipment and communications networks, such as mobile phones, satellite phones and so on. Once accident occurs, necessary action is taken for emergency shutting down, lowering pressure, reducing the influence of accident. Meanwhile, connect with the relevant emergency rescue, aiding, fire control, public security departments to quickly obtain help, and rush to the

accident scene in the shortest possible time to repair and treat, so as to minimize the impact of the accident. Each subproject regulates mobile phone of department supervisor is online 24 hours per day to ensure contact at any time. Nigh manage is guaranteed to equip with mobile phone on duty, and record. The doorkeeper is equipped special alarm phones connecting with outside telephone wires.

7.5.14 emergency monitoring

When gas leakage accident occurs, the main impact is on the atmosphere and human health, so the main content of the emergency monitoring is monitoring the surrounding atmosphere.

7.5.15 Emergency treatments

1. The treatment of pipeline or storage burst with a large biogas leakage

(1) Correctly analyze and judge the position of the pipeline section with a sudden accident. In the fastest way to cut off the upstream and downstream block valves, vent biogas in burst pipeline section, and at the same time organize manpower to guard for methane diffusion danger area, strict control of the possible fire from all combustive materials to prevent spread of fire and explosion expanding.

(2) Immediately report briefly to the superior leaders and production command system, and notify the local public security and fire departments to strengthen preventive measures.

(3) Organize rescue teams rushing to the scene rapidly. Under the unified organization of the leading group at the scene, according to the planed emergency repair scheme and safety technical measures with careful organization and divided responsibility, take emergency repair under the premise of ensuring security.

(4) For failing to restore and maintain normal gas production in a short time, the information should notify the users. After the shutdown, enterprise should use the spare biogas capacity in pipe according to each user production and life characteristics to ration based on the conditions, and efforts to reduce the indirect loss of the accident.

2. Fire and explosion emergency treatment

(1) After afire accident, the first found people rapidly and tell to the police about accident time, place, accident disaster status, etc.

(2) After dialing the fire alarm calls, the first found people report to duty room immediately. After receiving alarm, cadre on duty immediately launches the emergency response procedures and comprehensively processes various complex conditions at the scene.

(3) After the accident, the operation personnel in each position should follow the command from leading official.

(4) The cadres on duty arrange rescue mission, survey casualties at the scene, and organize the initial rescue work.

(5) The cadres on duty report fire and casualty to the branch operation department, at the same time clear road, ready to meet the vehicles. Personnel on duty in fire pump room release alarm message by shout, evacuate of personnel and vehicles, and ready for the start of fire pump and so on.

(6) When leakage leads to fire, operation department require shutdown and cutting process.

(7) After full-time fire team arrive at the scene, the cadres on duty report fire and extinguishing conditions and collaborate to make fire fighting program, and other personnel evacuate the scene and accept unified command from the cadres of duty to do well switch process and assist job of extinguishing.

(8) If starting the fire pumps and fire fighting foam pumps in the process of fire extinguishing, personnel on duty in fire pump room must replenish liquid volume in the fire water tank, foam tank, and ensuring water tank.

(9) If the fire can't be controlled, staff should leave quickly to the outside of flame thermal radiation damage.

(10) Emergency measures leader completely ensure fire is under control in fire and explosion scene, count number of people and organize clean-up timely, remove emergency state.

7.5.16 Close procedure of accident emergency rescue and recovery measures

(1) Recovery and re-entering:

When response and protective action effectively control of the emergency, stage of recovery and re-entering is begun. Recovery plan is determined by enterprise emergency commander. Before re-entering, enterprise emergency commander

determined the re-entering team member and arrange action in detail. When entering, search and rescue teams are equipped with necessary protective equipments and facilities.

(2) The scene cleaning and aftermath works after the accident:

Employees and emergency team members exposed to pollution at the scene must be cleaned; Purification, classification, and treatment for hurt body before remedy; Clean of contaminated instruments and equipment; Removal of the scene security and emergency conditions; Investigating the cause of the accident; Loss assessment of the damage; Solving the insurance and damage compensation; Clean up the damaged area and clear debris.

7.5.17 Emergency drill and continuous improvement

(1) Drill time: drill at least once every quarter.

(2) The drilling personnel should arrive at the scene in 15 minutes after receiving phone call, and sign in the headquarters.

(3) Group leader command each functional group, and the headquarters command the group leaders.

(4) After the drill, summarize the problems to rectify and reform according to the drill conditions.

(5) The program is assessed and revised once every three years in principle.

For the changes of the technology, gas scale, nonconformity in drill, revision is conducted timely.

7.6 Summary

Construction period: risk is mainly due to the use of unqualified construction tubes and the wrong operation in construction process to result in an accident of operating period. So the construction process must be in strict accordance with the construction specification, strengthen management to prevent the accidents in the future.

Operating period: risk is mainly fire and explosion problems of each subproject biogas storage and transportation facilities. So carefully prohibit gas leakage in the operation process, prevent fire source, formulate strict safety management regulations, strengthen management, and minimize the risk as much as possible.

After each subproject takes the proposed risk prevention and mitigation

measures and formulates the corresponding contingency plans, it can reduce the probability of the accident to a great extent, reduce the accident damage to property, and avoid loss of life.

8 Analysis of alternatives

8.1 With/Without project analysis

This analysis focuses on the environmental impact with or without project from the perspective of environment improving.

(1) Program 1: construction of the project.

(2) Program 2: no project plan.

Advantages and disadvantages of these two programs are compared in Table 8.1-1.

Table 8.1-1 Program comparison of the project or not

Type	Program 1: project implementation	Program 2: no project plan
Advantages	1. The biogas produced by each subproject will be supplied to surrounding households. This reduces the consumption of firewood and coal, adjust the fuel structure in its area, reduce air pollution, protect ecological environment, and promote economic development. And it plays a positive role for reducing air pollutants emissions to improve the local environment and life quality of people. 2. Subprojects will use livestock manure as raw material for fermentation or organic fertilizer, to reduce directly returning to field or arbitrary emission of the surrounding livestock manure, to avoid contamination of soil and groundwater. 3. Redundant biogas of subprojects can be made into automobile gas to ease natural gas shortage for automobile and lower automobiles' emissions. 4. Redundant biogas of subprojects can generate electricity for self-use. It will reduce the subproject electricity consumption and relieve electricity shortage. 5. Each subproject will digest local straws to avoid the atmospheric pollution caused by burning them in fields. 6. Some workers will be recruited from local area after subprojects completion to increase the employment opportunities for local residents, and then their living conditions will be improved.	1. To maintain the existing environmental state and avoid a variety of environmental impacts during construction and operation periods of the program 1. 2. It does not change land use status, and does not occupy land. 3. It doesn't need to relocate residents.
Disadvantages	1. Some subprojects will occupy farmland or need to relocate residents. The malodorous gases generated by organic fertilizer production will have a certain impact on surrounding environment.	1. Can not ease the electricity power shortage, and do not adjust the fuel

	2. Mechanical noise has some impact on surrounding environment in subprojects operating period. 3. Some subprojects occupy farmland, wasteland or woodland to change the regional land use pattern to some extent. But the area is relatively small and limited impact on the regional ecological integrity. During operation time, most of the subprojects land is changed into flat and hardened construction land, the remaining parts greening. So the coverage is increased and soil erosion intensity will be small. 4. Biogas produced by each subproject operation will generate some risks in the storage and transportation process. The risks may impact on the residents surrounding the subproject, gas station, along the pipeline, transport vehicles routes, and etc.	structure of residents. 2. The fuel structure of resident is not adjusted resulting in regional pollutant emissions increasing and aggravating environmental pollution. 3. Livestock manure of surrounding farms will be directly returned land or discarded, so not improving the local environment. 4. The straw disposal problems still can not be solved.
Comprehensive analysis	From the social and environmental point of view, program 1 is better than program 2.	

Table 8.1-1 shows that program 2 (no project plan) does not generate malodorous gas and noise from subproject construction to operation period, but the impact can be prevented and reduced by taking appropriate measures. Meanwhile, the subproject construction can adjust the energy structure of local residents' life, and reduce air pollution due to coal and straw burning. It can also solve the problem of livestock manure and straw disposal. It can reduce regional air pollutants emissions, improve residents' life quality, and increase employment. Social and environmental benefits of project operation are long-term. Therefore, from the social and environmental point of view, project construction program is better than no project plan, and the construction is necessary.

8.2 Comparison a tion of subprojects' sites

8.2.1 Anping Subproject

（1）Comparison and selection of subproject construction sites

Recommended site: Southeast of Hebei Yufeng Jingan Farm Co., Ltd, where is in the south of Dongzhaizi Village, Anping County.

Alternative site: 200 meters north of Dongliangwa Villege.

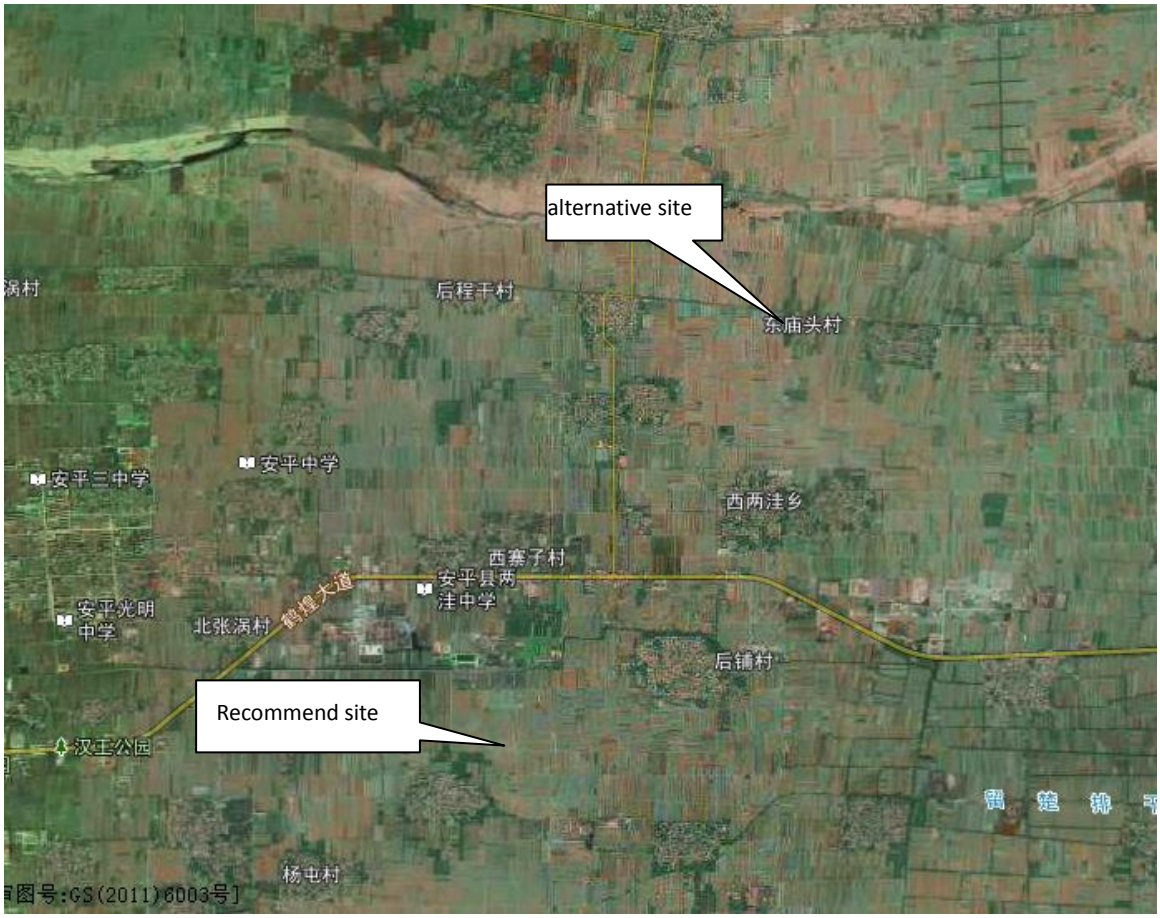


Figure 8.2-1 Anping subproject construction sites comparison

Table 8.2-1 Comparison and selection of subproject sites

Aspects / Programs			Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
			Southeast of Hebei Yufeng Jingan Farm CO., Ltd, where is in the south of Dongzhaizi Village, Anping County	200 meters north of Dongliangwa Villege	
Society	Area (10^4 m^2)		23775	20000	Equal
	Relocation (household)		0	0	Equal
	Topography and geology		The Hutuo River flood plain in hilly area	The Hutuo River flood plain in hilly area	Equal
	Land use type		Wasteland	Farmland	Program 1 is better.
Source of raw materials	Straw	Relative position	Existing 45000 mu farmland of Xiliangwa Town, 2000 m from the subproject	Existing 45000 mu farmland of Xiliangwa Town, 3000 m from the subproject	Program 1 is better.
		Transport condition	Each new residential neighborhood committee or	Each new residential neighborhood committee or	Equal

			village committee send special person accountable for transportation.	village committee send special person accountable for transportation	
	Livestock manure	Relative position	30m from Jingan livestock farm, 1500m from Liangwa Sige livestock farm	3000m from Jingan livestock farm, 300m from Liangwa Sige livestock farm	Program 1 is better.
		Transport condition	Pipeline	Pipeline	Equal
Products	Biogas residue and liquid users	Relative position of use sites	Locate in 4km range surrounding the subproject, the longest transport distance of biogas fertilizer is 5km.	Locate in 4km range surrounding the subproject, the longest transport distance of biogas fertilizer is 7km.	Program 1 is better.
		Transport condition	Tanker truck	Tanker truck	Equal
	Biogas	Users location	20000 households surrounding the subproject and CNG filling station	20000 households surrounding the subproject and CNG filling station	Equal
		Pipeline laying	1 km main pipelines	2.5 km main pipelines	Program 1 is better.
Environmental impact	Environmental sensitive point		No sensitive point surrounding the subproject site	No sensitive point surrounding the subproject site	Equal
	Environmental risk		No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	Equal
	Water environmental impact		The site from Hutuo River 5 km	The site from Hutuo River 3 km	Equal
Technical aspects	Water supply and drainage condition		Can rely on the existing facilities of Jingan Corporation	Subproject water come from self-served wells	Program 1 is better.
	Traffic condition		900 m from the highway S302	2000 m from the highway S302	Program 1 is better.
	Power supply condition		Provided by Hebei Yufeng Jingan Farm CO., Ltd.	Provided byDongliangwa Village	Equal
	Construction condition		The site without filling high, without earthwork and borrow area. Short construction time	The site without filling high, without earthworks and borrow area. Short construction time	Equal
	Construction time		Short construction time	Short construction time	Equal

Cost (10^4 RMB)	Land requisition cost	No	660	Program 1 is better.
	Total investment	18900	19100	Program 1 is better.
	Operating cost	843.55	976.96	Program 1 is better.

From the social impact analysis, two programs do not involve in resident relocation with similar terrain. But the recommended site is existing wasteland requisitioned by Hebei Yufeng Jingan Farm Co., Ltd, with no need more land. From the analysis of of raw materials source and product delivery, the planting crops area surrounding the recommended site is larger, and it is nearer to the farmland and two livestock farms. The length of pipeline laying and biogas fertilizer transport from the recommended site are all shorter. From the environmental impact analysis, no sensitive point neighbors two sites. From the analysis of technical and investment, the technical difficulty of two sites is similar, but the land requisition costs of the recommended site is less.

In summary, the recommended site is better than the alternative site.

（2）Comparison and selection of pipeline routes

Recommended route: laying along the village roads

Alternative route: laying a straight pipeline between biogas plants to Xingzhai Community and Wangpu Community.

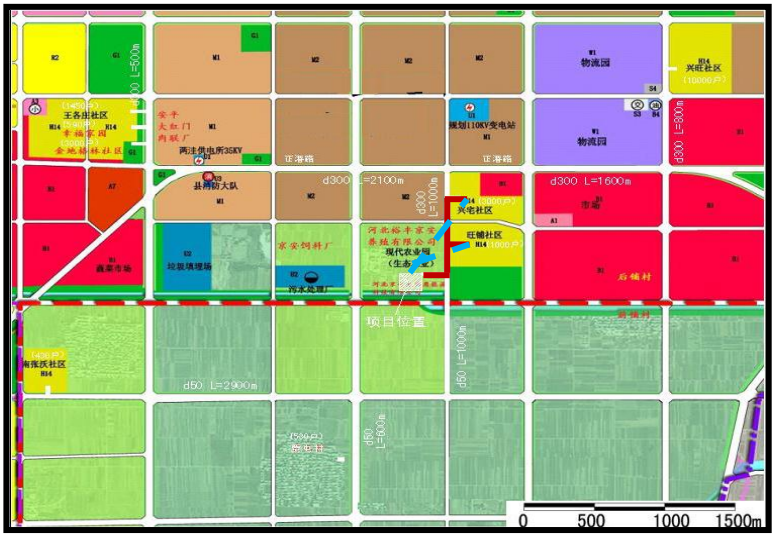


Figure 8.2-2 Biogas pipeline routes

Table 8.2-2 Comparison of biogas pipeline routes

Aspects \ Programs		Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Laying along the village roads	Laying a straight pipeline between biogas plants to Xingzhai Community and Wangpu Community	
Society	Relocation (household)	0	0	Equal
	Area of land temporary occupied (10^4 m^2)	2.8	2.8	Equal
Technical aspects	Construction difficulty	Cross village road once, 1km main pipelines	Cross village road twice, 0.8 km main pipelines	Equal
	Construction time	Small earthwork and short construction time	Small earthwork and short construction time	Equal
	Environmental sensitive point	Cross the east village road	Cross the east village road	Equal
Cost（10^4 RMB）	Compensation fees of temporary land use	100	120	Program 1 is better.
	Total investment	18900	18920	Equal
	Operating cost	100	100	Equal

From the analysis of social impact, two programs do not involve in resident relocation with similar terrain, and the areas of land temporary occupied are same. From the analysis technical aspects, although the main pipeline of recommended route is longer, but it less disturb the existing arable land. From the analysis of environmental impacts, two programs affect the village along the pipelines equally, but the recommended route only cross the east village road once and it have relatively smaller impact on traffic. From the investment analysis, the recommended route's compensation fees of temporary land use are higher.

In summary, the recommended route is better than the alternative route.

8.2.2 Laoting Subproject

（1）Comparison and selection of subproject construction sites

Recommended site: Hantuo village, Laoting County, Hebei Province (N39°23′25.62″, E118°54′30.64″)

Alternative site: industry cluster zone of Laoting County (N 39°26'19.34", E 118°56'5.81")

Figure 8.2-3 Laoting subproject construction sites comparison

Table 8.2-3 Comparison and selection of subproject sites

Aspects \ Programs			Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
			Hantuo village	Industry cluster zone	
Society	Area (mu)		100	100	Equal
	Relocation (household)		0	0	Equal
	Land use type		Cultivated land	Cultivated land	Equal
	Agricultural losses		All kinds of 9110 fruit trees	All kinds of 11000 fruit trees	Program 1 is better.
Source of raw materials	Straw	Transport distance	Existing farmland surrounding the site	Farmland surrounding the industry cluster zone, a distance of about 3 km	Program 1 is better.
		Transport condition	Road transport	Road transport	Equal
Products	Biogas residue	Relative position of	Existing farmland surrounding the site	Farmland surrounding the industry cluster	Program 1 is

	and liquid users	use sites		zone, a distance of about 3 km	better.
		Transport condition	Road transport	Road transport	Equal
	Biogas	Users location	Residents of Hantuo and its surround villages	Residents of Hantuo and its surround villages, but far from industry cluster zone	Program 1 is better.
		Pipeline laying	11500m main pipelines, 7000m pipelines into households	30000m main pipelines, 12000m branch pipelines	Program 1 is better.
Environmental impact in running period	Environmental sensitive point		No sensitive point surrounding the subproject site	No sensitive point surrounding the subproject site	Program 1 is better.
	Environmental risk		No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	Equal
	Water environmental impact		Xiaochang River is 500m from its north side	No	Program 2 is better.
Technical aspects	Water supply and drainage condition		1 self-served well	Municipal water supply	Program 2 is better.
	Power supply condition		Existing power supply pipelines	Existing power supply pipelines	Equal
	Construction condition		The site without filling high, without earthwork and borrow area. Short construction time	The site without filling high, without earthwork and borrow area. Short construction time	Equal
	Construction time		No complicated road, short construction time	No complicated road, short construction time	Equal
Cost	Income loss from land occupied		396890.17 RMB	408973.2 RMB	Program 1 is better.
	Land requisition cost		1984.77×10^4 RMB	2100.1×10^4 RMB	Program 1 is better.
	Total investment		18903.54×10^4 RMB	21302.67×10^4 RMB	Program

				1 is better.

From the analysis of social impact, the recommended site affects small population and less agriculture losses, and nearer surrounding farmland is easy to collect raw materials and consume biogas residue and liquid. The pipeline laying length is shorter for the recommended site. Its cost of raw material transport and pipeline construction is relatively smaller. From the environmental impact analysis, no sensitive point neighbors two sites. The land price of the recommended site is lower than that of alternative site. So the technological investment and land requisition costs of the recommended site is lower.

In summary, the recommended site is better than the alternative site.

（2）Comparison and selection of pipeline routes

Program 1 (recommended route): dendritic route

Program 2 (Alternative route): circular route

Pipelines routes, users and sensitive points along pipelines are shown in Figure 8.2-4. Main Comparison and selection are shown in Table 8.2-4.

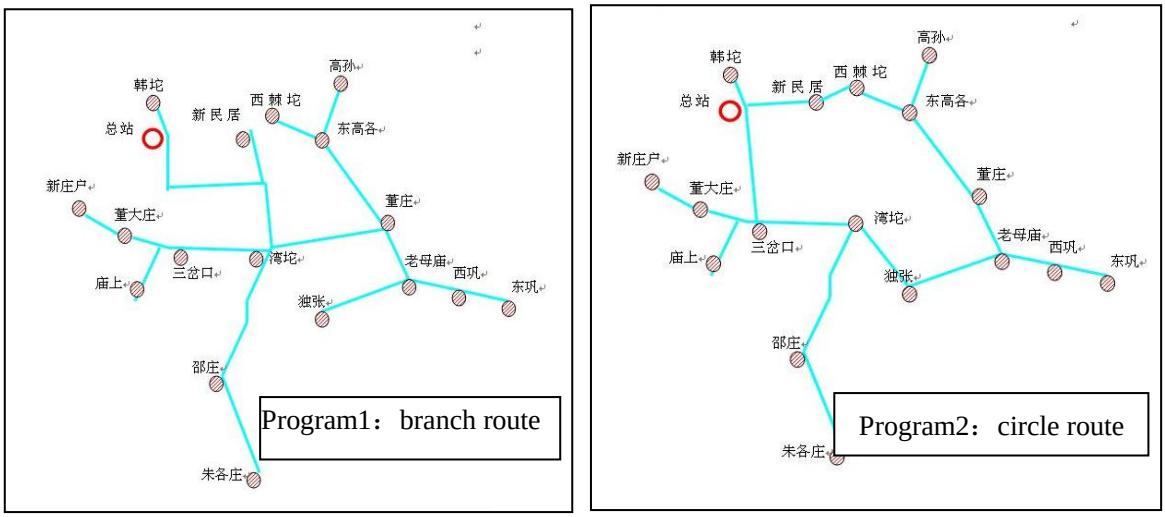


Figure 8.2-4 Biogas pipeline routes

Table 8.2-4 Comparison of biogas pipeline routes

Aspects \ Programs		Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Dendritic route	Circular route	
Society	Relocation (household)	0	0	Equal
	Area of land	11.5	18	Progra

	temporary occupied (10^4 m^2)			m 1 is better.
Technical aspects	Construction difficulty	Cross 2 village roads, Provincial Road S044, county road, Tanggang Motorway, Coastal Motorway, and Xiaochang River. 11500 m main pipelines, 7000 m pipelines into households	Cross 2 village roads, Provincial Road S044, county road, Tanggang Motorway, Coastal Motorway, and Xiaochang River. 15000 m main pipelines, 9000 m branch pipelines	Program 1 is better.
	Construction time	1 year	1 year	Equal
	Pressure regulating station	Without setting regulator station	Without setting regulator station	Equal
Environmental impact in construction period	Environmental sensitive point	Dongdazhuang Village, Wantuo Village, Shao Village, Donggaoge Village, Dongzhuang Village, Laomumiao Village, Xigong Village, Donggong Village, and Yucai Primary School	Dongdazhuang Village, Wantuo village, Shao Village, Duzhang Village, Dongzhuang Village, Laomumiao Village, Xigong Village, Yucai Primary School, Xijituo Village, Xinmingju Village, and Donggaoge Village	Program 1 is better.
Cost	Compensation fees of temporary land use	12.6	19.5	Equal
	Total investment	4920×10^4 RMB	5130×10^4 RMB	Program 1 is better.

From the analysis of social impact, two programs do not involve in resident relocation with similar terrain. The area of land temporary occupied of the recommended route is less, and the its distance to biogas users is shorter. From the technical aspects analysis, the laying pipelines length of the recommended route is shorter, its investment is lower. From the environmental impact analysis, the recommended route affects fewer households. From the investment analysis, total investment of the recommended route is less.

In summary, the recommended route is better than the alternative route.

8.2.3 Yutian Subproject

（1）Comparison and selection of subproject construction sites

Recommended site: The northwest corner of ecological farm, Yutian Yiheyuan Ecological Agricultural Co. Ltd.

Alternative site: The south open space of ecological farm, Yutian Yiheyuan Ecological Agricultural Co. Ltd.

Figure 8.2-5 Yutian subproject construction sites comparison

Table 8.2-5 Comparison and selection of subproject sites

Aspects / Programs			Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
			The northwest corner of ecological farm, Yutian Yiheyuan Ecological Agricultural Co. Ltd.	The south open space of ecological farm, Yutian Yiheyuan Ecological Agricultural Co. Ltd.	
Society	Area (10^4 m^2)		5.2	5.2	Equal
	Relocation (household)		0	0	Equal
	Land use type		Mountain land	Mountain land	Equal
Source of raw materials	Livestock manure	Relative position	Near to the self-owned livestock farm	Further t to the self-owned livestock farm	Program 1 is better.
		Transport condition	pipelines	Carrier vehicles	Program 1 is better.
Products	Biogas residue and liquid	Relative position of use sites	Near to vegetable greenhouses and orchards of self-owned farm	Further to vegetable greenhouses and orchards of self-owned farm	Program 1 is better.

	users	Transport condition	Pipelines, carrier vehicles	Carrier vehicles	Program 1 is better.
	Biogas	Users location	Residents in 3km range surrounding the subproject	Residents in 3km range surrounding the subproject	Equal
Environmental impact in running period	Environmental sensitive point		No sensitive point surrounding the subproject site	No sensitive point surrounding the subproject site	Equal
	Environmental risk		No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	Equal
	Water environmental impact		Less	Less	Equal
Technical aspects	Water supply and drainage condition		Water supply from the municipal pipeline	Water supply from the municipal pipeline	Equal
	Traffic condition		900 m from Road S264	900 m from Road S264	Equal
	Power supply condition		State Grid	State Grid	Equal
	Construction condition		The site without filling high, without earthwork and borrow area. Short construction time	The site without filling high, with earthwork and borrow area. Long construction time	Program 1 is better.
	Construction time		Belonging to the company self-owned land, so short construction time	Belonging to the company self-owned land, so short construction time	Equal
Cost (10^4 RMB)	Land requisition cost		0	0	Equal
	Total investment		705.4	884.0	Program 1 is better.

From the analysis of social impact, two programs do not involve in resident relocation with similar terrain. From the source of raw materials and product delivery analysis, the recommended site shows the convenient source of raw materials, straight transport by pipelines, and lower costs. Crop planting area surrounding the recommended site is relative larger, where is nearer to bio-fertilizer users. The transmission distance of biogas fertilizer is shorter, and the pipeline laying length is also shorter for the recommended site. From the environmental impact analysis, no sensitive point neighbors two sites. From the investment and technical analysis,

technical difficulty of two sites is equal, but land requisition cost of the recommended site is less.

In summary, the recommended site is better than the alternative site.

（2）Comparison and selection of pipeline routes

Recommended route: laying a straight pipeline between biogas plants to each village using biogas.

Alternative route: laying along the village roads.

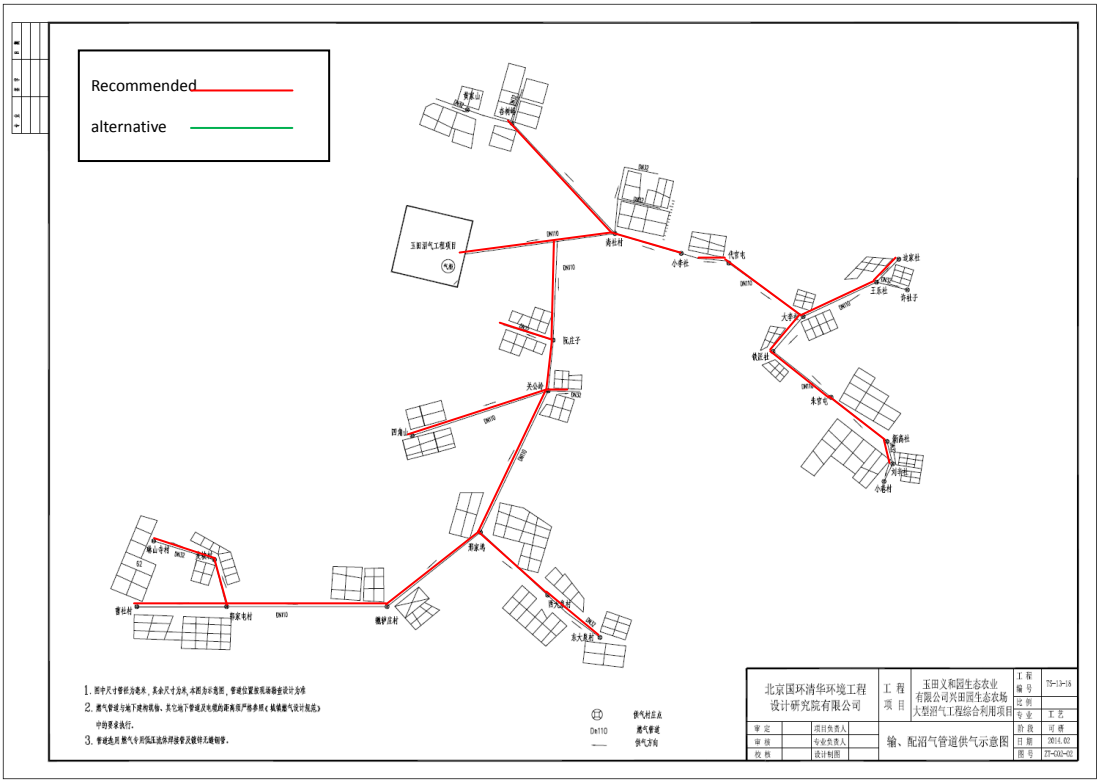


Figure 8.2-6 Biogas pipeline routes

Table 8.2-6 Comparison of biogas pipeline routes

Aspects	Programs	Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Laying a straight pipeline between biogas plants to each village using biogas	Laying along the village roads	
Society	Relocation (household)	0	0	Equal
	Area of land temporary occupied (10^4 m^2)	25	27	Program 1 is better.
Technical aspects	Construction difficulty	Cross 1 township road. 3.5 km main pipelines	Cross 1 township road and 1 provincial road. 11.20 km	Program 1 is

			main pipelines	better.
	Construction time	Small earthwork and short construction time	Large earthwork and long construction time	Program 1 is better.
Environmental impact in construction period	Environmental sensitive point	Huangjiashan Village, Shangzhuang Village, Xiaolizhuang Village, Ruanzhuangzi Village, Xingjiawu Village, Sijiaoshan Village, Guangongling Village	Huangjiashan Village, Xingshuyu Village, Shangzhuang Village, Xiaolizhuang Village, Ruanzhuangzi Village, Xingjiawu Village, Sijiaoshan Village, Guangongling Village	Equal
Cost (10^4 RMB)	Compensation fees of temporary land use	0	0	Equal
	Total investment	917.69	930	Program 1 is better.
	Operating cost	200	220	Program 1 is better.

From the analysis of social impact, two programs do not involve in resident relocation with similar terrain. The area of land temporary occupied of the recommended route is smaller. From the analysis of technical aspects, the length and construction time of main pipelines of the recommended route is shorter. From the analysis of environmental impact, two routes affect almost same number of villages and roads without crossing water. From the investment analysis, total investment and operating cost of the recommended route is less.

In summary, the recommended route is better than the alternative route.

8.2.4 Zunhua Subproject

（1）Comparison and selection of subproject construction sites

Recommended site: The reserved land for construction, north of main part in Xixindianzi Broiler Breeding Base of Hebei Meikeduo food Co., Ltd., where is in the north of Bangkuan Road (S356). The S356 is in the west of Xixindianzi Village, Baozidian Town, Zunhua City. (Abbr. to north site of Bangkuan Road)

Alternative site: The land, wasteland and ore dressing land, south of main part in Xixindianzi Broiler Breeding Base, Hebei Meikeduo food Co., Ltd., where is in the

south of Bangkuan Road (S356). The S356 is in the west of Xixindianzi Village, Baozidian Town, Zunhua City. (Abbr. to south site of Bangkuan Road)

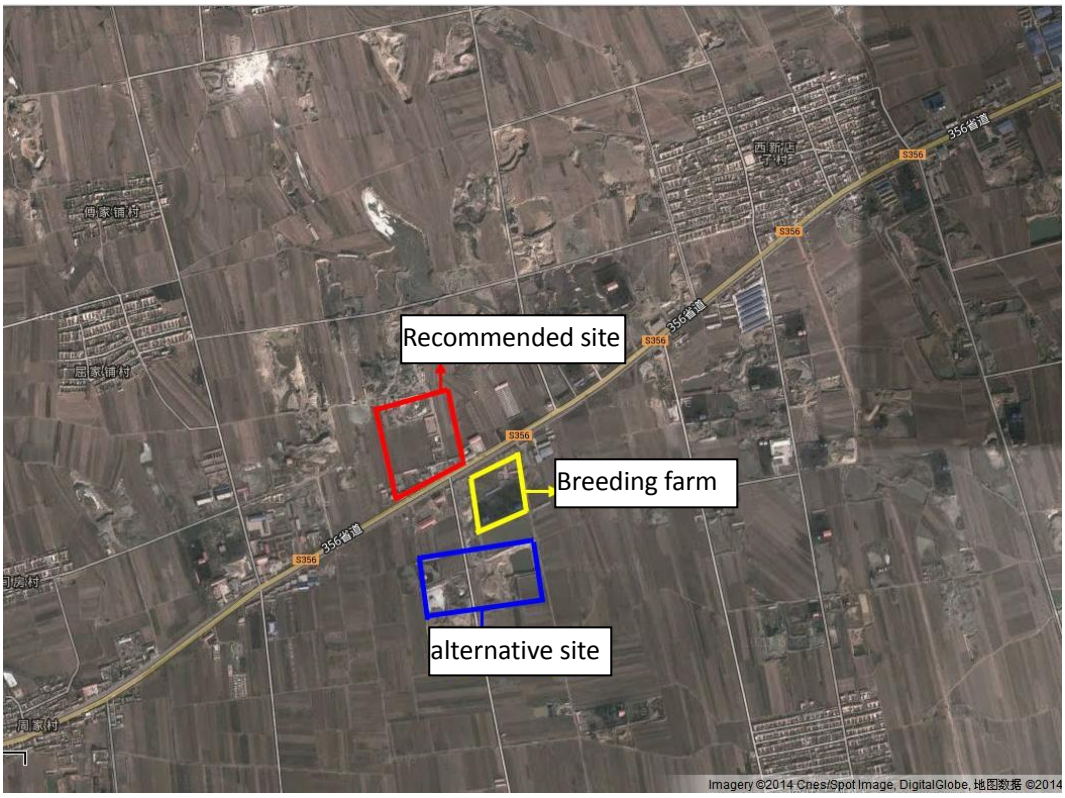


Figure 8.2-9 Zunhua subproject construction sites comparison

Table 8.2-9 Comparison and selection of subproject sites

Aspects \ Programs			Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
			North site of Bangkuan Road	Sorth site of Bangkuan Road	
Society	Area (10^4 m^2)		106656 (about 160 mu)	106656 (about 160 mu)	Equal
	Relocation (household)		An ore dressing plant with 100 thousands ton annual output	Two ore dressing plant with each 100 thousands ton annual output and an iron ore dressing plant with 50 thousands ton annual output	Program 1 is better.
Source of raw materials	Straw	Relative position	Existing farmland in the west and south of the site	Existing farmland surrounding the site	Equal
		Transport condition	Close to Bangkuan Road. Use transport vehicles.	Pave road between Bangkuan Road and the site. Use transport vehicles.	Program 1 is better.
	Livestock manure	Relative position	Just a road isolating the Breeding Base and site	Near to the Breeding Base	Equal
		Transport condition	Close to Bangkuan Road. Use transport vehicles.	Pave road between Bangkuan Road and the site. Use	Program 1 is

				transport vehicles.	better.
Products	Biogas residue and liquid users	Relative position of use sites	Weijinhe Tree Farm in the northwest of site, east river waste land, west and south farmland	Nearby farmland	Equal
		Transport condition	Good condition for biogas liquid pipeline transportation. Good condition for biogas residue road transportation.	Good condition for biogas liquid pipeline transportation, but need to cross Bangkuan Road. Good condition for biogas residue road transportation.	Program 1 is better.
	Biogas	Users location	Distribute around the site	Distribute around the site	Equal
		Pipeline laying	20 km main pipelines, 200 km branch pipelines	20 km main pipelines, 200 km branch pipelines	Equal
Environmental impacts	Environmental sensitive point		No sensitive point surrounding the subproject site	No sensitive point surrounding the subproject site	Equal
	Environmental risk		No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	Equal
	Water environmental impact		The site is 3 km from a grade I water source protection zone. 3.2 km from Weijin River	The site is 2 km from a grade I water source protection zone. 2 km from Weijin River	Equal
Technical aspects	Water supply and drainage condition		Subproject water come from self-served wells. The site is a slightly elevated land easy to collect and discharge rainwater	Subproject water come from self-served wells. The site is a slightly flat land needing for the construction processing to meet rainwater collection and discharge	Program 1 is better.
	Traffic condition		15 m from Bandkuan Road	30 m from Bandkuan Road	Program 1 is better.
	Power supply condition		Better	Better	Equal
	Construction condition		The site without filling high	The site with part of filling high. Source of soil is river's comprehensive regulation waste 4 km away.	Program 1 is better.
	Construction time		Short construction time due to the flat site	Long construction time due to filling high site and paving road	Program 1 is better.

Cost (10^4 RMB)	Land requisition cost	320	310	Program 1 is better.
	Total investment	1005.4	1224.89	Program 1 is better.
	Operating cost	218	244	Program 1 is better.

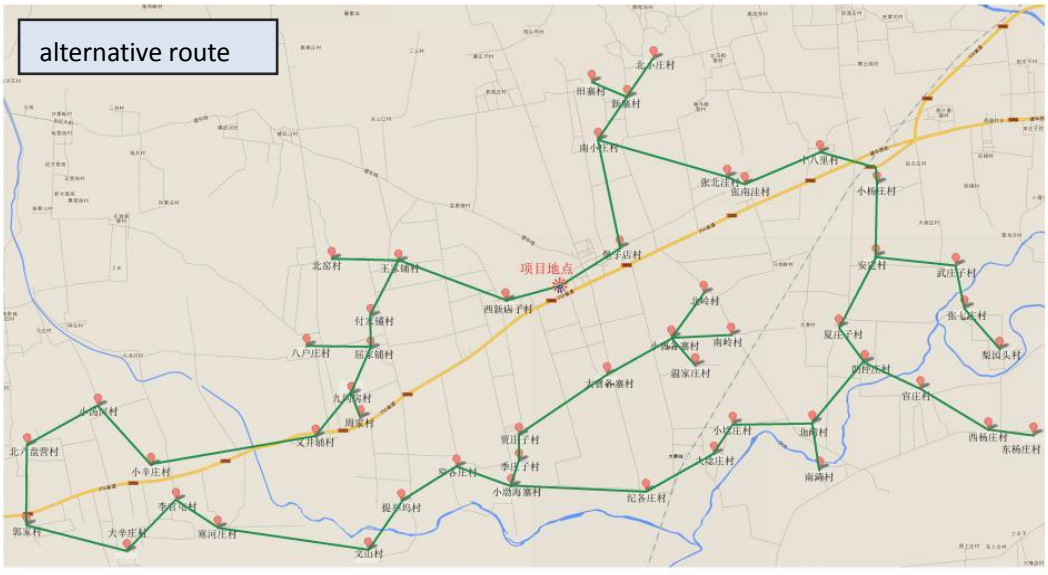
From the analysis of social impact, two programs do not involve in resident relocation with similar terrain and same area. From the source of raw materials and product delivery analysis, the recommended site shows more convenient transportation, surrounding with Weijinhe Tree Farm and farmland, with favorable conditions for the organic fertilizer conversion. From the analysis of environmental impact, there is no sensitive point in both sites, and the selected sites are far from the water source protection zone and Weijin River. From the analysis of technical, the recommended site has low construction difficulty, short construction time, less land requisition costs and operating costs.

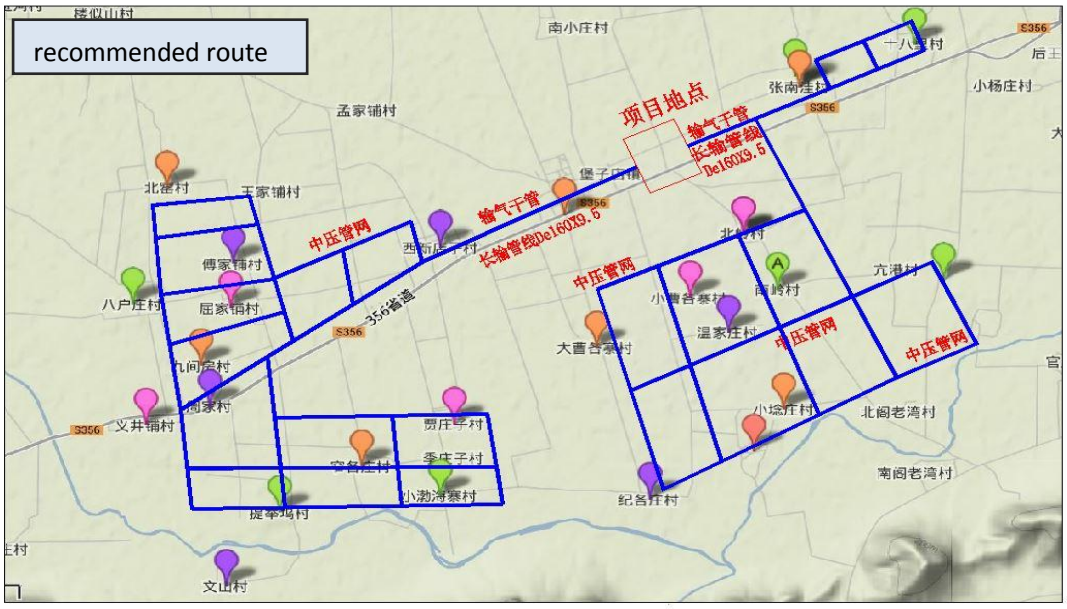
Therefore, the subproject finally chooses the recommended site.

（2）Comparison and selection of pipeline routes

Recommended route: dendritic structure route. Branch pipelines are radially laid from main pipelines with supply reaching each village.

Alternative route: Pipelines connect into a closed ring, which is basic form of urban transfer pipeline. The gas pressure in same ring is in same level.





Aspects \ Programs		Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Dendritic structure	Circular structure	
Society	Relocation (household)	0	0	Equal
	Area of land temporary occupied (10^4 m^2)	1.6	2.0	Program 1 is better.
Technical aspects	Construction difficulty	Cross Provincial Road S356, Da-qin Railway, and canals. 20 km main pipelines, 150 km branch pipelines	Cross Provincial Road S356, Da-qin Railway, and canals. 13 km main pipelines, 200 km branch pipelines	Equal
	Construction time	Small earthwork and short construction time	Large earthwork and long construction time	Program 1 is better.
	Pressure regulating station	Without setting regulator station	Without setting regulator station	Equal
Environmental impact in construction period	Environmental sensitive point	Wangjiapu Village, Qujiapu Village and Xiaocaogezhai Village.	Wangjiapu Village, Qujiapu Village, Xiaocaogezhai Village, Xindianzi Village and Tijuwu Village.	Program 1 is better.
Cost (10^4 RMB)	Compensation fees of temporary land use	12	15	Equal

	Total investment	240	260	Program 1 is better.
	Operating cost	100	100	Equal

From the social impact analysis, two programs do not involve in resident relocation with similar terrain, and the areas of land temporary occupied of the recommended route is less. From the technical aspects analysis, the main pipelines of recommended route are shorter. From the environmental impacts analysis, the environmental sensitive point of recommended route is less. From the investment analysis, the area of land temporary occupied and total investment of the recommended route is also less.

In summary, the recommended route is better than the alternative route.

8.2.5 Chengde Subproject

（1）Comparison and selection of subproject construction sites

Recommended site: 400 m northeast of Beigushan Village, east side of Provincial Road S354.

Alternative site: 100 m northeast of Beigushan Village, west side of Provincial Road S354.

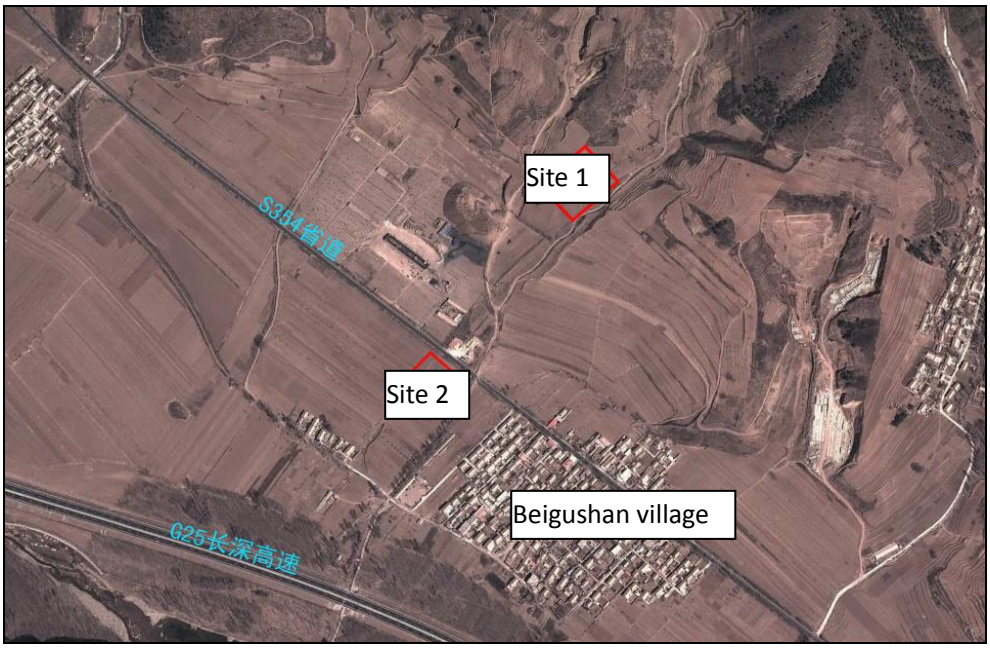


Figure 8.2-11 Chengde subproject construction sites comparison

Table 8.2-11 Comparison and selection of subproject sites

Aspects \ Programs			Program 1 (recommended site) 400m northeast of Beigushan Village, east side of Provincial Road S354	Program 2 (alternative site) 100m northeast of Beigushan Village, west side of Provincial Road S354	Pros and cons
Society	Area (10^4 m^2)		30000 (about 45 mu)	30000 (about 45 mu)	Equal
	Relocation (household)		Do not involve in resident relocation	Do not involve in resident relocation	Equal
	Land use type		Mountain land	Farmland	Program 1 is better.
Source of raw materials	Straw	Relative position	Site locate is 400 m far from the northeastern part of Beigushan Village. The distance is relatively long.	Site locate is 100 m far from the northern part of Beigushan Village. It is relatively sensitive.	Program 1 is better.
		Transport condition	Need to pave road from the site to Provincial Road S354	Close to Provincial Road S354 and convenient transport conditions	Program 2 is better.
Products	Biogas residue and liquid users	Relative position of use sites	Existing farmland surrounding the site with favorable conditions for the organic fertilizer conversion.	Existing farmland surrounding the site with favorable conditions for the organic fertilizer conversion.	Equal
		Transport condition	Biogas liquid pipeline transportation and biogas residue road transportation	Biogas liquid pipeline transportation and biogas residue road transportation	Equal
	Biogas	Users location	Distribute around the site	Distribute around the site	Equal
		Pipeline laying	53341 m main pipelines	53341 m main pipelines	Equal
Environmental impacts	Environmental sensitive point		No sensitive point surrounding the subproject site	No sensitive point surrounding the subproject site	Equal
	Environmental risk		No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	Equal
	Water environmental impact		No	No	Equal
Technical aspects	Water supply and drainage condition		Water supply from the municipal pipeline	Subproject water come from self-served wells.	Program 1 is better.

	Traffic condition	340 m from Provincial Road S354	Next to Provincial Road S354	Program 2 is better.
	Power supply condition	Power grid of Beigushan Village	Power grid of Beigushan Village	Equal
	Construction condition	The site without filling high, only needs clearing	The site with part of filling high. Source of soil is river's comprehensive regulation waste.	Program 1 is better.
	Construction time	Short construction time due to the flat site	Long construction time due to filling high site	Program 1 is better.
Cost	Land requisition cost	220×10^4 RMB	220×10^4 RMB	Program 1 is better.
	Total investment	5984650.3 RMB	619603.5 RMB	Program 1 is better.
	Operating cost	230×10^4 RMB	280×10^4 RMB	Program 1 is better.

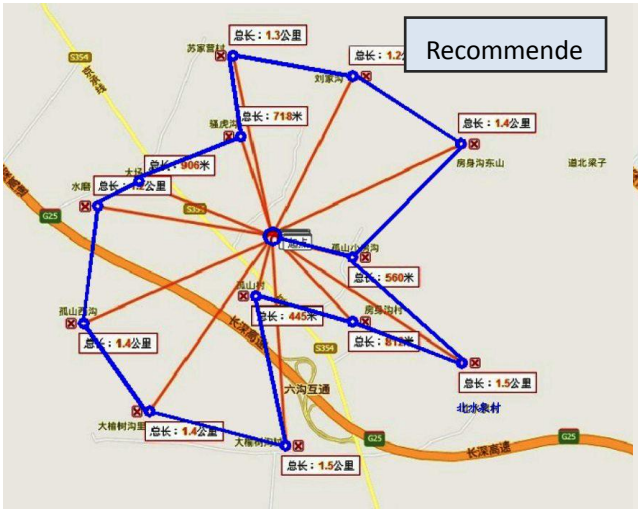
From the analysis of social impact and technical difficulty, two programs do not involve in resident relocation, but the recommended site is flat with smaller construction difficulty. From the analysis of source of raw materials, product delivery and other aspects, two sites are equal.

In summary, the recommended site is better than the alternative site.

（2）Comparison and selection of pipeline routes

Recommended route: circular Route

Alternative route: radial route



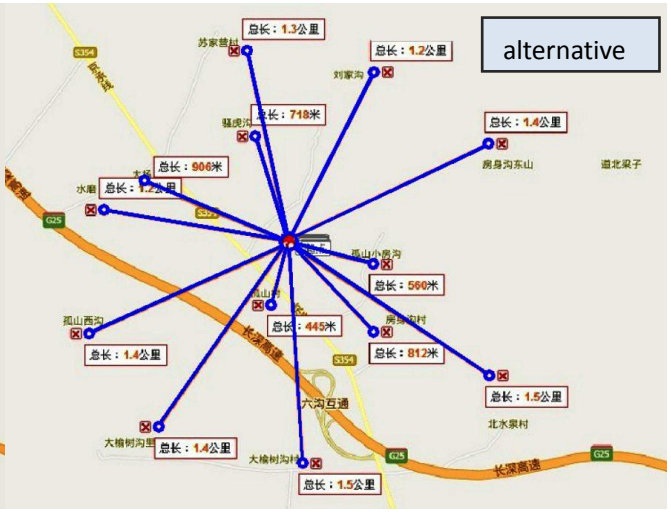


Figure 8.2-12 Biogas pipeline routes

Table 8.2-12 Comparison of biogas pipeline routes

Aspects \ Programs		Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Circular Route	Radial route	
Society	Relocation (household)	0	0	Equal
	Area of land temporary occupied (10^4 m^2)	1.2	2.0	Equal
Technical aspects	Construction difficulty	Cross Provincial Road S145, Jing-Shen Expressway, and Laoniu River. 11.56 km main pipelines, 39 km branch pipelines	Cross Provincial Road S145, Jing-Shen Expressway, and Laoniu River. 14.341 km main pipelines, 39 km branch pipelines	Program 1 is better.
	Construction time	1 year	1 year	Equal
	Pressure regulating station	Without setting regulator station	Without setting regulator station	Equal
Environmental impact in construction period	Environmental sensitive point	No	No	Equal
Cost (10^4 RMB)	Compensation fees of temporary land use	24	30	Program 1 is better.
	Total investment	2600	3000	Program 1 is better.
	Operating cost	80	110	Program 1 is better.

From the analysis of social impact, two programs do not involve in resident relocation with similar terrain, and the areas of land temporary occupied of the recommended route is less. From the technical aspects analysis, no need setting regulator station for two routes, but the main pipelines of recommended route are

shorter with convenient construction conditions. From the environmental impacts analysis, the area of land temporary occupied of the recommended route is less with fewer disturbances to cultivated land. From the investment analysis, the recommended route's compensation fees of temporary land use and pipeline operating cost is lower.

Therefore, the recommended route is better than the alternative route.

8.2.6 Linzhang Subproject

（1）Comparison and selection of subproject construction sites

Recommended site: Modern Agricultural Science and Technology Demonstration Zone of Linzhang County, Hebei Province. Total area is 70 mu.

Alternative site: Modern Agricultural Science and Technology Model Demonstration Zone of Linzhang County, Hebei Province. Total area is 50 mu.

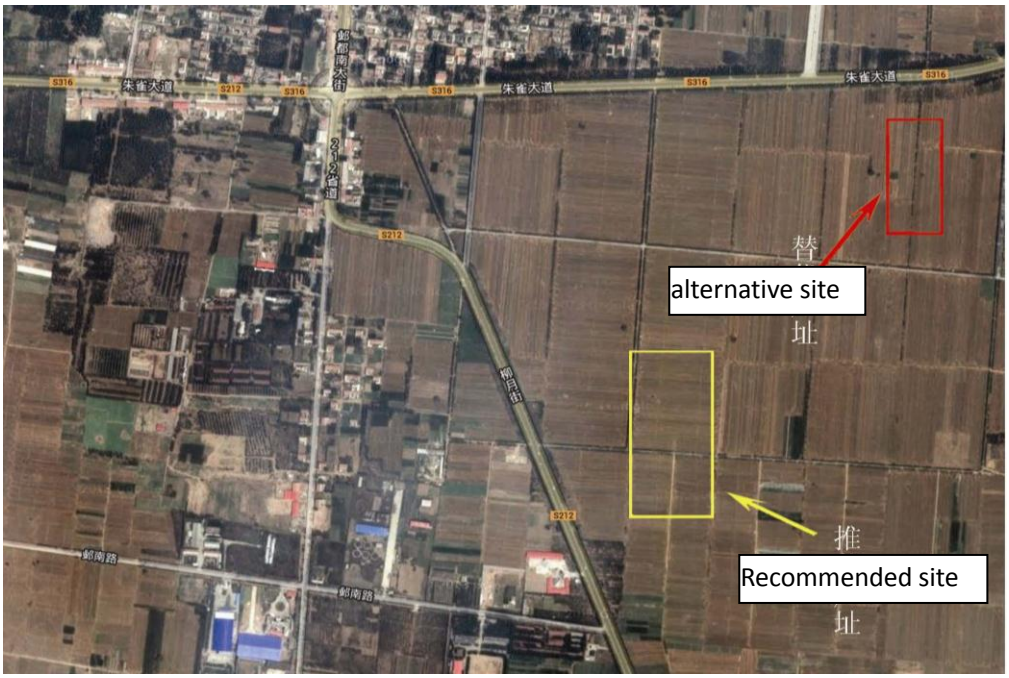


Figure 8.2-13 Linzhang subproject construction sites comparison

Table 8.2-13 Comparison and selection of subproject sites

Aspects	Programs	Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Modern Agricultural Science and Technology Demonstration Zone of Linzhang County	Modern Agricultural Science and Technology Demonstration Zone of Linzhang County	
Society	Area (mu)	70	50	Equal
	Relocation (household)	0	An orchard, some cemeteries, some	Program 1 is

				vegetable greenhouses	better.
	Land use type		Farmland	Farmland	Equal
Source of raw materials	Straw	Relative position	5 km in the range of subproject site	5 km in the range of subproject site	Equal
		Transport condition	Close to road, vehicle transport	Close to road, vehicle transport	Equal
Products	Biogas residue and liquid users	Relative position of use sites	Used by owned planting base of construction unit, the remaining for sale	Used by owned planting base of construction unit, the remaining for sale	Equal
		Transport condition	Close to road, vehicle transport	Close to road, vehicle transport	Equal
	Biogas	Users location	4.5 km in the range of subproject site	4.5 km in the range of subproject site	Equal
		Pipeline laying	30 km main pipelines, 21 km branch pipelines	45 km main pipelines, 18 km branch pipelines	Program 1 is better.
Environmental impacts	Environmental sensitive point		No sensitive point surrounding the subproject site	No sensitive point surrounding the subproject site	Equal
	Environmental risk		No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	No sensitive point at the death radius, serious injury radius, minor injury radius and property damage radius	Equal
	Water environmental impact		No water source protection zone near the site	No water source protection zone near the site	Equal
Technical aspects	Water supply and drainage condition		Water supply from two municipal pipelines and a self-served wells.	Water supply from the municipal pipeline	Equal
	Traffic condition		10 m from the southern extension road of Yenanda Street	10 m from Weifeng Road	Equal
	Power supply condition		1500 KW transformer, biogas generators. Power supply is reliable.	1500 KW transformer, biogas generators. Power supply is reliable.	Equal
	Construction condition		The site without filling high, without earthwork and borrow area. Short construction time.	The site without filling high, with earthwork and borrow area. Long construction time.	Program 1 is better.

	Construction time	Short construction time due to the area reaching three supplies and one leveling and other good conditions	Long construction time due to the site needing filling high and more items of resident relocation	Program 1 is better.
Cost (10^4 RMB)	Land requisition cost	700×10^4 RMB	575×10^4 RMB	Program 2 is better.
	Total investment	1280	1390	Program 1 is better.

From the analysis of social impact, two programs have similar terrain. Although the alternative site area is smaller, it involves in a relocation of an orchard, some cemeteries and some vegetable greenhouses with a great impact on the residents living. From Source of raw materials and product delivery analysis, surrounding infrastructure, source of raw materials, product is basically same, but pipeline laying length of the recommended site is shorter. From the environmental impact analysis, two sites are equal. From the technical and investment analysis, two sites technical difficulty is equal, but the total investment of recommended site is less.

Therefore, the recommended site is chosen for Linzhang subproject.

（2）Comparison and selection of pipeline routes

Recommended route: dendritic route

Alternative route: circular route

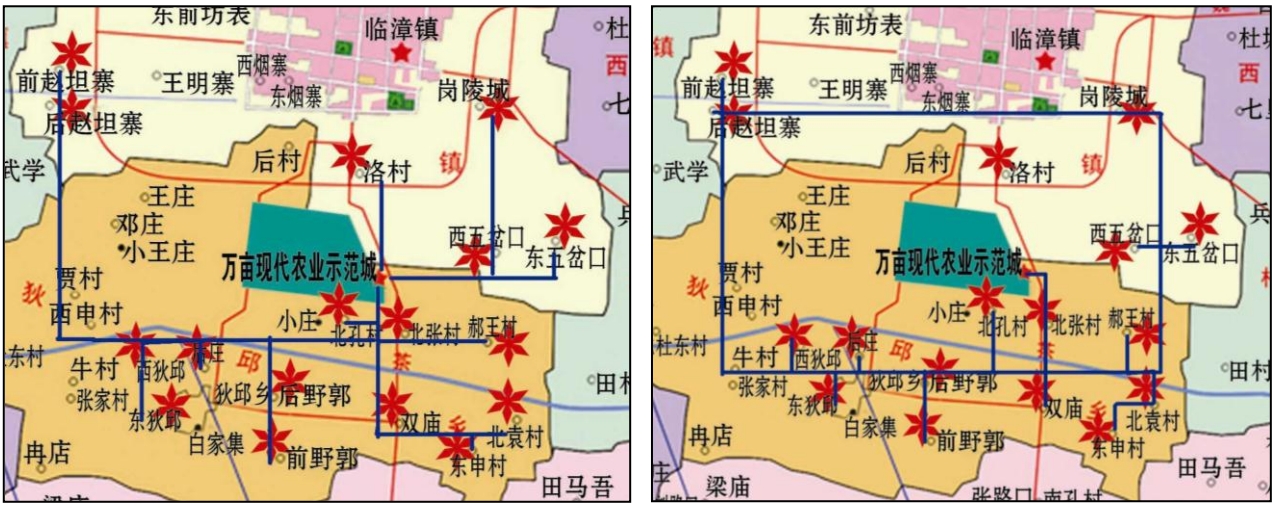


Figure 8.2-14 Biogas pipeline routes

Table 8.2-14 Comparison of biogas pipeline routes

Aspects \ Programs		Program 1 (recommended site)	Program 2 (alternative site)	Pros and cons
		Dendritic route	Circular route	
Society	Relocation (household)	0	0	Equal
	Area of land temporary occupied (10^4 m^2)	15	18.9	Program 1 is better.
Technical aspects	Construction difficulty	Cross Provincial Road S212, 3 town and county roads. 30 km main pipelines, 21 km branch pipelines	Cross Provincial Road S212 and S316, 5 town and county roads. 45 km main pipelines, 18 km branch pipelines	Program 1 is better.
	Construction time	3 months	4 months	Program 1 is better.
	Pressure regulating station	Without setting regulator station	Without setting regulator station	Equal
Environmental impact in running period	Environmental sensitive point	Subpeoject affects Jia Village, Xidiqiu Village, Beizhang Village, and ShuangmiaoVillage.	Subpeoject affects Jia Village, Xidiqiu Village, Houzhuang Village, Beizhang Village, and Ganglingcheng Village.	Program 1 is better.
Cost	Compensation fees of temporary land use	30×10^4 RMB	46×10^4 RMB	Equal
	Total investment	1022×10^4 RMB	1575×10^4 RMB	Equal

From the social impact analysis, two programs do not involve in resident relocation with similar terrain, and the areas of land temporary occupied of the recommended route is less. From the technical aspects analysis, laying pipelines length of recommended route is shorter with less construction time. From the environmental impacts analysis, the number of villages and roads impacted by the recommended route is less. From the investment analysis, the recommended route's total investment is also less.

In summary, the recommended route is better than the alternative route when considering the reducing of construction and environmental impact in operation

period.

8.3 Process Comparison and selection

8.3.1 Process parameters

At present, the mainly used anaerobic fermentation reactors involved conventional anaerobic reactor, CSTR, plug flow reactor (PFR), upflow anaerobic sludge blanket reactor (UASB), upflow solid reactor (USR), internal circulation anaerobic reactor (IC), and etc. Various fermentation parameters are shown in Table 8.3-1.

Table 8.3-1 List of fermentation parameters

Reactor types		Range of raw materials	Concentration of fermentation (%)	Hydraulic residence time, HRT (day)	Biogas production rate (m^3/m^3 d)	Each tank volume	Heat energy consumption	Water needs	Biogas liquid volume	Fermentation volume for same raw materials	Investment of same amount of raw materials
Conventional anaerobic reactor		All raw materials are suitable for fermentation	3-10	15-30	0.8-1.2	300-4000	High, about 20-30% of biogas energy generation	Large	Large	Large	High
CSTR		All raw materials are suitable for fermentation	5-12	20-40	0.6-1.0	300-5000	High, about 20-30% of biogas energy generation	Large	Large	Large	High
PFR		High stabilization and solidification waste (especially for cow manure)	7-10	20-30	0.6-1.2	300-2500	High, about 10-20% of biogas energy generation	Less	Less	Moderate	Low
Upflow solid reactor (USR)		High concentration wastewater	3-6	15-25	0.8-1.2	300-1000	High, about 20-30% of biogas energy generation	Large	Large	Large	High
Dry fermentation	Dry anaerobic fermentation by membrane covered through (MCT)	Manure, straw, organic waste	15-30	20-40 (Sequencing)	0.6-0.9	300-800	Low, about 10-15% of biogas energy generation	Very little or no	Very little or no	Small	Moderate
	Dry fermentation in garage-type	All kinds of organ raw materials	25-50	20-40	1.0-2.0	1000-2000	Low, about 10-20% of biogas	Very little	Very little or	Small	Low

Reactor types	Range of raw materials	Concentration of fermentation (%)	Hydraulic residence time, HRT (day)	Biogas production rate（m^3/m^3 d）	Each tank volume	Heat energy consumption	Water needs	Biogas liquid volume	Fermentation volume for same raw materials	Investment of same amount of raw materials
digester						energy generation	or no	no		
Two-phase biogas fermentation of high efficient anaerobic producing methane (solidoid producing acid and liquidoid producing methane fermentation process in series, SAPS)	Waste containing high level dry materials	20-30	Solid: 20-30; Liquid:15-25	0.8-1.2	300-800	Low, about 10-20% of biogas energy generation	Very little or no	Very little or no	Small	High
Integrated two-phase (recirculated inoculation) anaerobic digestion	Straw	15-30	50-90	0.8-1.5	300-9000	Low, about 10-20% of biogas energy generation	Very little or no	Very little or no	Small	Low
Vertical plug flow anaerobic digestion	Straw	6-8	50-90	1.0-1.3	300-1500	Low, about 10-20% of biogas energy generation	Very little or no	Very little or no	Small	Low

8.3.2 Process comparison and selection

Design principles:

(1) Biogas, breeding and planting techniques are optimized to use energy in multi-level and rationally recycle substance by following the principles of reducing, harmless, reusing and comprehensive utilization.

(2) The technical process is non-patent technology, simple and reasonable with less investment, convenient and reliable operation with low operating costs.

(3) Increase the concentration of fermentation to enhance gas production quantities and reduce operating costs.

(4) Improve the use efficiency of biogas liquid and residue to avoid secondary pollution.

(5) There are successful and stable operation cases.

8.3.2.1 Pure straw fermentation process

Table 8.3-2 Comparison and selection of pure straw Fermentation processes

Process selection	Recommended process	Alternative process	
	VPF	Integrated two-phase anaerobic digestion process	SAPS
Suitable raw materials	Straw	Straw	Waste containing high level dry materials
Suitable volume (m^3)	300-3000	300-9000	300-800
Biogas production rate （m^3/m^3 d）	1.0-1.3	0.8-1.5	0.8-1.2
Construction costs	Low investment	Low investment	Low investment
Operating costs	Low, about 10-20% of biogas energy generation	Low, about 10-20% of biogas energy generation	Low, about 10-20% of biogas energy generation
Successful cases	A: 400 m^3 biogas project of Dongyaozhuang Village, Qin County, Hebei Province. B: Large scale straw biogas project of Hebei Gengzhong Biogass Energy Co., Ltd. in	A: Large scale straw biogas project in Fengrun Strict, Tangshan City with 900 m^3 single fermentation bank, in the commissioning phase. B: Straw biogas project of Sidangkou Village,	A: Straw biogas project of Huangshi Village, Kaihua County, Zhejiang Province. B: Straw biogas project of Zibo City, Shandong Province

	Gengguantun Village, Qin County	Jinghai County, Tianjin	
Advantages and disadvantages	Simple structure, low operating energy consumption, good stability, high biogas production rate, no influence from seasons	High biogas production rate, but the technology running time is shorter.	No biogas generated, but no experience in running large-scale project.

Based on the above comparison, the investment of SAPS is lower. However, the single bank volume of this process is smaller, which can't meet the requirements of the subproject design. All conditions of VPF and integrated two-phase anaerobic digestion process are basically same, but biogas production rate of VPF is more stable, and there are successful operation cases in Hebei Province. Therefore, pure straw fermentation subprojects are recommended to use VPF.

8.3.2.2 Fermentation process with straw and manure mixed materials

Table 8.3-3 Comparison and selection of fermentation processes with straw and manure mixed materials

Process selection	Recommended process	Alternative process	
	Dry fermentation process in garage-type digester	Dry fermentation using plug-flow type	Dry anaerobic fermentation by membrane covered through
Suitable raw materials	All kinds of organic raw materials	Raw materials containing solids higher than 20%	Manure, straw and other organic wastes
Suitable volume (m^3)	1000-2000	300-4000	300-800
Biogas production rate（m^3/m^3 d）	1.0-2.0	1.0-2.0	0.6-0.9
Construction costs	Low investment	Low investment	Low investment
Operating costs	Low, about 10-20% of biogas energy generation	Low, about 10-20% of biogas energy generation	Low, about 10-20% of biogas energy generation
Successful cases	Melzingen Biogas Plant of Germany	A: Dry fermentation tank using plug-flow type, Shanghai Sennong Environmental Protection Technology Co. Ltd. B: Straw biogas project	A: 180m^3 pilot-scale project of Daxing District, Beijing B: Dry biogas project by MCT reactor of Chuangxin Dairy Farm

		of Gannan County, Qiqihaer City, Heilongjiang Province	in Panggezhuang Village, Daxing District, Beijing
Advantages and disadvantages	Raw materials without pretreated, biogas residue containing high level dry matter, and no biogas liquid produced	Low energy consumption, high energy output rate, high TS concentration of fermentation materials without scum problem	Sequencing batch feed and fermentation without external heat resource, Simultaneously producing biogas and solid organic fertilizer

Suitable volume and biogas production rate of MCT is low. Dry fermentation of plug-flow type is used to deal with the kitchen waste and small energy crops. Although there are built cases and operation in Shanghai and Heilongjiang, the process reliability is not clear . Dry fermentation process in garage-type digester has good running experiences in Germany. Its investment, operating costs and single tank volume can meet the needs of subproject design. Therefore, Fermentation subprojects with straw and manure mixed materials are recommended to use dry fermentation process in garage-type digester.

8.3.2.3 Universal class fermentation process

Table 8.3-3 Comparison and selection of fermentation processes

Process selection	CSTR	Conventional anaerobic reactor
Suitable raw materials	All raw materials are suitable for fermentation	All raw materials are suitable for fermentation
Suitable volume (m^3)	300-5000	300-4000
Biogas production rate （m^3/m^3 d）	0.8-1.2	0.8-1.2
Construction costs	High investment	High investment
Operating costs	High, about 20-30% of biogas energy generation	High, about 20-30% of biogas energy generation
Hydraulic residence time	15-30 days	15-30 days
Successful cases	A: Jindongtai Biogas Power Generation Project of COFCO Meat (Jiangsu) Co. Ltd. B: 3 MW biogas project producing heat, power and fertilizer of Shandong Minhe Husbandry C: 2 MW biogas power	Commonly used in Chinese rural biogas digesters

	generation project of Beijing Deqingyuan Healthy Farming Ecological Park	
Advantages and disadvantages	Forced continuous stirring to increase the exposure chance of materials and microorganism. Suitable to deal with high TS content materials. Materials evenly distributed in the reactor to avoid encrustation.	Without stirring device to make only reactor bottom easily digest. Lower efficient.

All raw materials are suitable for CSTR, and its single tank volume is large. There are a lot of its large-scale successful cases with pure straw, pure manure, and mixture of straw and manure as raw materials. Under the basically same conditions of investment, operating costs, biogas production rate, and etc., CSTR is more suitable for the subproject requirements.

Table 8.3-4 Comparison and selection of each subproject fermentation processes

Subprojects	Raw materials types	Raw materials source	Regional advantages	Process Selection
Linzhang Subproject	Straw	Self-owned farmland and a lot of farmland surrounding the subproject	Locate in Modern Agricultural Science and Technology Demonstration Zone, straw sources assured, biogas fertilizer guaranteed	VPF
Laoting Subproject		Farmland surrounding the subproject	A lot of farmland surrounding the subproject to consume biogas fertilizer produced by subproject	
Chengde Subproject		Farmland surrounding the subproject	A lot of farmland surrounding the subproject to consume biogas fertilizer produced by subproject	
Anping Subproject	Pig manure/ Straw	Self-owned livestock farm and a lot of farmland surrounding the subproject	Self-owned livestock and wastewater treatment plant. A lot of farmland surrounding the subproject to guarantee raw materials source, and wastewater with certain treatment site	CSTR process
Yutian Subproject	Pig manure, chicken manure	Self-owned livestock farm	Self-owned livestock farm and farmland to consume biogas fertilizer produced by subproject	
Zunha	Chicken	8 self-owned	8 self-owned chicken farm to	Dry

Subproject	manure/Straw	chicken farm and farmland surrounding the subproject	guarantee raw materials source	fermentation process in garage-type digester

For straw is rich carbon-containing material, the decomposition rate in the fermentation process is slower with longer fermentation period. VPF possess the characteristics of low energy consumption, sequence control fermentation process, high raw materials utilization, low investment, high biogas production rate, and etc. And it can well meet the design requirements of 4 subprojects such as Linzhang subproject. In addition, VPF process produces less biogas liquid and biogas residue, liquid and organic fertilizer produced by 4 subprojects can be consumed in areas surrounding subprojects without secondary pollution.

Most of Chinese large-scale biogas projects use CSTR process. Its fermentation tank volume can more than 5000 m^3, and design volumes of Anping and Yutian subprojects are 2500-4700 m^3. From the point of current operation experiences from existing projects, the process meets the geogarphical conditions, raw materials ingredients, scale requirements of above 3 subprojects. Otherwise, part of the produced biogas is used for heat needed by subproject production to meet relatively high energy consumption during CSTR process running.

Dry fermentation process in garage-type digester process is widely used in Europe which is of over 10 years experiences in the actual operation. Its discharge (biogas residue) is of high dry matter content without dehytdration such as solid-liquid separation, drying and etc.This is beneficial to subsequent conposting process without dealing with biogas liquid. So it suits for the design conditions of Zunhua Subproject.

8.4 Comparison and selection of organic fertilizer process

Microbial organic fertilizer is a kind of fertilizer that possesses effects of microbial fertilizer and organic fertilizer. This kind of fertilizer is obtained using the microbe of special function and main plant and animal residues (such as livestock and crop straw) as source after harmless treatment and mixing of well-composted organic materials. The quality of organic fertilizer product should meet the standard requirement from Biological Organic Fertilizer (NY 884-2012).

The biogas liquid and residue will be produced in the operation period of each subproject. To use the waste source adequately, biogas liquid is canned to biogas liquid fertilizer after stabilization and filtration in biogas liquid temporary storage pool, and biogas residue needs to further treatment of fermentation and dry before making the end product of organic fertilizer.

For the raw materials of anerobic fermentation in the early stage is different, there are differences for the contents of the biogas residue in each subproject. To achieve the quality standards of organic fertilizer, additional manure, straws, and nutrients, etc. should be added based on the original biogas residues and then the residues are processed via the aerobic fermentation, maturity and windrow composting. Raw materials comparison and the selected process of organic fertilizer of each subproject are as follow:

Table 8.4-1 Raw material contents and processing comparisons of organic fertilizers

No.	Name	Contents of biogas residue (Raw materials of anerobic fermentation)	Annual demand of straws (10, 000 t)	Annual demand of manures (manure+pig urine+ washing water) (10, 000 t)	Additive of organic fertilizer process	Annual demand (10, 000 t)	Process	Fermentation time
1	Yutian subproject	Pig manure	0	11.62	Straw	0.54	aerobic composting	5-7 d
2	Laoting subproject	Straw	7.49	0	NPK trace elements	0.075	aerobic composting	5-7dd
3	Anping subproject	Pig manure, straw	1.46	8.69	NPK trace elements	1.5	drying+ aerobic composting	5-7 d
4	Linzhang subproject	Straw	2.116	0	Humic acid	2.2	drying+ aerobic composting	5-7 d
5	Chengde subproject	Straw	4.27	0	NPK trace elements	——	drying+ aerobic composting	5-7 d
6	Zunhua subproject	chicken manure, straw	3.8	2.5	chicken manure, mushroom residue	0.5 2.5	drying+ aerobic composting	5-7 d
Total	--	--	19.136	22.81		7.315	aerobic	aerobic

No.	Name	Contents of biogas residue (Raw materials of anerobic fermentation)	Annual demand of straws (10, 000 t)	Annual demand of manures (manure+pig urine+ washing water) (10, 000 t)	Additive of organic fertilizer process	Annual demand (10, 000 t)	Process	Fermentation time
							composting, windrow composting	composting of 12 days, windrow composting of 15 to 20 days

9 Due diligence

9.1 Due diligence for raw materials guarantee and the infrastructure in each subproject

There are 6 subprojects involved in Hebei new energy demonstration projects in rural. Corn straw is essential in all the 6 subprojects as the fermentation raw materials. The raw materials of 3 subprojects (including Yutian subproject, Zunhua subproject and Anping subproject) contain the livestock and poultry manure, and the waste water of Anping subproject needs to be discharged to the sewage treatment plant. This due diligence report is focused on the assurance system and infrastructure of the 6 subprojects above.

9.1.1 Anping subproject

Table 9.1-1 Summary of straw resources amounts in Anping subproject area

Name	Corn acreage in the range of 5 km (10^4 mu)	Collectable amount of resources (10^4 tons)	Percentage of straw consumption in farming	Percentage of straw returning	Utilization and disposal of energy	Usable quantity of resources (10^4 tons)
Anping subproject	13.44	10.08	3%	70%	27%	9.58

The annual consumption of the ensilage auxiliaries in Anping subproject is 15968.75 t. The corn acreage which is located in the core region of the subproject is 134, 400 mu. The annual straw production is 100, 800, which could meet the requirement of the subproject. The crop planting area around will not be increased for the construction of the subproject. The construction unit of the subproject has signed the contract with the village committees around. And the special person will be assigned by the committees to be responsible for the collection and ensiling of corn straw as well as the transportation of the straws to the main stockyard of the subproject.

Table 9.1-2 Summary table of the straw resources quantity in the implementing regional of Anping subproject

No.	Company name	Location/Distance from the subproject (km)	Breed	Quantity	Sewage emissions (kg/d)	Excretion emissions (kg/d)
1	Jingan pig farm of Hebei YufengJingAn farm Co.,	0	Pig	114394	572000	228788

	Ltd.					
2	LiangwaGesi pig farm of Hebei YufengJingAn farm Co., Ltd.	Liangwa village/1.5	Pig	16282	81400	32560

There are 5 pig farms affiliated to Hebei YufengJingan farm Co., Ltd. Jingan pig farm has 114, 394 hogs, and the manure production is 228.8 t/d. The pig manures of the farm are treated as follows: the manures are drained and sent into the compositing site for the composting fermentation; the treated manures as the farmyard manure are sold to the farmers around who will applied them as the base fertilizer; after treated by the intra-plant sewage water treatment plan, the waste water is discharged to Anping sewage water treatment plan. LiangwaGesi pig farm has 16, 282 hogs, and the manure and waste water production is 228.8 32, 560 t and 81.4 t, respectively. The manures and waste water will be all discharged into the intra-plant available biogas project to ferment and the generated biogas is applied to the heat-supply of biogas and intra-plant use. The biogas residues that are sold to the farmers around as the base fertilizer are deposited in the biogas poll.

After the completion of Anping biogas project, the manures of Jingan pig farm and LiangwaSige pig farm as the raw materials of fermentation will be transported to the plant by the pipelines in this biogas subproject. According to the design, the requirement of manures for the project operation is 261.36 t/d and the project operation can handle 653.4 t of wastewater Therefore, the manures generated by Jingan pig farm and LiangwaSige pig could meet the requirement of the project, and it is not need to expand the farming scale or purchase the external manures.

The total hogs of Langren pig farm, Zhaotuan pig farm and Nanwangzhuang pig farm is 41, 550. The pigpens of Langren farm sweeps up the dungs by dry method, and pigpens in Zhaotuan and Nanwangzhuang farms sweep up the dungs using manure-soaking method, which will produce large amount of fecal water. The manure production is about 407.75 t/a. The manures and waste water produced by these pig farms will be all discharged into the internal buffer pools and then sold to the farmers around as the fertilizer. Available information shows the impervious layers have not been set for these buffer pools in the early stage of construction, which will affect the groundwater around in some extend. The manure of the 3 pig farms will be piped to the plant for biogas power generation until the biogas power generation project of Hebei Yufengjingan breeding Co., Ltd is completed, the existing tanks without lining

layers will be cancelled.

"A/O" treatment process is applied in the sewage treatment station of YufengJingan farm. At present, the actual processing capability of the project is 2, 000 m^3/d, and the remaining processing capability is 1, 300 m^3/d. The biogas liquid production of this subproject is 836.1 m^3/d, in which of 82.5 m^3/d is used to produce the organic fertilizers. The 753.6 m^3/d residue is discharged into the sewage treatment station, which accounts for 58% of whole processing capability. The water quality basically conforms to present, and the entire sewage-admitting of this subproject will not affect the operation of the sewage treatment plant. According to the monitoring data of sewage treatment station from Hengshui environmental monitoring station, it will be seen that the actual processing capability of the sewage treatment station is 91.6% for COD, 90.4% for BOD_5, 86.4% for SS and 94.7% for NH_4-N. The concentrations of the pollutants before and after the treatment are shown in Table 9.1 3.

Table 9.1-3 List of influent and effluent quality of sewage treatment plant Unit: mg/L

Items	pH	COD	BOD_5	SS	NH_3-N	TP
Influent quality	7.07～7.21	3000	600	500	500	14.0
Effluent quality	6.84～7.02	252	58	70	27	8.0
GB8978-1996 Level 3 standard	6～9	500	300	400	—	—
GB18596-2001 Table 5 standard	—	400	150	200	80	8.0
Influent quality of Anping sewage treatment plant	6～9	349	155	191	28.7	8.0
Amalgamated execution	6～9	349	150	191	28.7	8.0

According to Table 9.1-3, it is seen that the treated waste water could meet the third level of discharge standard (Table 4) of the *Integrated Wastewater Discharge Standard* (GB8978-1996), standards (Table 5) of *Livestock and poultry breeding industry pollutant discharge standards* and water-quality indexes of Anping sewage treatment plant.

Anping sewage treatment plant is located in the east of the county, east of Donguan Road, south side of Weimin Street, and the north side of Jingtangbeifen main canal. The total investment of the subproject is 62.2968 million yuan. The domestic sewage and the pretreated industrial wastewater are treated centralized using *catenary aeration process*, and chlorine dioxide disinfection process, and the recent and long-term design treatment scale is 30, 000 and 50, 000 m^3/d, respectively. The water quality of effluent executes one-class A standard of *Emission standards of*

municipal wastewater treatment plant (GB18918-2002). The waste water is discharged into the trunk canal of Jingtang Beifen. After mechanical concentration and dehydration (14, 600t/a), the sludge is transported to the sanitary landfill of municipal solid waste by the semi-enclosed dumpers and then for landfill.

Process flow chart of Anping sewage treatment plant is shown in Fig. 9.1-1.

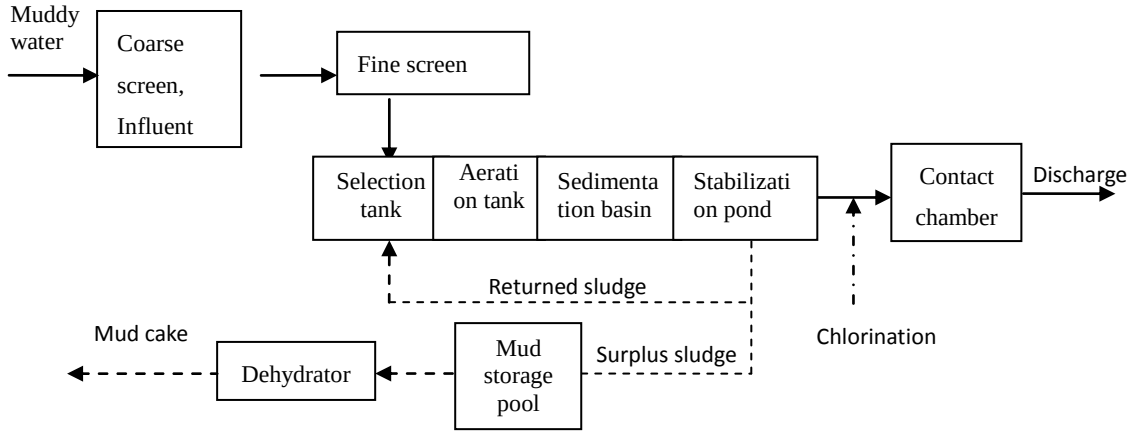


Fig. 9.1-1 Process flow chart of Anping sewage treatment plant

Table 9.1-4 Influent and effluent quality of Anping sewage treatment plan

Factor / Subproject	COD	BOD_5	SS	NH_3-N	TP	pH
Influent quality (mg/L)	349	155	191	28.7	8.0	6~9
Effluent quality (mg/L)	28.7	8.5	4.8	2.7	0.5	6~9
Purification efficiency	91.8%	94.5%	97.5%	90.6%	93.7%	——

In August 2008, the construction project of Anping sewage treatment plan got the EIA approval from the formal Hebei EPA. Nowadays, this project has passed the EP acceptance at 15th Oct., 2009. The actual handling capacity of the sewage treatment plan is 26, 000 m^3/d, and it still have the remaining capacity of 5, 000 m^3/d.

Anping project is located at 1 kilometer far from the east side of the Anping sewage treatment plan, within which range of water collection. The waste water volume is 735.6 m^3/d, and the effluent quality is: COD of 252 mg/L, BOD_5 of 58 mg/L, SS of 70 mg/L, and NH_4-N of 27 mg/L. The water volume accounts for 2.5% of the handling capacity of the sewage treatment plan, and the water quality could meet the requirement of its influent quality. There is no effect on the operation load of the sewage treatment plan. The wastewater flow of the project can be accepted, and the sludge volume will not increase obviously because of the sewage-admitting.

9.1.2 Laoting subproject

Table 9.1-5 Summary table of the straw resources quantity in the implementing regional of Laoting subproject

Name	Corn acreage in the range of 5 km (mu)	Collectable amount of resources (million tons)	Percentage of straw consumption in farming	Percentage of straw returning	Utilization and disposal of energy	Usable quantity of resources (million tons)
Laoting subproject	15.2	11.74	3.30%	10%	87%	10.21

Laoting is a large agriculture county of Hebei, and it has abundant biomass resources. The corn acreage is 15, 2000 mus, which is in the range of the core region of Laoting subproject. On the basis of 0.77 t corn straw per mu, the annual yield of the corn straw is about 132, 200 t. The corn straw consumption of Laoting subproject is only 8, 7500 t, which is far lower than the annual output. The purchase of raw materials is within a controllable range, and the crop acreage around will not increase for the subproject construction. 40 straw brokers, who are responsible for the purchase, processing and transportation of ensiling straw to the subproject site via the specified route, will be assigned in the range of the implementation region.

9.1.3 Yutian subproject.

Table 9.1-6 Summary table of the straw resources quantity in the implementing regional of Yutian subproject

Name	Corn acreage in the range of 5 km (million mus)	Collectable amount of resources (million tons)	Percentage of straw consumption in farming	Percentage of straw returning	Utilization and disposal of energy	Usable quantity of resources (million tons)
Yutian subproject	2.31	1.49	40%	10%	50%	0.75

In the range of the 5 km of Yutian subproject, the corn acreage is 13, 000 mus. On the basis of 0.65 t straw produced per mu, the annual yield of dry straw is about 14, 900 t. After meeting the demand of breeding and farmland returning, the rest could meet the requirement of Yutian subproject (5, 400 t/a), and the crop acreage around will not increase for the project construction. Yutian Yiheyuan ecological agriculture Co., Ltd will build 8 collection sites of raw materials in the village of Guojiatun. To ensure the supply of straw materials, each collection site is responsible for the

centralized purchase and storage of raw materials (54, 000 t) during the harvest time of corn stovers (within 2 months).

Table 9.1-7 Summary table of faeces supply farms in Yutian subproject

No.	Company name	Location/Distance from the subproject (km)	Breed	Quantity	Sewage emissions (kg/d)	Excretion emissions (kg/d)
1	Yiheyuan ecological agriculture Co., Ltd., Yutian (before extension of breeding scale)	0	pig	30000	150000	60000
			chicken	100000	30000	12000
2	Yiheyuan ecological agriculture Co., Ltd., Yutian (after extension of breeding scale)	0	pig	177000	354000	320000
			chicken	150000	45000	23000

Yutian Yiheyuan ecological agriculture Co., Ltd plans to breed 30, 000 hogs and 100, 000 chickens. The annual production of chicken manure is 4, 380 t, pig manure is 21, 900 t and breeding wastewater is 79, 935 m^3. The livestock and poultry manure and pig urine are discharged into the intra-filed biogas plants. After the solid-liquid separation, the biogas liquid and biogas residues could all be applied to the intra-filed fertilization of agricultural regions. Little washing water of hog house and pig urine of delivery room are discharged into the intra-filed aeration tank, and then flow into 3 wastewater treatment stations available (Total area is 51, 600 m^2, and the impermeable layer of wastewater treatment station is set in the early stage, which could prevent the region influence on the groundwater efficiently.). After retention and purification in wastewater treatment station, the waste water is returned to the washing process of hog house, which could achieve the fully recovery of waste water and no discharge into the environment. Currently, this subproject is in the infrastructure stage, and the layers and pigs have not been breed yet. Therefore, there are no EP problems in the subproject.

Based on the needs of enterprise development, Yutian Yiheyuan ecological agriculture Co., Ltd is implementing the expansion project of the farm. After the expansion, the herds of pigs is 177, 000, layers is 150, 000, and the annual faces production is 125, 200 t and 146, 000 t, respectively. The livestock and poultry manure and waste water consumption of Yutian subproject will be 125, 200 t, and 116,

200 t, respectively, and this subproject could handle all the faces and waste water intra-filed. There is no need to purchase the faces or expand the farming scale.

Because the breeding wastewater and biogas liquid quantity is relatively large, and there is no municipal sewage treatment plant nearby, its wastewater treamment and biogas utilization measures is further analyzed, referring to Figure 5.3-1 for Yutian water balance, referring to Figure 5.3-2 for Yutian wastewater treatment station process.

Yutian wastewater treatment process use "coagulation+ Hydrolytic acidification+3 grade aeration+ stabilization", the treated water quality meet the "standards for irrigation water quality (GB5084-2005)". According to the site survey, Yutian subproject relies on exist farm, the surrounding terrain can hold adequate aeration tank, stabilization ponds and storage pool. The breeding farm keep strict implementation of manure separation, rain-sewage separation, solid-liquid separation, etc.

The breeding wastewater is firstly solid-liquid separated, then pass "coagulation+ Hydrolytic acidification+3 grade aeration+ stabilization". The Hydrolytic acidification volume is 1500 m^3, equipped with biological filler, HRT 24 hours, COD removal efficency 30%; 3 grade aeration+ stabilization volume is 3000 m^3(each), each aeration tank is divided into three cells, the bottom is distributed with aeration tubes, each of the tube is installed four aeration header, which have strong stirring and mixing capabilities, HRT 48 hours, COD removal efficency 50%; stabilization tank volume is 10000 m^3, water depth 0.5m, HRT 6 days, COD removal efficency 50%, BOD5 removal efficency 80%.

After the treatment, the wastewater can meet the "standards for irrigation water quality (GB5084-2005)", and is used for irrigation. According to thenon-irrigation season (120 days), irrigation season (245 days), the wastewater discharged into storage pool during non-irrigation season will include: breeding wastewater 650 m^3/d, concentrated slurry supernatant 160 m^3/d, totally 810 m^3/d, $29.6\times10^4 m^3$/y. Yutian subproject presently has storage pool capacity 30×10^4 m^3, all the wastewater discharged into the storage pool during non-irrigation season will be used for the irrigation of project company's farmland (3540 mu), referring to "norm of water intake part 1: agricultural water (DB13)", the irrigation quantity in Yutian area is 160 m^3/mu, 56.6×10^4 m^3/y, the project farmland can exhaust all the water generated by the project. Besides, there is small amount of sludge produced by the coagulation process,

after drying, it will be taken away by local sanitation department.

Refer to table 9.1-8 for The influent and effluent water quality of water treatment facilities at all levels of Yutian project.

Table 9.1-8 The influent and effluent water quality of water treatment facilities at all levels of Yutian subproject **unit：mg/L**

Item		COD	BOD_5	SS
Wastewater	Influent water quality	2640	1400	1300
coagulation	Influent water quality	2640	1400	1300
	Influent water quality	1900	1120	260
Hydrolytic acidification	Influent water quality	1900	1120	260
	Effluent water quality	1330	780	280
3 grade aeration	Influent water quality	1330	780	280
	Effluent water quality	170	200	130
Stabilization	Influent water quality	170	200	130
	Effluent water quality	90	40	60
Final effluent (after storage pool)	Effluent water quality	≤90	≤40	≤60
"Standards for irrigation water quality (GB5084-2005)	Standards value	200	100	100
Standard analysis	--	√	√	√

9.1.4 Zunhua subproject

Table 9.1-9 Summary table of the straw resources quantity in the implementing regional of Zunhua subproject

Name	Corn acreage in the range of 5 km (mu)	Collectable amount of resources (million tons)	Percentage of straw consumption in farming	Percentage of straw returning	Utilization and disposal of energy	Usable quantity of resources (million tons)
Zunhua subproject	6.87	4.99	10%	13%	77%	3.84

In the range of the 5 km of Zunhua subproject, the corn acreage is 68, 700 mus,

and the annual yield of straw is about 49, 900 t. The disposal amount of straw as feed, fertilizer, industry and fuel could account for 23% of total amount. The rest of 38, 400 t could meet the requirement of the straw amount of 18, 000 t and the crop acreage around the project will not increase for the project construction. 5 cooperatives will be set at each town around the subproject. Meikeduo Food Co., Ltd will sign the contract with each cooperative. The cooperatives will sign the purchase contract with farmers and organize them to bundle and transport the straws to the collection sites.

Table 9.1-10 Summary table of faeces supply farms in Zunhua subproject

No.	Company name	Location/Distance from the subproject (km)	Breed	Quantity	Sewage emissions (kg/d)	Excretion emissions (kg/d)
1	Xixindianzi farm	0.5	broiler	210000	0	1479
2	Xixiaying farm	3	broiler	210000	0	1479
3	Xixiaying farm	3	broiler	210000	0	1479
4	Datanghe farm	3	broiler	210000	0	1479
5	Xiaobohaizhai farm	4	broiler	210000	0	1479
6	Yijingpu farm	4	broiler	210000	0	1479
7	Tijuwu farm	4	broiler	210000	0	1479
8	Xiliucun farm	5	broiler	210000	0	1479

Hebei Meikeduo Food Co., Ltd has 8 chicken farms that in the range of 5 km of Zunhua subproject, and the total amount of chickens is about 1330, 000. The annual manure production is 43, 200 t, most of which is applied as base fertilizer by the private farmland or used by the farmers for free. The rest of the fertilizer is sold out as the biogas raw materials.

Depending on the design, the biogas project of Zunhua could handle 25, 000 t of chicken manure and the processing of organic fertilizer could handle 5, 000 t.annually, Therefore, this subproject could handle most of the manure.

9.1.5 Chengde subproject

Table 9.1-11 Summary table of the straw resources quantity in the implementing regional of Chengde subproject

Name	Corn acreage in the range of 5 km (mu)	Collectable amount of resources (million tons)	Percentage of straw consumption in farming	Percentage of straw returning	Utilization and disposal of energy	Usable quantity of resources (million tons)

Chengde subproject	13.36	11.9	16%	3%	81%	9.64

The crop acreage is 133, 600 mu in the core region of the 5 km of Chengde subproject, and the main crop is corn. As the calculation that there is 0.89 t corn straw per mu, the annual yield of the corn straw is about 119, 000 t. According to the investigation, 16% of the straw is applied in animal feeding, 3% is in field returning, 1% is used as fuel, and the 80% remaining could be collected as the raw materials of the subproject (94, 600 t), which could meet the requirement of the project (65, 700 t). The crop acreage around the project will not increase for the project construction.

Chengde lvneng organic fertilizer Co., Ltd will contact the broker of the village for the purchase and bundling of straw in the harvest time. The straw will be transport to the storage sites by tricycles, trucks and tractors, and then to the work site in accordance to the production requirement.

9.1.6 Linzhang subproject

Table 9.1-12 Summary table of the straw resources quantity in the implementing regional of Linzhang subproject

Name	Corn acreage in the range of 5 km (mu)	Collectable amount of resources (million tons)	Percentage of straw consumption in farming	Percentage of straw returning	Utilization and disposal of energy	Usable quantity of resources (million tons)
Linzhang subproject	40	26.84	3%	50%	47%	12.61

Linzhang is a large agriculture county of Hebei. In the range of 5 km of the subproject, the corn acreage is 400, 000 mus, and the amount of straw resources is 268, 400 t. The 47% remaining of straw could be used by the subproject (about 126, 100 t), which could meet the straw requirement of the subproject (23, 200 t). The crop acreage around the project will not increase for the project construction. There are 40 collection and storage sites of corn straw that will be built in the range of 5 km of the core region. Within the harvest time of the corn straw (20 days), each collection and storage site in the core region offer the concentrated supply of corn stalk about 240 t, and the totals is 9, 600 t. Each site completes the task of collection and storage of corn stalk about 400 t, and arranges the transportation to the plant area according the schedule time to ensure the supply of raw materials easily and continuously.

According to the data analysis above, it could observed that the main application of the straw is in livestock and poultry production in Yutian region, however, in the

region of Anping, Linzhang and Laoting, the most of straws are returned to soil. After the deduction of livestock and poultry production and straw returning, the straw waste could meet the normal operation requirement of the biogas project. Therefore, this project will not affect the corn acreage of the project's core region.

This project involves 3 livestock and poultry manure items. The resources of manure are from the farms of the construction units, and the manure production could meet the requirement of the demand. Therefore, the scale of farming in the region will not increase for the project construction. Available information indicates that the main application of manure is field returning. After the construction of the project, the amount of the manure that returned to the field will be decreased, which will offset the effect on soil and groundwater.

9.2 Due diligence of fertilizer markets

According to *Hebei economic almanac 2013*, the application amount of chemical fertilizers is 3.2931 million tons, which increases 0.93% compared to the 3.2628 million tons of 2012. The nitrogen fertilizer accounts for more than 46%, and the compound fertilizer, bio-fertilizer and new-type fertilizers accounts for less than 10% which is far from the developed Country (70%-80%). This indicates the wide development space and prospects of our organic fertilizer market.

With the development of green food and organic food, the requirement of organic fertilizers increased significantly in the Province and the regions around. According to the investigation, the requirement of organic fertilizers with high quality is more than 3 million tons in Hebei Province. The biogas fertilizers of the project mainly base on the local market, which is in the region of 20 km. The cultivated area is 3.9908 million mus, fruit planting area is 1.142 million mus, and vegetable planting area is 0.926 million mu in the project region, and the biogas fertilizer requirement have reached 1.0657 million tons. According to the suggested fertilizer application quantity(liquid fertilizer 0.475 t/hm ^{2}a, solid fertilizer 0.789 t/hm ^{2}a), the market demand of fertilizer of subjects are calculated as follows:

Table 9.2-1 Market demand statistics of organic fertilizer in project district

No.	Name	Cultivated area 10^4 mu)	Organic fertilizer demand of farmland (10^4 tons/a)	Planting area of fruit tree (10^4mu)	Organic fertilizer demand of fruit tree 10^4tons/a)	Planting area of vegetable (10^4 mu)	Organic fertilizer demand of vegetable (10^4 mu)

1	Anping subproject	95.00	5.0	4.00	0.2	30	2.0
2	Zunhua subproject	37.08	2.0	4.90	0.3	22.1	1.2
3	Linzhang subproject	60.00	3.2	40.00	2.1	35	1.1
4	Chengde subproject	75.00	3.9	12.20	0.6	0.2	0.01
5	Yutian subproject	13.30	0.7	33.30	1.8	0.2	0.01
6	Laoting subproject	66.70	3.5	7.60	0.4	20	1.1
Total		351.78	18.5	102	5.4	107.5	5.7

Table 9.2-2 Supply ability statistics of organic fertilizer in project district

No.	Name	Organic fertilizer demand (10^4 tons/a)	Organic fertilizer production (10^4 tons/a)	Available supply ratio
1	Anping subproject	7	4.61	68
2	Zunhua subproject	3	2.55	76
3	Linzhang subproject	7	3.31	97
4	Chengde subproject	5	1.76	97
5	Yutian subproject	2	1.66	76
6	Laoting subproject	5	12.7	59
Total		30	26.59	

The orchard and vegetable planting area of Laoting is 7.6×10^4 and 20×10^4 mu, respectively. The organic fertilizer of this subproject is mainly used for the supply of the vegetable greenhouse and orchard in the range of transport radius of 20 km, which could handle the products of the organic fertilizer of the subproject, thoroughly.

The solid organic fertilizers of Yutian subproject are firstly applied to the agriculture sightseeing tourist area of 540 mu in the farm as well as the orchard and farmland of 3000 mu. The rest of the organic fertilizers are sold externally as commodity. There is about 47, 000 mu farmland and 33, 465 mu orchard in Guojiatun village that could handle the products in the organic fertilizer of the subproject, thoroughly. Yutian Yiheyuan ecological agriculture Co., Ltd., signs a sales contract with Yutian Xingyu agricultural means of production, Co., Ltd. and Yutian Zhongxu

agricultural means of production, Co., Ltd as the sales agents for organic fertilizers saling. The irrigation pipeline laying could be applied when the districts is close to the filed area; if the districts is far from the filed area, tank cars are equipped to transport the fertilizers to the application areas. Furthermore, the construction units will sign a compensated use contract of biogas liquid with the surrounding villages.

For Zunhua project, the organic fertilizer products supply to the organic vegetable greenhouse, chestnut park and forest farm owned to Meikeduo group itself, preferentially. The organic fertilizer requirement of Meikeduo group is 30000 tons, annually, which could handle the products of the organic fertilizer of the subproject, thoroughly. The project has signed a sales contract of organic fertilizer with its vegetable greenhouse and chestnut park.

Raoyang county, located in the east of the Anping subproject, is the "National planting base of green food raw materials", "National standard Demonstration County of green vegetable production" and "Vegetable town of Hebei". Through the solid-liquid separation of the manure in the sewage treatment plant, the solid of the pig farm is carried away by the farmer households of organic farming of Raoyang and then applied to the farmland. The committees of the village which is in the range of 4 km around the subproject have signed a letter of intent with the construction units about the biogas fertilizer, and the longest transport distance is 5 km.

The construction unit of Linzhang subproject-Hebei Runze Zhimin Agricultural Science and Technology Co., Ltd possesses a 20, 000 mu planting and processing bases of green fruit, vegetable and cereals. There is a 60, 000 mu green fruit and vegetable base and a 100, 000 mu organic grains planting base, and the requirement of organic fertilizer of biogas residue and liquid is 70000 t/a.

Chengde project produces organic fertilizer 4.84×10^4 tons/y. In the core areas, there are 23 towns with 28230 mu of arable land; in the radiation area, the Liugou town and Shihuiyao town have arable land 75×10^4 mu, orchard land 12.2×10^4 mu, vegetable base 0.2×10^4 mu. Presently, these lands use chemical fertilizer, no organic fertilizer application yet. These lands can consum 5×10^4 tons of organic fertilizer. Simultaneously, with the development of ecological agriculture, farmers have a correct understanding of organic fertilizer, the organic fertilizer has a huge market potential in these regions.

In summary, all subproject area have large organic fertilizer demand, the organic fertilizer production can be fully consumed, and no risk of excessive application would happen in these areas.

10 EMP

10.1 Environmental management organization setup

10.1.1 Environmental management organization and staff

10.1.1.1 Environment management system structure

The project introduced in this report is involving 6 subprojects in Hebei Province. The environmental management organization setup of this project is as follow: Setup of Heibei Rural New Energy Development Project Management Office (PMO) and its leader group. They organize the implementation and management of the subprojects. In feasibility research stage, the report of EIA and management plan are prepared by the EIA group, and submitted to Provincial EPD and WB for auditing. In this stage, the Provincial EPD will listen to the suggestions of municipal (county) to the EIA. Hebei Provincial EPD, the competent department of environmental protection administration, is responsible for the environmental regulations and supervision within the province and the Municipal EPA is responsible for these works in their local jurisdictions.

The staff determined by the provincial program unit is responsible for the annual report formulation of the EMP under specific conditions. These reports will be submitted to Municipal EPA, Provincial EPD, and WB on request. During the Operation Service Period, the environmental monitoring program mentioned in EMP will be carried out.

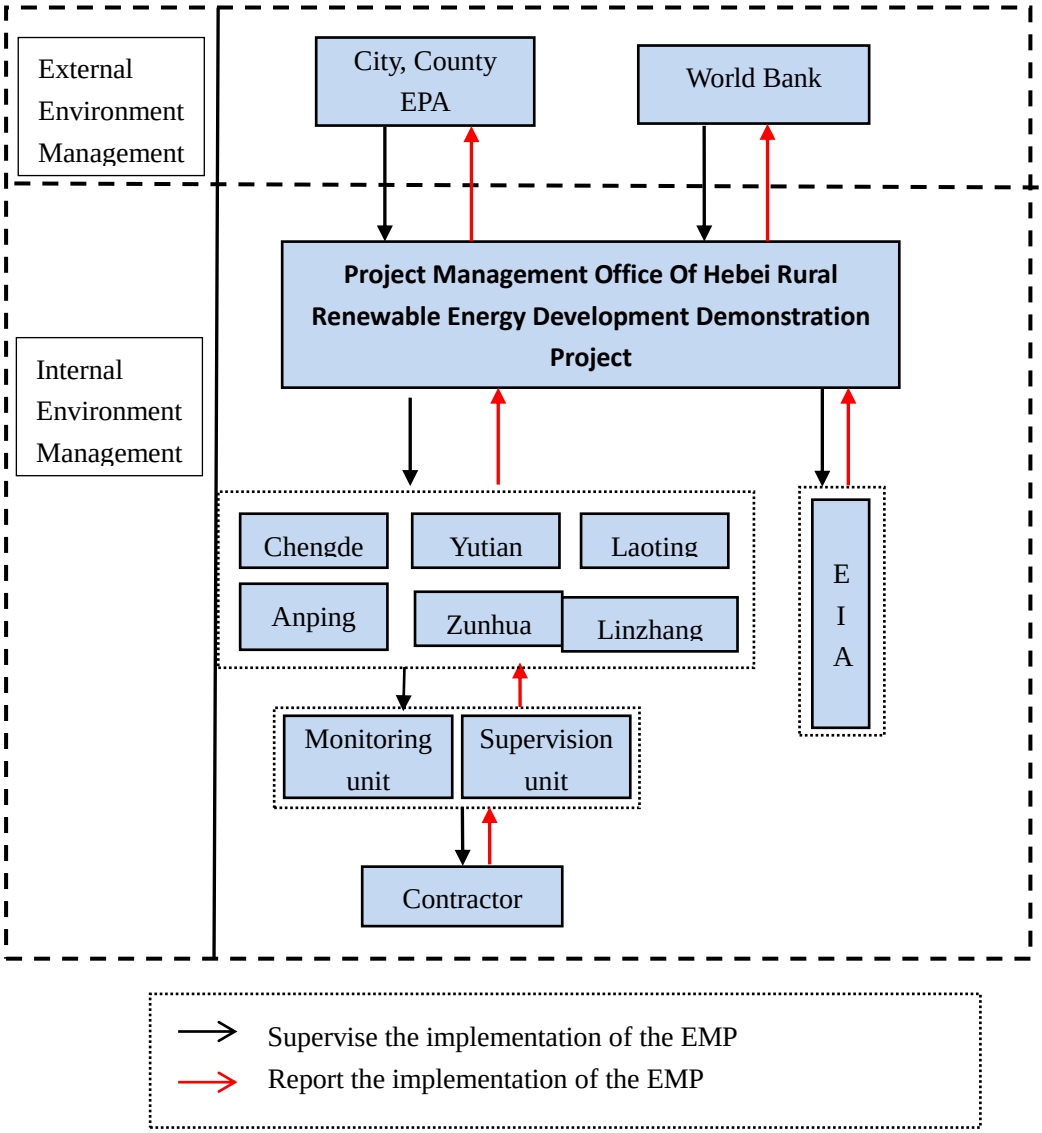


Figure 10.1-1a Environment management system during Design and Construction

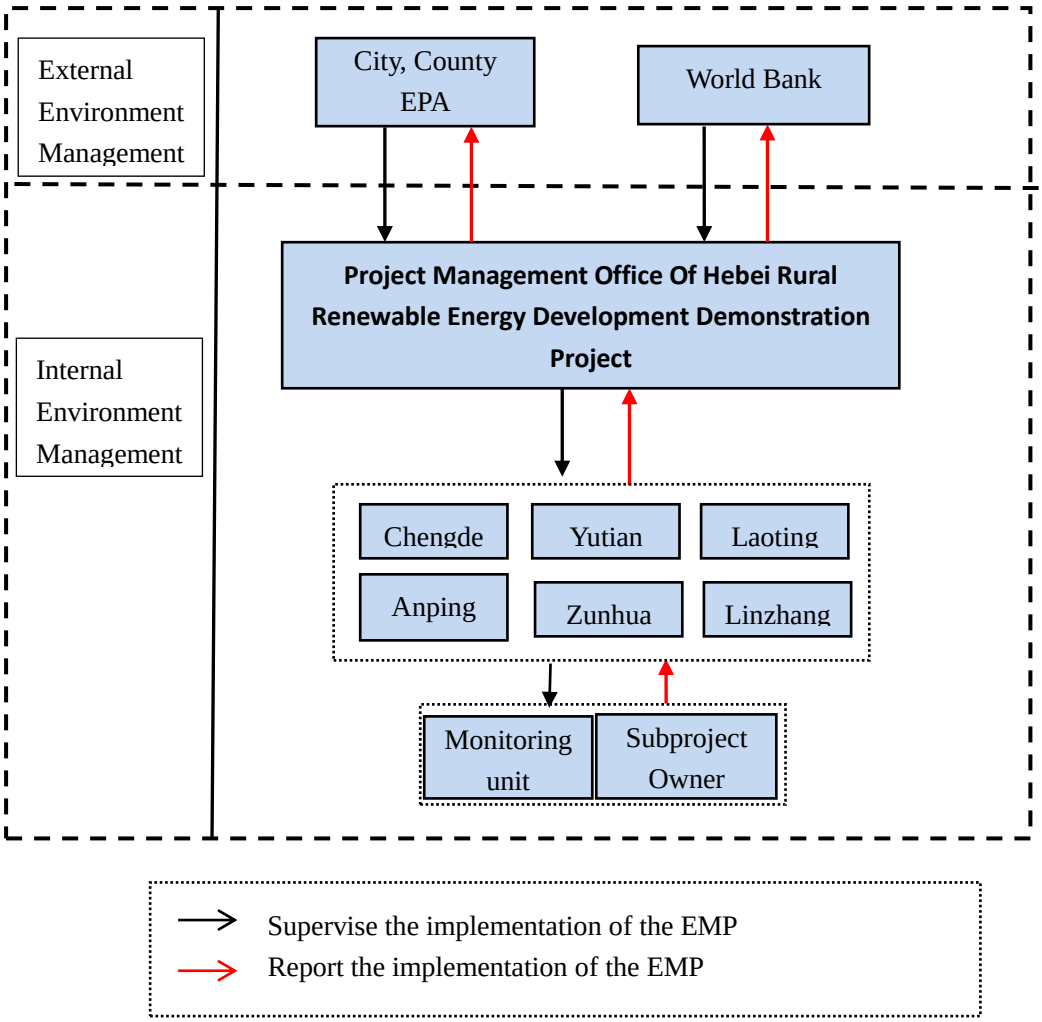


Figure 10.1-1b Environment management system during Operation

Table 10.1-1 Organizations of environmental management system

Stage	Nature	Name	Assignment
Construction period	Management agency	Subproject owners	Project environmental management
	Supervision agency	WB	Supervise and inspect the implementing of the EMP. During the construction period, WB should supervise and inspect the implementing condition of EMP once at least.
		Municipal (County) EPA	Government supervision and administration organizations
	Implementing agency	Construction contractor	Fulfill the environment protection measures during the Construction period.
	Coordinate and communicate agency	Subproject owners	Responsible for mutual communication and coordination among the office, supervising unit and each subproject leader; Responsible for data collection from each subproject leader regularly, formation of report, which will be submitted to WB.
Operation period	Management agency	Subproject owners	Project environmental management agencies Implementing of the EP measures during the Operation period, collecting data, forming a report, and submitting it to WB
	Supervision agencies	WB	Supervise and inspect the implementing of the EMP. During the construction period, WB should supervise and inspect the implementing condition of EMP once at least.
		Municipal (County) EPA	Government supervision and administration organizations
	Consultancy	Environmental monitoring institution	Undertake the environmental monitoring task on commission of Environmental management agencies

10.1.1.2 Staffing

Management agency, supervision agency, implementing agency and consulting services agency are included and comprise the complete environmental management system for the project. The agencies take different work content, with different responsibilities. The project is organized by the provincial program office and the government organization of each county (city) participated in the project, to make sure the project construction meet the requirements of PRC and the WB in the respects of work procedures, pollution prevention measures, etc.

(1) PMO

One person is suggested to set for the PMO to responsible for environmental management in the preparation period, reception of complaint staff and solution of complaint problems.

(2) Subproject director

A factory manager or supervisor is mainly responsible for the construction of environmental measures, supervision and management of implemented project,

reception of supervision and inspection of the WB and the Environmental Protection Agency, reception of complaint staff and solution of complaint problems.

(3) Environmental monitoring

Environmental monitoring can be entrusted to municipal (country) environmental monitoring station where the subproject located, or be completed by the local environmental monitoring unit with the corresponding qualifications.

(4) Environmental supervision

Environmental supervision can entrust subproject engineering supervision unit. A full-time environmental supervision engineer is responsible for the environmental supervision work of the subproject.

Capacity requirements: environmental supervision engineer should receive EP training, participate in the environmental management training of the project, and has the qualification of environmental management.

Responsibility:

① Fill in the environment checklist.

② Complete environmental supervision. Check the relative environment report. Perform the environmental impact mitigation measures during construction period.

③ Supervise and check the sewage treatment in construction area, production wastewater treatment, water and soil loss conservation measures, control measures of exhaust, dust and noise, production and living garbage, health prevention, etc.

④ Propose solutions of relative environmental problems in the construction activities for contractors.

⑤ Ensure the contractor manning quotas and submit Monthly Environmental Report.

⑥ Check the Monthly Environmental Report. Propose formal or informal solutions about all kinds of problems in the work. Communicate with engineering supervision engineer, coordinate the opinion of contractor when necessary.

⑦ Observe the effects of construction activities to the people around the construction area. Determine whether the contractor needs additional protection measures. If the contractor takes the wrong measure, he will be fined.

Environmental management personnel configuration is shown in Table 10.1-2.

Table 10.1-2 Staffing of environmental management system in each agency

Name	Nature	Staffing
EPDs at all levels	Supervision agency	3 persons
WB	Supervision agency	one person
PMO and its leader group	Regulatory agency	6 persons
Units with CP-EIA qualification certificate	Consulting services agency	5 persons/subproject
Project supervisor (undertake environmental supervision)	Consulting services agency	1-2 persons/subproject
Environmental monitoring agency	Consulting services agency	6-7 persons/subproject
Contractors of civil works	Implementing agency during the construction period	some
Owner unit	Implementing agency during the construction and operation period	some

10.1.2 Capability assessment

Environmental management work is a science as well as a daily management. The main task is to manage and supervise the EP work of the whole plant, and urge and inspect the all of the EP work going on normally, based on the regulations and policies made by the national, industrial, and local supervision departments of EP. Therefore, the solid professional knowledge and good executive ability are required for environmental managers. In this scheme, the environmental management ability of each agencies concerned are investigated and verified. The capability assessment of environmental management system in each agency is shown in Table10.1-3:

Table 10.1-3 Capability assessment of environmental management system in each agency during construction period

Name	Nature	Capability assessment		Assessment result
		Qualification certificate	Industry advantages	
Environmental monitoring agency	Consulting services agency	Public institution，the secondary environmental monitoring station	Generally, direct affiliations of EPA, fully staffed, advanced monitoring devices and technologies, standard management, all data issued with high credibility	Qualified
Contractors of civil works	Construction agency	Qualification of construction	Possess the construction qualification enacted by country, having experience in biogas project construction	Qualified
Environmental supervision	Supervisor organization	Qualification of project	Environmental supervision engineer by training，	Qualified

agency		supervisory	possessing the environmental management qualification	
Construction unit	Implementing agency	Formed by owner units	Having management experience in straw or faeces biogas engineering, able to meet the credit of WB and loan guarantee	qualified

Table 10.1-4 Capability assessment of environmental management system in each agency during operation period

Name	Nature	Capability assessment		Assessment result
		Qualification certificate	Industry advantages	
Construction unit	Management agency	Formed by owner units	Staffing environmental management professionals, able to meet the credit of WB and loan guarantee	Qualified
Environmental monitoring agency	Consulting services agency	Public institution，the secondary environmental monitoring station	Generally, direct affiliations of EPA, fully staffed, advanced monitoring devices and technologies, standard management, all data issued with high credibility	Qualified

10.1.3 Office responsibilities of environmental management system

Environmental management work is a science as well as a daily management. The main task is to manage and supervise the EP work of the whole plant, and urge and inspect the all of the EP work going on normally, based on the regulations and policies made by the national, industrial, and local supervision departments of EP.

During the design, construction and operation period, the implementing agencies of environmental management and monitoring plan is the individual subproject. The provincial, municipal and Country EPDs are responsible for the collection of data required to ensure the execution of EMP and check the implementation status of mitigation measures. The provincial project office requires municipal (Country) EPA or qualified experts to monitor and inspect according to the environmental management and monitoring plan, which will be a part of the project activities. To ensure the consistency between the implementation of the EMP and national environmental regulations, subproject owners should arrange the persons trained by environmental monitoring to be responsible for the smooth execution of mitigation measures and EMP (see Chapter 7) of construction and operation period (at least 5 years before) referred in EIA report (see the details in this Chapter) under the guidance of provincial project office. To guarantee the subproject implement of the all EMP located within the jurisdiction of the Country, a staff received the training of

environmental inspection and the implement of the EMP is arranged for each subproject.

1. PMO

PMO as the core institutions in environmental management will assign a dedicated person to manage the EP work of each subproject. The main task of Provincial Project Office is to ensure the implementation EP plan that identified by EIA in construction period, minimize the adverse impact or decrease it to the acceptable degree, and produce the best environmental benefit. The tasks mainly include:

(1) Compile and supervise implementation of the environmental management rules and regulations.

(2) Supervise and ensure the implementation of EP measures that required in EIA report and make the project design meet the demands of EIA.

(3) Supervise and ensure implementation of EP measures referred in the EIA report involved in the project construction contract.

(4) Invite, supervise and coordinate the environmental monitoring (Qualification, duty, analysis results and management).

(5) Supervise, organize and implement the training plan of the environmental management.

(6) Invite, organize, arrange and assist the environmental expert group and other consultation.

(7) Special work of environment (odor, boiler gas control and implement of safety precautions, etc.)

(8) Responsible for the record and arrangement of the complaint, answer the processing results to public, and solve the problems common complaint.

(9) Receive and accept the inspection of environmental work (including the project inspection of WB)

(10) Others (document management, department coordination, propaganda and report, etc.)

2. EIA accountability unit of each subproject

EIA accountability unit of each subproject, as the project executor, is responsible for the communication and coordination of the relationship between Project Office, each subproject owner, and consultancy agency. Details are as follows:

(1) Be responsible for project EIA and suitable EIA agency chosen for the

project;

(2) Assist the EIA unit to carry out the public participation work, and provide the technical data for EIA unit;

(3) Be responsible for the coordination of Project Office and subproject units;

(4) Assist to urge and ensure the implementation of EP facilities required by EIA, and the project design meet the EIA requirement;

(5) Assist to urge and ensure the implementation of EP measures proposed in the EIA report which is contained in the project construction contract;

(6) Assist, organize, and arrange the environmental expert group and other consultancies.

(7) Be responsible for the data collection from each subproject owner monthly. Compile the report and submit it to the WB annually.

Their responsibilities include approval and EIA of biogas project

3. Environmental monitoring agency

Environmental monitoring unit that entrusted by the project environmental office will monitor the important parameters of work zone and affected zone regularly or irregularly and propose the correction recommendations if the unit finds the critical environmental problems.

4. Environmental expert group

According to the WB requirement, the environmental expert group consists of the national and foreign consultants employed by the PMO. They will carry out the consultancy, inspection and proposal of the suggestion and improving measures for EP works, regularly. Additionally, the related national experts shall be invited as required irregularly for consultancy, such as carrying out the environmental management training, workshop, etc.

5. WB

According to the requirements of Chinese Government and WB, at least one inspection team will be sent by WB to carry out special examinations of the project including the implementation of the project agreement and EMP, etc.

6. Municipal (Country) EPA

Municipal/Country EPAs are the administrative departments. They will carry out the environmental supervision and administration of this project in the whole processes according to the law, including approval of the EIA report, supervision and administration in construction and operation periods, examination of environmental

monitoring report and acceptance of the project.

7. Each subproject owner and project contractor

Each subproject owner is the implementing agency. The project contractor is the construction agency as well as the implementing agency of EP facilities during the construction period. During the construction period, each subproject owner should execute the EP measures formulated in EIA, and accept the EP supervision and inspection from WB and EPA. Their duties are listed in Table 10.1-4.

Table 10.1-4 Office responsibilities of the environmental management system

Name	Nature	Responsibility
①EPD in each level	Supervision agency	1. Carry out the environmental supervision and administration over the whole process according to the law, including: approval of project EIA report (including subproject EIA) and the environmental supervision in construction and operation stage.
②PMO and its leader group	Regulatory agency	1. Draw up and supervise the implementation of "EMP". 2. Urge the coordination and implementation of the environmental management requirement of our country and WB. 3. Submit the relevant reports to WB half a year. 4. Inspect the environmental management work of the project office at all level. 5. Coordinate the solution of the critical environment problems with other departments. 6. Entrust the external environmental experts to inspect the project.
③Owner units of each subproject	Regulatory agency	1. Draw up and supervise the implementation of the subproject environmental management rules and regulations. 2. Organize and submit the EIA report for approval. 3. Prompt the engineering design to meet the requirement of EIA. 4. Make the EP measures of the EMP involved into the Engineering and Construction Contract. 5. Employ, supervise, and coordinate the project supervision (qualification, responsibility, and management). 6. Organize and implement the environmental management training plan. 7. Organize the monographic studies or relevant investigation. 8. Record and arrange the details of complaint during the construction and operation periods, answer the results to the public, and solve the public complaints. 9. Examine the environmental supervision and consulting

		reports. 10. Submit the reports (statements) to the provincial project office each quarter. 11. Sign for the site check-lists of construction and supervision units, verify the environmentally sensitive issues, and archive. 12. Accept environmental inspections (including project check from WB)
④WB	Supervision agency	1.WB will send inspection team that be responsible for special inspection of project implementation, annually. 2.Inspect the implementation of the project loan agreement and "EMP".
⑤Unit that possessing qualification certificate of construction project EIA (grade B or above)	EIA agency	1.Carry on on-the-spot investigation and take EIA for each program 2.Be responsible for writing the "EMP"
⑥External expert group of Provincial Program Office	Consulting services agency	1.Contractors conduct onsite inspections for construction site, and assist the Provincial Program office to inspect the environmental conservation work of each subproject. 2.Guide the EIA and implementation units on design and implementation of practice for EP, prepare the draft report to Provincial Program Office, present the recommendations and advice of EP
⑦Project environmental supervisor (undertake environmental supervision work)	Consulting services agency	1.Project supervisor will be entrusted by Provincial or Local Program Office, separately. 2.Supervise the following items: the treatment of domestic wastewater and production wastewater; the protective measure of water and soil erosion; the control measures of exhaust gas, dust, and noise; the treatment of industrial and household wastes and sediment; and epidemic prevention in work zone. 3.Fill each checklist of the attachment in "EMP", regularly (Attached table 1 and 2). 4.Propose the improvement and solution plan for construction units when they meet the EP problem in the construction process, and follow up the implementation, including issue the rectification and improvement notice (Attached table 3) and checklist, check the file archiving. 5.Ensure that project implementations be compiled by the construction units and submitted to the Country (District)

		Program Office weekly.
⑧Environmental monitoring organization	Consulting services agency	1. According the "EMP", carry out the environmental monitoring in construction and operation period, archive and submit to the Country (District) Program Office.
⑨Civil engineering contractors	Implementing agency during the construction period	1. Establish the EP measures in construction period; 2. Receive supervision and inspection in EP from the environmental supervisor, WB and environment protecting department in each level 3. Establish a feedback system, complete the rectification within 3 days after receive the rectification notice (when need for coordination by regulatory agency, complete the rectification within 10 days) 4. Complete the checklist with supervisor before construction (Attached table 1 and 2), and submit to Country (District) Program Office. 5. Construction units report the project implementation status to supervisor weekly.
⑩ Subproject leader	Implementing agency in both construction and operation period	Be responsible for the supervision of construction units to carry out the EP measures that are established in the EIA report. Receive the supervision and inspection of EP by WB and EPA.

10.1.4 Environmental supervision

10.1.4.1 Supervision purpose

According to the design requirement of EP, the project supervisor (also served as environmental supervisor) should carry out the environment supervision to monitor and inspect the implementation and effects of EP facilities comprehensively, and to process and solve the environmental pollution accidents timely during the construction period. Meanwhile, supervision achievement in construction period will be used as the work-acceptance fundamental and the requisite special report of receival reports of development project.

10.1.4.2 Supervision content

Following the policies, laws and regulations of EP made by national, local governments and WB, implementing the EP items by the project contractors in the project is supervised. The principal duties are:

1. Compile the environmental supervision plan, and protocol the items and contents.

2. Responsible for the contents of EP items in the bidding document of the project

3. Supervise the contractors to prevent and relieve environmental pollutions, and the destruction of farmland as well as the wild animals and plants caused by the construction operations.

4. Combine the investigation data to supervise and inspect the implementation and actual effects of the EP measures, comprehensively, and to process and solve the environmental pollution emergencies timely.

5. Inspect the treatment and restoration of dreg site and construction site, for which place the construction units take responsible, including slope stability, site recovery and greening as well as the greening rate, etc.

6. Responsible for the implementation of environmental monitoring, table audit. Make the requests based on the monitoring results of the water quality, air and noise to minimize the adverse impact of construction to the environment.

7. Make good supervision record and report in the daily work, and participate the completion of construction projects.

10.1.4.3 Workflow of implementation of EP plan in construction period

Environmental supervision is the important part of environmental management. The independent environmental supervising agency should be established for is relative independence. Environmental supervision is undertaken by the units with supervision certification. Based on the monitoring data and inspection results, supervision units will supervise, check and estimate the implementation of environmental facilities of construction units according to the contract terms and national laws, regulations and policies of EP; find out and correct the construction activities which violate the EP clauses of the contract and EP requirements in time. Environmental supervisor should inspect the construction site at least once a week, fill the management check-list (Schedule 1 and 2), and archive. They should propose the improvement plan to the construction units for the environmental problems met in the construction process and follow up the implementation and report to the experts of Project Office and WB half a year. The workflow process of environmental supervision in construction period is shown in Fig10.1-2.

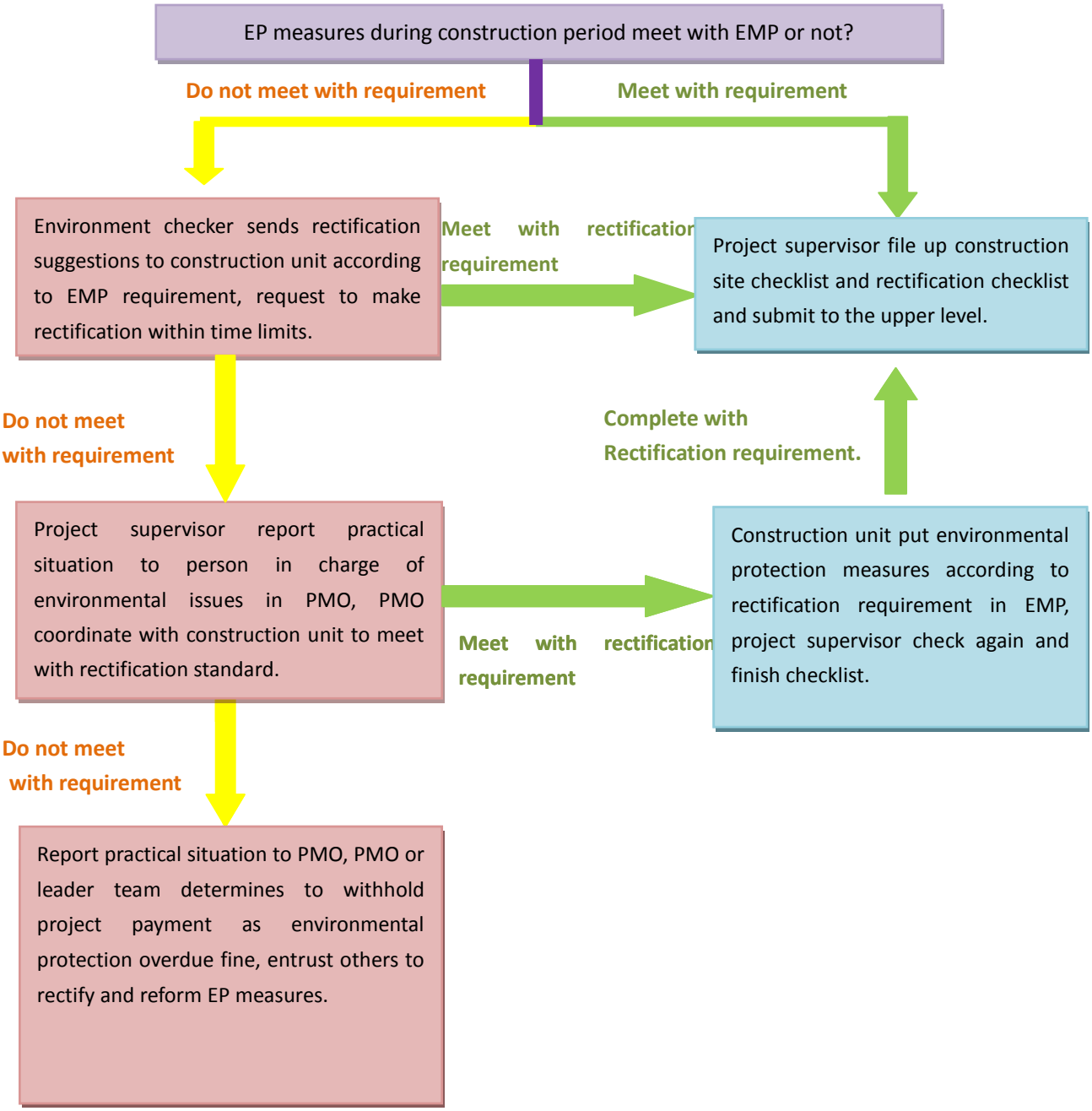


Figure 10.1-2 Environment supervision workflow during construction period

10.1.4.5 Acceptance content of the project

Acceptance of completed management engineering for livestock and poultry waste should implement *the construction project (engineering) completion acceptance procedures*. Acceptance of EP for livestock and poultry industry pollution treatment project should implement *the construction project environmental protection management regulations*.

Applicant should provide the system performance test report of pollution control engineering, besides the required acceptance materials in *the construction project environmental protection management regulations*. The main content of the performance test report should be included:

1. Whether there is a problem in each structure elevation layout, when each structure operates at full load according to the design.
2. Calculate and test the process parameters of each structure.
3. Slag quantity and biogas residues moisture content of solid-liquid separation equipment.
4. Quality of raw wastewater and treated water, sludge flow and degrees of discharging sludge of biogas liquid pool.
5. Quality of raw wastewater and treated water in the anaerobic reaction unit, alkalinity in the reactor, sludge characteristics and concentration.
6. Quality of raw wastewater and treated water, sludge characteristics and concentration in the aerobic treatment system under the standard discharging model.
7. Harmless hygiene index of the reused biogas liquid and biogas residues. Water quality and quantity of wastewater treatment system under the standard discharging model.
8. Composting detection of solid manure.
9. Technical economical indices of manure treatment engineering, involving labor costs, power costs and chemical costs, etc.

After the completion of the project, the related design and acceptance documents such as completion acceptance testimonial should be filed and archived by the construction units. If completion and acceptance can not be passed, reapply after rectification is needed.

Table 10.1-4 Prepared materials and data required in project acceptance

Basics	Name			
	Address			
	Project owner		Phone number	
	Production scale			
	Area			
Production process				
Data and content acceptance	1. If the elevation layout of the structures have any problem when they run at full-load, 2. Calculate and test the process parameters of each structure 3. Slag volume and moisture content of solid-liquid separation equipment, 4. Influent and effluent quality, sludge mass and sludge-discharging times in biogas liquid pools. 5. Influent and effluent quality of anaerobic reaction unit, alkalinity, sludge characteristic and concentration in the reactor. 6. For standard discharge mode, the influent and effluent quality, and the sludge characteristic and concentration of aerobic treatment system. 7. Innocuous hygienic indexes of biogas liquid and resident that returned to field; for standard discharge mode, the influent and effluent flow and quality of the entire wastewater treatment system. 8. Compost measurement of solid manure 9. Technical and economic indicators of sewage treatment engineering, including labor costs, electricity, chemical costs, etc.			
Circumstance of new-built pollution control engineering	1. design information 2. construction contract 3. purchase invoices of construction materials 4. government subsidy materials			
Circumstance of waste storage facility	1. storage yard of raw materials, area m^2 2. storage pool of sewage/urine, area m^3 3. biogas digester, area m^3 4. anaerobic tank, area m^3 5. aeration tank, area m^3 6. Waste-reducing ground and eco-ponds, area mu 7. Electricity consumption documents of sewage disposal facilities 8. Operation records of sewage disposal facilities 9. Photos of waste storage and treatment facilities			
Circumstance of waste destination	1. Stock in sheet of faeces 2. Stock out sheet of organic fertilizer 3. Sale Certificate of organic fertilizer 4. Sales contract or order of organic fertilizer of biogas liquid and resident 5. Transfer record of biogas liquid and resident			
Circumstance of supporting funds	Total investment of the waste storage and treatment facilities 10,000￥ Of which，fiscal subsidy 10,000￥ Of which，self-financing 10,000￥			
Circumstance of the EIA of new-built project	EIA report (table) of the project			

10.1.4.6 Environmental supervising workflow for implementation of EMP during the operation period

After the subproject acceptance, the project enters the normal running state. To perform the environmental management work continuously and effectively, there are the special environmental supervising contents in operation period. The environmental supervising workflow for the implementation of EMP during the operation period is as follow:

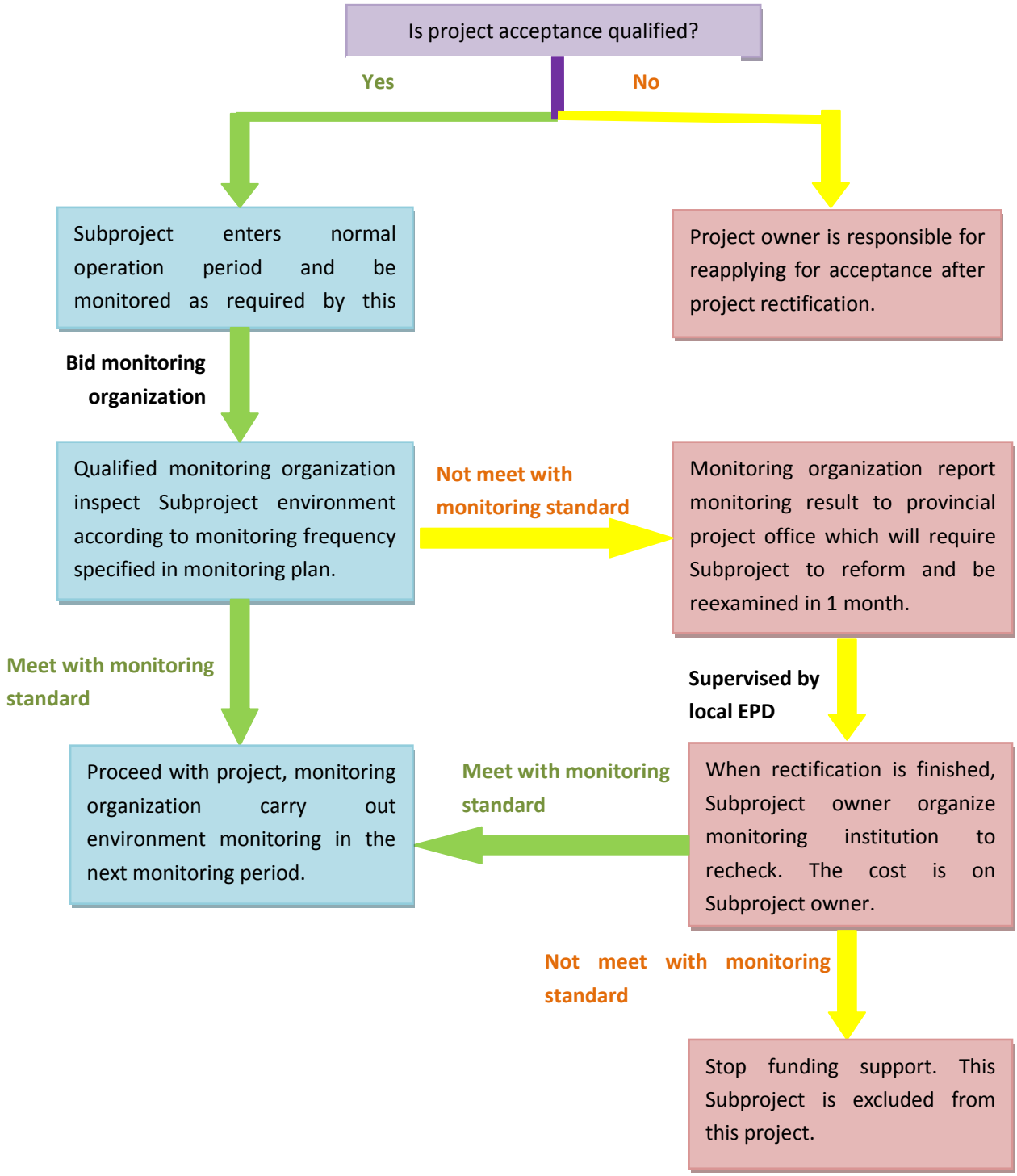


Figure 10.1-3 Environment Supervisor's workflow during operation period

10.2 Environmental management regulation ECOP

10.2.1 Environmental code of practice (ECOP)

10.2.1.1 Minor civil work (biogas and gas supply station) ECOP

Through the screening of EIA factors, the corresponding mitigation measures for environmental management activities of biogas plants, gas filling station and other minor civil works are proposed from the designed period, construction period and operation period, respectively (detailed in Appendix 1).

10.2.1.2 Pipeline ECOP

Through the screening of EIA factors, the corresponding mitigation measures for environmental management activities of gas and power supply pipeline are proposed from the designed period, construction period and operation period, respectively (detailed in Appendix 2).

10.2.2 Special EMP

For environmental characteristics of each subproject location, production process and the approach of raw materials supply differing from one another, the environmental impact of the environment sensitive spots caused by the subproject and the corresponding disposal measures are analyzed specifically. The adverse impacts on the sensitive spots are minimized (detailed in Appendix 3).

10.3 Capability strengthen and training

10.3.1 Training purpose

The purpose of environmental management training is to ensure that the work developed smoothly and efficiently, the related staffs are familiar with the management contents, the management abilities of manager improved, and the protection measures are implemented efficiently. The related trainings of management knowledge and skills will be carried out for the project managers in each level and most of the beneficiaries to achieve the following objectives:

(1) Make the managers in each level (provincial, municipal and country) to understand and master the laws, regulations and rules, positive and negative effects in project implementation and the scheme and measures of environmental management. Make them execute in the project seriously and accurately.

(2) Make the beneficiaries of the project including the representative of the entity

to learn and master the scheme and measures of environmental management and related operation techniques. Make them to carry out and accomplish the construction activities according to the "*Specification for environmental protection*", strictly. The management training will be carried out at 3 levels (provincial, municipal and country) to ensure that the training achieve the intended purpose and effects.

10.3.2 Target Group

The target groups are environmental management agencies of this project involving PMO and its leader group, project contractors, owners, community/village cadres, residents, external supervisors, monitoring unit, environmental supervising unit, etc.

10.3.3 Training

Technology management training, monitoring training, environmental training, social training, financial training, procurement training, exchange survey, etc.

Table 10.3-1 Training content

Category	Training name	Training content	Training objects
Technology management training	Biogas operation management training	The raw materials into the factory management, fermentation equipment operation management, operation and management of detection test, equipment operation, operation principle and method of biogas engineering, maintaining principle and requirement, operation principle and assessment are included in the content. Project managers are the main training objects, including three levels of senior workers, technicians and senior technicians.	Subproject units
	Biogas project construction training	The biogas construction personnel of relevant units are trained about the overall layout, process, process design, pre-treatment engineering design, equipment selection, construction, biogas purification, desulphurization, storage and post-processing, etc.	Subproject units, construction unit
	Construction safety management training	Construction safety and crisis management	Project owner, construction unit
	Security operation management training	Gas operational safety management for household, vehicle gas safety and refueling station security management training	Project owner, biogas users

Category	Training name	Training content	Training objects
	Project crisis management training	Biogas project, pipeline construction safety and crisis management	Project owner, construction unit, biogas users
Monitoring training	Biogas debugging and operation training	The biogas project monitoring, engineering operation and maintenance, laboratory and process optimization of biogas are trained.	Provincial PMO, subproject units, provincial monitoring center
	Monitoring system training	Monitoring system training is conducted mainly about the monitoring systems using methods, data reporting systems, etc.	Provincial PMO, subproject units
Environmental training	EMP training	The environmental protection responsibilities in construction period and operating period of the project, main task, the main content of environmental protection in project construction period, EMP, internal monitoring method, data collection and treatment are included in the content.	Project owner, construction unit
	Project environmental monitoring training	Environmental monitoring inspection report, environmental protection facilities inspection, environmental quality monitoring, compiling the report	Provincial PMO, project owner, environmental monitoring unit
	Project environmental regulations and policies	Environmental protection laws and regulations, environmental policies and plans, the WB environmental management	Provincial PMO, project owner, environmental monitoring unit
	Project environment protection facilities and measures	Regulations and procedures of environmental safety, biogas operating contingency plans	Project owner, environmental monitoring unit
Exchange visits	Domestic exchange visits	Domestic existing biogas construction, operation management experience and project monitoring technology are investigated.	Provincial PMO, subproject units
	Foreign exchange visits	Biogas project operation management experience and project monitoring technology are investigated in Germany.	Provincial PMO, subproject units

10.3.4 Environmental training plan

Environmental training will be performed at the beginning of the project mainly to ensure all the participators understand their responsibilities when they execute the

related environmental activities, the reason why they execute the EMP, and the long-time effects of this plan on the project in economic and health aspects.

Table 10.3-2 Capacity building and training schedule

Category	Training name	Time	Training	Teachers	Training methods	Target audience	Training times	Total hours	Number of people
Technology management training	Biogas operation management training	2016~2020	The raw materials into the factory management, fermentation equipment operation management, operation and management of detection test, equipment operation, operation principle and method of biogas engineering, maintaining principle and requirement, operation principle and assessment are included in the content. Project managers are the main training objects, including three levels of senior workers, technicians and senior technicians.	Domestic / international	Centralized training	Subproject units	5	200	100
	Biogas project construction training	2015~2018	The biogas construction personnel of relevant units are trained about the overall layout, process, process design, pre-treatment engineering design, equipment selection, construction, biogas purification, desulphurization, storage and post-processing, etc.	Domestic / international	Centralized and on-site training	Subproject units, Construction unit	4	96	80
	Construction safety management training	2015~2018	Construction safety and crisis management	Domestic	Centralized and on-site training	Project owner, construction unit	4	64	80
	Security operation management training	2017~2020	Gas operational safety management for household, vehicle gas safety and refueling station security management training	Domestic	Centralized and on-site training	Project owner, biogas users	4	64	80

Category	Training name	Time	Training	Teachers	Training methods	Target audience	Training times	Total hours	Number of people
	Project crisis management training	2016~2020	Biogas project, pipeline construction safety and crisis management	Domestic	Centralized and on-site training	Project owner, construction unit, biogas users	5	80	100
Monitoring training	Biogas debugging and operation training	2016~2020	The biogas project monitoring, engineering operation and maintenance, laboratory and process optimization of biogas are trained.	Domestic / international	Centralized and on-site training	Provincial PMO, subproject units, provincial monitoring center	4	64	80
	Monitoring system training	2017~2020	Monitoring system training is conducted mainly about the monitoring systems using methods, data reporting systems, etc.	Domestic	Centralized training	Provincial PMO, subproject units	4	32	80
Environmental training	EMP training	2015~2020	The environmental protection responsibilities in construction period and operating period of the project, main task, the main content of environmental protection in project construction period, EMP, internal monitoring method, data collection and treatment are included in the content.	Domestic	Centralized training	Project owner, construction unit	6	96	120
	Project environmental monitoring training	2016~2020	Environmental monitoring inspection report, environmental protection facilities inspection, environmental quality monitoring, compiling the report	Domestic	Centralized and on-site training	Provincial PMO, project owner, environmental monitoring unit	5	40	100

Category	Training name	Time	Training	Teachers	Training methods	Target audience	Training times	Total hours	Number of people
	Project environmental regulations and policies	2015~2019	Environmental protection laws and regulations, environmental policies and plans, the WB environmental management	Domestic	Centralized and on-site training	Provincial PMO, project owner, environmental monitoring unit	4	64	80
	Project environment protection facilities and measures	2016~2020	Regulations and procedures of environmental safety, biogas operating contingency plans	Domestic	Centralized and on-site training	Project owner, environmental monitoring unit	4	64	80
Exchange visits	Domestic exchange visits	2015-2020	Domestic existing biogas construction, operation management experience and project monitoring technology are investigated.	Domestic	Centralized and on-site training	Provincial PMO, subproject units	10		100
	Foreign exchange visits	2015-2017	Biogas project operation management experience and project monitoring technology are investigated in Germany.	International	On-site training	Provincial PMO, subproject units	3		55

10.4 Environmental monitoring plan

10.4.1 Monitoring purpose

Environmental monitoring is an important part of environmental management work. The formulation and implementation of the plan can inspect the result of the environmental management work efficiently and allow us to adjust and improve the plan in time, which will ensure the normal running of the environmental protection facilities, make the environmental protection management work performed normally, and protect the environment practically.

The aims of soil and water conservation monitoring are as follow: Assist the construction unit to implement the plan, enhance the formulation and construction management, optimize the preventing measures, and coordinate the construction progress of the soil and water conservation project and main project; get the status of soil erosion and control efficacy in construction period accurately, and propose the improvement measures to minimize the man-made erosion in time; find the major hidden dangers of soil erosion, and propose the prevention countermeasure; provide the technical basis of soil erosion supervision and administration and the basic information of public supervision to improve the project ecotope protection efficiently and recovery timely.

10.4.2 Environmental protection monitoring plan

Environmental protection monitoring plans of 6 subprojects needs to be formulated in construction period, construction acceptance period, and operation period; Soil and water conservation monitoring plan of Chengde Country needs to be formulated in construction period. **Monitoring plan of environmental protection and soil and water conservation (See attachment 4)**

First, the time span of the monitoring plan are throughout the construction period, construction acceptance period, and operation period; many contents of the monitoring plan are needed to entrust environmental monitoring station affiliated to the EPD to monitor. Next, there are different charge standard of environmental monitoring station in diverse districts and the monitored parameters and frequency varied in different stages. Therefore, the funding required in contraction period is provided by construction unit, and the funding required in operation period shall be

paid from the profit part of the project by owner unit, which should be incorporated in to the operating costs.

10.4.3 Investment estimation of environmental protection monitoring

The investment estimation of environmental protection monitoring is listed in Table 10.4-1.

Table 10.4-4 Estimated investment list of environmental protection monitoring (Unit: 10,000 ￥)

Stage / Project	Receipt acceptance period	Operation period	Soil and water conservation	Total
Laoting	6	4.2	0	10.2
Yutian	6	4	0	10
Zunhua	6	4	0	10
Linzhang	7.6	4.8	0	12.4
Chengde Country	6	4	18	28
Anping	6	5.4	0	11.4
Total	37.6	26.4	18	82

10.4.4 System of environmental monitoring report

The environmental monitoring reports are carried out by the municipal (County) monitoring stations and the monitoring data will be submitted to EPA. After the statistical processing, the total environmental monitoring reports are prepared and submitted to Provincial Project Office and WB.

10.5 Mechanisms for information management and public complaints

10.5.1 Information exchange

In environmental management, the exchange of information is required between different sectors and positions of the project office, each subproject owner, EIA responsible units and project contractors; meanwhile, the relevant informations should be notified to external (interested party, publics, etc.). Internal information exchange is performed via meeting, internal mail and other ways. The official meeting should be hold once a month and all the exchange informations should be recorded and archived. External information exchange is performed once every half a year or annually, and the informations should be summarized and archived.

10.5.2 Recording mechanism

The comprehensive recording system must be established for the effective operation of environmental management system, and the contents below should be reversed:

(1) Requirements of law and regulations;

(2) License;

(3) Environmental factors and relevant enviromental impacts;

(4) Training;

(5) Inspection, check and maintenance;

(6) Monitoring data

(7) Efficiency of corrective and preventive measures

(8) Informations for interested party

(9) Examination

(10) Reviews

Additionally, the necessary control must be carried out for the above-mentioned records, including records identification, collection, cataloging, archiving, storage, management, maintenance, inquiry, treatment of storage life and other aspects.

10.5.3 Report mechanism

In the implementation process, each subproject owner, construction contractor, monitoring unit and supervision unit should record and report the contents including project progress, EMP implementation, and monitoring results of environmental quality to the related departments. 5 contents should be included in the main reports as follow:

(1) The environmental supervisors of project engineering will record the implementation status in detail and submit the problems occurred to each subproject owner and contractor. After the end of the project, they should summarize the implementation of EMF and preserve the documents.

(2) Each subproject owner should report the project progresses and EMP implementations to Project Office at the end of construction and before formal communication. Meanwhile, in the operation process, they should report the status of production operation and environmental management to Project Office once half a year.

(3) After finishing the monitoring delegate tasks, the monitoring unit should submit the reports to contractors and environmental supervisors in time.

(4) If serious violation occurrs in environmental protection aspect, environmental supervisors and Project Office will notify the local competent department of environmental protection and report to the next superior administration when necessary.

(5) The annual EMP execution reports must be submitted to WB before 31th March of the next year.

Execution reports of EMP include the main contents as below:

a. Implementation of training plan.

b. Project status

c. Implementation of project environmental protection measures, development situation of environmental monitoring and main monitoring results.

d. Are there any public complaints? If yes, record the main contents of complaint, solutions and public satisfaction.

e. Execution plan of EMP in next year.

10.6 Cost estimating of environmental investment

10.6.1 Cost estimating of environmental investment

Environmental investment in this project mainly consists of four part: environmental monitoring investment, environmental protection measures investment, independent cost and reserve cost. Noise reduction, dust prevention and control, reservoir, etc. of construction period are considered in the funding program of civil engineering, and they are not listed here. The environmental investments are financed by the subproject owners.

10.6.1.1 Environmental monitoring investment

(1) Atmosphere environmental monitoring: It is carried out mainly in operation period accoding the monitoring frequency listed in monitoring plan.

(2) Noise environmental monitoring: monitoring frequency is based on the monitoring plan during the operation period.

(3) Solid-waste monitoring: It is carried out mainly in operation period and the monitoring frequency is based on the monitoring plan.

10.6.1.2 Environmental protection measures investment

The environmental protection measures involving the air treatment facilities

(desulfurizing tower, enclosing of the treating ponds, etc.), solid waste environmental protection measures (house refuse disposal) and plant greening will be assessed in accordance to the national charging standard concerned and local regulations.

10.6.1.3 Independent cost

The independent cost in this project contains EIA cost and the staff training costs.

10.6.1.4 Reserve cost

About 10% of the environmental protection investment above-mentioned is set as the reserve cost that will be used flexibly.

Table 10.6-1 List of the environmental protection investment

No.	Name of the project or cost	Laoting subproject	Yutian subproject	Zunhua subproject	Linzhang subproject	Chengde subproject	Anping subproject	Estimated Investment（10,000￥）
Part I Investment in environmental monitoring		10.2	10	10	12.4	28	11.4	82
1	Inspection period	6	6	6	7.6	6	6	37.6
2	Operation period	4.2	4	4	4.8	4	5.4	26.4
3	Soil and water conservation	0	0	0	0	0	18	18
Part II Investment in environmental protection measures		75	373	77	73	85	85	768
1	Exhaust gas treatment measures	10	24	15	15	20	20	104
2	Wastewater treatment measures	30	324	20	13	30	22	130
3	Solid waste treatment measures	5	5	2	5	5	5	27
4	Noise treatment measures	10	10	20	10	10	18	78
5	Impervious measures	10	10	10	10	10	10	60
6	greening	10	10	10	20	10	10	70
Part III Independent fee		156.72	125.32	152.72	52.21	104.51	156.72	748.2

Training cost	10.52	8.42	10.52	3.51	7.01	10.52	50.5
Reserve cost	146.2	116.9	142.2	48.7	97.5	146.2	697.7
Total							1598.2

10.6.2 Capital guarantee of environmental protection investment

The first batch of subprojects biogas investment refer to table 10.6-2 for details.

Table 10.6-2 Biogas Investment channel list (first batch)

Name	Estimated Investment（10,000 ￥）	Biogas Investing channel			
		WB loan (10^4 RMB)	Loan from WB (10,000 $)	Counter part fund	Self-raising
Anping subproject	80629	37666.23	6174.79	22559.26	20403.69
Yutian subproject	17280	8549.23	1401.51	4554	4177
Zunhua subproject	13133	6332.88	1038.18	3600	3199.76
Linzhang subproject	16553	7469.15	1224.45	4800	4283.43
Chengde subproject	5703	2466.3	404.31	1680	1556.88
Laoting subproject	10930	5143.94	843.27	3125.26	2661.24

The first batch of subprojects capacity building investment refer to table 10.6-3 for details.

Table 10.6-3 Capacity building Investment channel list (first batch)

No.	Name	Capacity building (laboratories, training, monitoring)				
		Total	Loan from WB (10,000 ￥)	Loan from WB (10,000 $)	Government subsidy（10,000 ￥）	Self-financing（10,000 ￥）
1	Anping subproject	558.57	235.57	38.618	0	323
2	Yutian subproject	1653.19	255.12	41.82	0	1398.07
3	Zunhua subproject	296.69	226.11	37.07	0	70.58
4	Linzhang subproject	322.99	248.19	40.69	0	74.8
5	Chengde subproject	320.32	163.06	26.73	0	157.26
6	Laoting subproject	366.26	255.77	41.93	0.00	110.49

10.7 EMF

It is the purpose of EMF compiling that to provide the environmental management guide for the project management agency and the department concerned ,

standardize the site selection, construction and management of the project and make sure to avoid and minimize the environmental impacts in all activities of the WB Loan. For these unavoidable effects, the verification, drafting and implementation of essential cutting measures should be carried out according to WB Policies and China Law. The mechanisms of public participation and solution of possible public complaint are established in EMF, and it covers the utility suggestion of the specific screening devices in all of the subprojects. The related technical specifications of EMF will be added in the operational handbook as the guidance of EIA and screening devices of the environmental experts. These guidance contains the important materials required for capacity building of the project, and will be further modified and updated in the executing processes of the project in order to incorporate the experience obtained.

EMF is shown in Appendix 5.

11 Public consultation and information disclosure

11.1 The purpose of public consultation and information disclosure

The public consultation and information disclosure is an important part of EIA work for the project. The purpose of information disclosure is making the project stakeholders to understand the project information in a timely manner, put forward the concerns of the impact on the project or put forward opinions and suggestions for the project. The purpose of public consultation is getting advice of the public affected by the project and making the decision-making departments to identify potential problems, modify and perfect the design in a timely manner in order to solve the fundamental problem of the public, perfect the technical design of the project, environmental protection measures and environmental monitoring and management, and unify the project construction in the aspects of environmental benefits, social benefits and economic benefits.

The object of public consultation and information disclosure mainly is units and individuals in the influenced scope of the project. The public consultation and information disclosure especially pay special attention to the needs and demands of school, hospital and NGOs groups.

11.2 The methods of public consultation

Public consultation is divided into two rounds. The first one is in the project preparation stage before the EIA finalizing. The second is in the stage after the completion of the EIA report draft. The purpose of first public consultation is to inform the stakeholders and public about the relevant project information and potential impact, understand their cognition, attitude and concerns about environmental and social impact on the project, contact with project stakeholders preliminarily including the affected people around the project and river, railway, highway management department, listen their views and feed back in time. The seconds public consultation mainly consults in the draft of EIA report of the project, reflects public opinion and suggestion to the relevant aspects, feeds back in time and considers this in the report.

According to the provisions of the *Interim measures for public participation in*

EIA (Environment and development 2006[28]), Word Bank OP/BP4.01 *Environmental Assessment* and BP17.50 *Information Disclosure*, the public consultation project mainly adopts the method of public consultation seminars and interviews combined with questionnaires. Public consultation process list is shown in Table 11.1-1 (It summarizes the related content of social evaluation and the resettlement plan public consultation comprehensively）.

Table 11.1-1 The public consultation process schedule

Subproject	Stage of project progress	Content	Investigator	Respondent	Time	Place	Demond of the Word Bank
Yutian subproject	Before the completion of the EIA draft	**The questionnaire:** Questionnaire to the affected villagers in the scope of all the affected villages is held by the EIA unit, in order to understand the local basic environment, the understanding degree of local residents to the basic situation of project construction and operation, the attitude, opinions and suggestions to the project construction, etc. **Symposium:** Enterprise introduces the project product, production and management profiles to local public representatives. EIA units introduce the effect to local economy and the possible environment impacts on atmosphere, water, noise and solid waste in the project construction period and operation period. The local government department introduces the role of acceleration to the local economy and employment after the operation of the project. Finally, the opinions and suggestions of local public representatives to the project is listened. EIA units and enterprises representative answer the questions.	2 people of EIA company and 2 representatives of Yutian Yiheyuan ecological agriculture co., LTD.	Some affected villagers in the affected villages	2013-11-11 2014-1-15	**The questionnaire:** Huangjiashan Village, Xingshuyu Village, Shangzhuang Village, Xiaolizhuang Village, Ruanjiazi Village, Xingjiawu Village, Sijiaoshan Village, GuanshanlingVillage **Symposium:** Huangjiashan Village, Xingshuyu Village, Shangzhuang Village, Xiaolizhuang Village, Ruanjiazi Village, Xingjiawu Village, SijiaoshanVillage, Guanshanling Village	OP4.01: Public consultation and information disclosure: at least two times. The first time is in the stage after the screening and before ultimately determination of the environmental problems

	After the completion of the first draft of the environmental impact report	**The questionnaire:** Questionnaire to the affected villagers in the scope of all the affected villages is held by the EIA unit, in order to understand the local basic environment, the understanding degree of local residents to the basic situation of project construction and operation, and the attitude, opinions and suggestions to the project construction, etc. **Symposium:** Enterprise introduces the project product, production and management profiles to local public representatives. EIA units introduce the effect to local economy and the possible environment impacts on atmosphere, water, noise and solid waste in the project construction period and operation period. The local government department introduces the role of acceleration to the local economy and employment after the operation of the project. Finally, the opinions and suggestions of local public representatives to the project is listened. EIA units and enterprises representative answer the questions.	2 people of EIA company and 2 representatives of Yutian Yiheyuan ecological agriculture co., LTD.	Some affected villagers in the affected villages	2014.3.6	**Symposium:** Huangjiashan Village, Xingshugu Village, ShangzhuangVillage, Xiaolizhuang Village, Ruanzhuangzi Village, Xingjiawu Village, Xijiaoshan Village, Guanshanling Village	OP4.01: The second public consultation and information disclosure: before the completion of draft report. The borrower should reveal the full text of the report to public (the report is placed in the village committee around).
Zunhua subproject	Before the completion of the EIA draft	**Symposium:** Enterprise introduces the project product, production and management profiles to local public representatives. EIA units introduce the possible environment impacts	1 publicity Committee of the baozidian town government, 1	Some affected villagers in the affected	Symposium 2013-1-15 Questionnaire 2013-10-18	**Symposium:** Wangjiapu Village, Qujiapu Village, Xiaocaogezhai Village, Jiazhuangzi Village,	OP4.01: Public consultation and information disclosure: at least two times.

		on atmosphere, water, noise and solid waste in the project construction period and operation period. The local government department introduces the role of acceleration to the local economy and employment after the operation of the project. Finally, the opinions and suggestions of local public representatives to the project is listened. EIA units and enterprises representative answer the questions. **The household survey:** Two families in each project effect area village are investigated randomly by the EIA units, in order to understand natural environment and social economic development in the project effect area, realize residents heating conditions, understand the effect of project construction to the residents living environment and economy, control their questions and concerns and consult with their attitude and suggestions to the proposed project.	people of the baozidian environmental protection agency, 1 people of Meikeduo project manager and 2 people of EIA unit	villages		Bahuzhuang Village, Qujiapu Village, Baozidian Village, Xixindianzi Village, Zhoujia Village **The household survey：** Wangjiapu Village, Qujiapu Village, Xiaocaogezhai Village, Jiazhuangzi Village, BahuzhuangVillage, Qujiapu Village, Baozidian Village, Xixindianzi Village, Zhoujia Village	The first time is in the stage after the screening and before ultimately determination of the environmental problems.
	After the completion of the first draft of the environmental impact report	**Symposium:** Enterprise introduces the project product, production and management profiles to local public representatives. The local government department introduces the role of acceleration to the local economy and employment after the operation of the project. EIA units	2 people of Meikeduo company and 2 people of EIA unit	The affected villagers in the affected villages	2014-2-27	**Symposium:** Wangjiapu Village, Qujiapu Village, Xiaocaogezhai Village, Jiazhuangzi Village, Bahuzhuang Village, Qujiapu Village, Baozidian Village,	OP4.01: The second public consultation and information disclosure: before the completion of draft report. The borrower should

		introduce the possible environment impacts on atmosphere, water, noise and solid waste in the project construction period and operation period, and the mitigation measures and governance effect. Finally, the opinions and suggestions of local public representatives to the project is listened. EIA units and enterprises representative answer the questions.				Xixindianzi Village, Zhoujia Village	reveal the full text of the report to public (the report is placed in the village committee around).
Laoting subproject	Before the completion of the EIA draft	**Symposium:** The main contents of the project and the preliminary work are introduced. The questions of villagers are accepted and answered.	EIA unit	The affected villagers in the affected villages	2013.7.21	**Symposium:** Dongdazhuang Village, Wantuo Village, Shao village, Donggaoge Village, Dongzhuang Village, Laomumiao Village, Xigong Village, Donggong Village	OP4.01: Public consultation and information disclosure: at least two times. The first time is in the stage after the screening and before ultimately determination of the environmental problems
	After the completion of the first draft of the environmental impact report	**Symposium:** A complete EIA report is issued in the village committee of the relative project sensitive villages. The second public symposium is held under a better understanding of the public to the environmental impact of the project and the relevant environmental protection measures. The environmental impact, social benefits and economic benefits for	EIA unit villagers in sensitive areas	The affected villagers in the affected villages	2014.3.20	**Symposium:** Dongdazhuang Village, Wantuo Village, Shao Village, Donggaoge Village, Dongzhuang Village, Laomumiao Village, Xigong Village, Donggong Village	OP4.01: The second public consultation and information disclosure: before the completion of draft report. The borrower should reveal the full text of the report to public (the report

		the project are discussed and illustrated from positive and negative sides on the symposium. The doubts and problems of the villagers are answered on site.					is placed in the village committee around).
Anping subproject	Before the completion of the EIA draft	**The household survey:** Two families in each project effect area village are investigated randomly by the EIA units, in order to understand natural environment and social economic development in the project effect area, realize residents heating conditions, understand the effect of project construction to the residents living environment and economy, control their questions and concerns and consult with their attitude and suggestions to the proposed project. **Symposium:** Enterprise introduces the project product, production and management profiles to local public representatives. EIA units introduce the possible environment impacts on atmosphere, water, noise and solid waste in the project construction period and operation period. The local government department introduces the role of acceleration to the local economy and employment after the operation	2 representatives of Yufengjingan breeding co. LTD and 2 people of EIA company	The affected villagers in the affected villages	2013-1-15	**The household survey:** Xizhaizi Village, Nanliangwa Village, Xiliangwa Village **Symposium:** Xizhaizi Village, Nanliangwa Village, Xiliangwa Village	OP4.01: Public consultation and information disclosure: at least two times. The first time is in the stage after the screening and before ultimately determination of the environmental problems

		of the project. Finally, the opinions and suggestions of local public representatives to the project is listened. EIA units and enterprises representative answer the questions.					
	After the completion of the first draft of the environmental impact report	**Symposium:** Enterprise introduces the project product, production and management profiles to local public representatives. The local government department introduces the role of acceleration to the local economy and employment after the operation of the project. EIA units introduce the possible environment impacts on atmosphere, water, noise and solid waste in the project construction period and operation period, and the mitigation measures and governance effect. Finally, the opinions and suggestions of local public representatives to the project is listened. EIA units and enterprises representative answer the questions.	2 representatives of Yufengjingan breeding co. LTD and 2 people of EIA company	The affected villagers in the affected villages	2014-2-27	**Symposium:** Xizhaizi Village, Nanliangwa Village, Xiliangwa Village	OP4.01: The second public consultation and information disclosure: before the completion of draft report. The borrower should reveal the full text of the report to public (the report is placed in the village committee around).
Linzhang subproject	Before the completion of the EIA draft	**Symposium:** The main contents of the project and the preliminary work are introduced. The questions of villagers are accepted and answered.	EIA unit	The affected villagers in the affected villages	2014.1.10	**Symposium:** Jia Village, Xiqiulin Village, Beizhang Village, Shuangmiao Village	OP4.01: Public consultation and information disclosure: at least two times. The first time is in the stage after the screening and before ultimately

							determination of the environmental problems
	After the completion of the first draft of the environmental impact report	**Symposium:** A complete EIA report is issued in the village committee of the relative project sensitive villages. The second public symposium is held under a better understanding of the public to the environmental impact of the project and the relevant environmental protection measures. The environmental impact, social benefits and economic benefits for the project are discussed and illustrated from positive and negative sides on the symposium. The doubts and problems of the villagers are answered on site.	EIA unit	The affected villagers in the affected villages	2014.3.17	**Symposium:** Jia Village, Xiqiulin Village, Beizhang Village, Shuangmiao Village	OP4.01: The second public consultation and information disclosure: before the completion of draft report. The borrower should reveal the full text of the report to public (the report is placed in the village committee around).
Chengde subproject	Before the completion of the EIA draft	**Symposium:** The main contents of the project and the preliminary work are introduced. The questions of villagers are accepted and answered.	EIA unit	The affected villagers in the affected villages	2014.1.10	**Symposium:** Beigushan village (Contain two natural villages: Gushanxiaofanggou and Gushanxigou), Dayushugou village (Contain Dayushugouli natural village), Fangshengou village (Contain Fangshengoudongshan natural village) Beishuiquan village, Sujiaying village	OP4.01: Public consultation and information disclosure: at least two times. The first time is in the stage after the screening and before ultimately determination of the environmental problems

						(Contain four natural villages: Saohugou, Dachang, Shuimo and Liujiagou) etc., BeiShuiquan primary school.	
	After the completion of the first draft of the environmental impact report	**Symposium:** A complete EIA report is issued in the village committee of the relative project sensitive villages. The second public symposium is held under a better understanding of the public to the environmental impact of the project and the relevant environmental protection measures. The environmental impact, social benefits and economic benefits for the project are discussed and illustrated from positive and negative sides on the symposium. The doubts and problems of the villagers are answered on site.	EIA unit	The affected villagers in the affected villages	2014.3.17	**Symposium:** Beigushan village (Contain two natural villages: Gushanxiaofanggou and Gushanxigou), Dayushugou village (Contain Dayushugouli natural village), Fangshengou village (Contain Fangshengoudongshan natural village) Beishuiquan village, Sujiaying village (Contain four natural villages: Saohugou, Dachang, Shuimo and Liujiagou) etc., BeiShuiquan primary school.	OP4.01: The second public consultation and information disclosure: before the completion of draft report. The borrower should reveal the full text of the report to public (the report is placed in the village committee around).

Public participation symposium of environment impact evaluation for the project of rural biogas resources development and utilization in Anping County, Hebei province

Public participation symposium for livestock and poultry manure and straw biogas comprehensive utilization project in Hebei Meikeduo food group

Public participation symposium for Sewage centralized treatment and three bog comprehensive utilization project of Xingtianyuan ecological farm in Yutian Yiheyuan ecological agriculture co., LTD.


Public participation symposium for straw biogas development and biogas slurry and residues comprehensive utilization project in Laoting Conty, Hebei Province


public participation symposium for large straw biogas project in Beigushan Village, Sangou Town, Chengde County


Public participation symposium for straw biogas combined gas supply and biogas slurry and residues comprehensive utilization project in Linzhang County

11.3 Public consultation notes, comments and feedback

11.3.1 The first round of public consultation

Comprehensive summary of public consultation is shown in table11.3-1. The related images of public consultation and information Publish are shown in appendix 1.

Table 11.3-1 Public consultation summary

Subproject	Stage	Public questions or comments	Reply and effect to public opinions
Yutian subproject	Before the completion of the EIA draft	On the symposium, surrounding residents express support for the construction of the project. Some residents question the biogas use security.	In view of the biogas use security problem, enterprise representatives explain the operation specification and risk prevention for biogas production, conveying and use; EIA unit analyzes and explains from the environmental risk, fire and explosion prevention measures, and does a detailed analysis to the corresponding chapter of EIA report. Participant residents express the acceptance for this. The affected local road transportation departments are visited. They agree to the crossing project and the construction method, and issue the construction suggestion.
Zunhua subproject	Before the completion of the EIA draft	On the symposium, residents in gas supply villages express support for the project. They think this project will improve the local environment. Some residents ask for the construction costs of gas supplied to the household, the origin of kitchen burning gas fee and the gas price.	In view of the gas prices and gas pipeline construction costs problems, enterprise representatives explain one by one. The participant residents understand and accept it. The affected local road transportation departments are visited. They agree to the crossing project and the construction method, and issue the construction suggestion. The local departments in charge of water conservancy are visited. The units agree to the project of crossing canal/river and the construction method.
Laoting subproject	Before the completion of the EIA draft	Participant residents express support and welcome to the project. Some residents question the mephitic impact of biogas production.	The investigation to public opinions strengthen the communication and exchange between the construction unit and the public around the project. Public opinions, requirements and suggestions for the engineering project and the suggestions are positive, serious and responsible. The construction unit comprehensively consider the public opinion and public concerned environmental problems, and adopt reasonablely. The affected local road transportation departments are visited. They agree to the crossing project and the construction method, and issue the construction suggestion. The local departments in charge of water

			conservancy are visited. The units agree to the project of crossing canal/river and the construction method.
Anping subproject	Before the completion of the EIA draft	On the symposium, villagers in sensitive areas question the biogas price and security. They hope to get clean, cheap and safe energy	In view of the odour produced in biogas production, enterprise representatives detailedly introduce the measures for the odour prevention. EIA units will add the environmental management measures for odour in the corresponding sections, and the odour treatment measures and management plan in the production process. Participant residents are satisfied for this. The affected local road transportation departments are visited. They agree to the crossing project and the construction method, and issue the construction suggestion.
Linzhang subproject	Before the completion of the EIA draft	Participant residents express support and welcome to the project. Some residents question the mephitic impact of biogas production.	Project construction is supported by the local people. They think the project construction will promote the economic development of the region, improve the local environment and agree with site selection and construction of the project. At the same time, the highway transportation road station in Linzhang country is visited, the unit agrees the project main line crossing the provincial road S212 and S216, and agrees the construction method of pipe jacking operation mode.
Chengde subproject	Before the completion of the EIA draft	This consultation meeting introduces the basic production and construction content of the project, the possible impacts on the environment, the preliminary engineering analysis result of this EIA, detailed contact information of related units, the approach for public consultation and suggestion to the EIA report, etc.	The understanding and support of the public are gained basicly. The overall opinion of public to the project construction is support. They think the project construction will improve the local economic development and people's living level, and have great contribution to the improvement of the local environment. The affected local road transportation departments are visited. They agree to the crossing project and the construction method, and issue the construction suggestion. The local departments in charge of water conservancy are visited. The units agree to the project of crossing canal/river and the construction method.

11.3.2 The Second round of public consultation

Table 11.3.2 The second round of public consultation

Subproject	Stage	Public questions or comments	Reply and effects to public opinions
Yutian subproject	After the completion of the first draft of the	On the Symposium, villagers in sensitive areas welcome the implementation of this project, and concern about	Enterprise representatives explain for the biogas household cost, and communicate with the villagers, who express understanding.

	environmental impact report	the biogas household pipeline laying cost. They hope to be provided the free biogas household and kitchen burning gas.	
Zunhua subproject	After the completion of the first draft for the environmental impact report	On the symposium, villagers in sensitive areas question the biogas price and security. They hope to get clean, cheap and safe energy.	The enterprise representatives explain for the price of gas, and introduce the biogas cleaning, safety and biogas safety use training. The villagers are satisfied for this.
Laoting subproject	After the completion of the first draft for the environmental impact report	The overall opinion of public to the project construction is support. They think the project construction will improve the local economic development and people's living level, and have great contribution to the improvement of the local environment.	The investigations of public opinions strengthen the communication and exchange between the construction unit and the public around the project. Public opinions, requirements and suggestions for the engineering project and the suggestions are positive, serious and responsible. The construction unit comprehensively considerate the public opinion and public concerned environmental problems, and adopt reasonablely.
Anping subproject	After the completion of the first draft for the environmental impact report	On the symposium, villagers express welcome to the project, and ask the biogas smell, safety and price at the same time.	The enterprise representatives introduce the biogas properties (such as smell, color and fire point), biogas safety use training program and biogas price. Villagers express satisfaction.
Linzhang subproject	After the completion of the first draft for the environmental impact report	Project construction is supported by the local people. They think the project construction will promote the economic development of the region, improve the local environment and agree with site selection and construction of the project.	The highway transportation road station in Linzhang county is visited, the unit agrees the project main line crossing the provincial road S212 and S216, and agrees the construction method of pipe jacking operation mode.

Chengde subproject	After the completion of the first draft for the environmental impact report	This consultation meeting introduces the basic production and construction content of the project, the possible impacts on the environment, the preliminary engineering analysis result of this EIA, detailed contact information of related units, the approach for public consultation and suggestion to the EIA report, etc.	Project construction is supported by the local people. They think the project construction will promote the economic development of the region, improve the local environment and agree with site selection and construction of the project.

According to public consultation and feedback, we can get the attitude of public supports for the project construction. The public think the project construction can promote the local economic development and improve the quality of the local environment. The public doubt to this project is mainly focused on the biogas household expenses and the safety issues of biogas use. In order to solve the problem of public concern preferably, the opinions of engineering experts and fire control safety experts are consulted. The corresponding adjustment and supplement is also made in the aspects of management measures, staff training, and emergency plan. These problems can be solved by organizing biogas use safety training and biogas household economy propaganda.

In addition, this project also consults the opinions of the local traffic administration. It is possibly to minimize the impacts on local traffic during the project construction through the section construction, shortening the construction period, different laying methods of gas pipelines. The project construction receives the consent of the local traffic administration.

11.4 Information disclosure

11.4.1 The first round of information disclosure

Information disclosure of the project is divided into two rounds. The first one is

in the stage shortly after screening of environmental problems conjuncted with engineering and environmental analysis. The approach adopted is posted and online publicity. The second time is after the completion of the first draft of the EIA. The drafts of EIA and EMP are placed in the relevant village committee and offered to public for inspection. Simultaneously, notice is published in the local newspapers to inform the public a network disclosure of the project plan information for the EIA reports and EMP. People can also go to the nearest place to view the text of the report easily and reflect their appeals or opinions. In the above information disclosure and public places, the EIA unit will collect and respond the feedback information.

The first disclosure informations include: basic information (name, address, scale, content, potential impacts and mitigation measures for the project, subproject construction plan, pipeline route figure), the EIA procedures and main content, the main issues for public comment, public feedback methods and contact information of related units.

The project information disclosure for the first round is summarized in Table 11.4-1.

Table 11.4-1 Project information disclosure for the first round

Projectve	Round	Mode	Time	Location / Website
General report	The first round	Online publicity	2013.10.18	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2013-10/18/c_117778176.htm
Yutian subproject	The first round	Online publicity	2014.01.13	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2014-01/13/c_118948242.htm
		Posted publicity	207.6.1	Huangjiashan Village, xingshuyu Village, shangzhuang Village, xiaolizhuang Village, ruanzhuangzi Village, xingjiawu Village, sijiaoshan Village, guangongling Village
Zunhua subproject	The first round	Online publicity	2013.12.31	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2013-12/31/c_118776661.htm
		Posted publicity	2013.9.17	Wangjiapu village, Qujiapu village, Xiaocaogezhai village, Xixindianzi village, Baozidian village, Zhoujia village, Qujiapu village, Bahuzhuang village, Jiazhuangzi village,
Laoting subproject	The first round	Online publicity	2013.12.31	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2013-12/31/c_118776663.htm
		Posted publicity	2014.3.20	Dongdazhuang village, Wantuo village, Shao village, Donggaoge village, Dongzhuang village, Laomumiao village, Xigong village, Donggong village
Anping subproject	The first round	Online publicity	2013-12-31	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2013-12/31/c_118776663.htm
		Posted publicity	2013-12-31	Xizhaizi village, Nanliangwa village, Xiliangwa village
Linzhang subproject	The first round	Online publicity	2013-12-31	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2013-12/31/c_118776663.htm
		Posted publicity		Jia Village, xidiqiu Village, beizhang Village, shuangmiao Village
Chengde subproject	The first round	Online publicity	2014-01-10	Hebei New Energy Network http://www.he.xinhuanet.com/zfwq/2014-01/10/c_118919180.htm
		Posted publicity	2014-01-10	Sensitive points involved in the project
		Placing files in the village committee		Sensitive points involved in the project

河北省农村新能源开发项目环境管理计划信息公示

Information publicity of livestock and poultry manure and straw biogas comprehensive utilization project in Zunhua City

Information publicity of large straw biogas project in Beigushan Village, Sangou Town , Chengde County

Information publicity of construction ecological farm waste centralized treatment and three bog comprehensive utilization project for Hebei Yutian Yiheyuan ecological agriculture co., LTD.

Information publicity of straw biogas development and biogas slurry and residues comprehensive utilization project in Laoting County, Hebei Province

11.4.2 The second round of information disclosure

The second round of information disclosure mainly tell the public: the EIA report compiling work has been completed, the public can read it on website and village committee and feed back advices through network, telephone and fax directly. The project information disclosure for the second round is summarized in Table 11.4-2.

Table 11.4-2 Project information publicity for the second round

Project	**Round**	Mode	**Time**	**Location / Website**
General report	The second round	Online publicity	2014.5.15	http://www.he.xinhuanet.com/zfwq/2014-05/15/c_1110711767.htm
Yutian subproject	The second round	Placing files in the village committee	2014.3.6	Huang Jia Shan Village, apricot village, Shang Zhuang Village, Xiao Li Zhuang Village, Chuang-tzu, Ruan Village Xing Jia Wu Village, four angle, Guan Gong Ling Village Village
Zunhua subproject	The second round	The newspaper notice	2013.3.11	The Zunhua Weekly
		Online publicity	2014.5.15	http://www.he.xinhuanet.com/zfwq/2014-05/15/c_1110711781.htm
		Placing files in the village committee	2014.2.27	Xi Xin Dian Zi Village, Bao Zi Dian Village, Zhou Jia Village, Qu Jia Pu Village, eight Hu Zhuang Village, Jia Chuang-tzu Village, Bohai small village
Laoting subproject	The second round	The newspaper notice		Laoting County, the local newspaper
		Online publicity	2014.5.15	http://www.he.xinhuanet.com/zfwq/2014-05/15/c_1110711760.htm
		Placing files in the village committee	2014.3.20	Dong Da Zhuang Village, Wan Tuo, Mura, East Village, Dong Zhuang Village, the old Miao, Dong Gong Xi Gong
Anping project	The second round	The newspaper notice	2014.1.2	The Anping County Agriculture
		Online publicity	2014.5.15	http://www.he.xinhuanet.com/zfwq/2014-05/14/c_1110686767.htm
		Placing files in the village committee	2014.2.27	Dong Zhai Zi Village, Xi Zhai Zi Village, Xi Liang wa Village, Hou Pu Village, Qian Pu Village, Zheng Jia Zhuang Village, Jia Tun Village, Nan Zhang Wo Village
Linzhang project	The second round	The newspaper notice	2014.3.21	Hebei postal advertising
		Online publicity	2014.2.26	Hebei new energy network http://www.he.xinhuanet.com/zfwq/2014-02/26/c_119509229.htm
		Placing files in the village committee	2014.3.17	Jia Village, Xi Di Qiu Village, Bei Zhang Village, Shuang Miao Village
Chengde project	The second	The newspaper notice	2014.3.19	The Chengde Daily

	round	Online publicity	2014.2.28	Hebei new energy networkhttp://www.he.xinhuanet.com/zfwq/2014-02/28/c_119545695.htm
		Posted publicity	2014.3.17	Beigushan village (Contain two natural villages: Gushanxiaofanggou and Gushanxigou), Dayushugou village (Contain Dayushugouli natural village), Fangshengou village (Contain Fangshengoudongshan natural village) Beishuiquan village, Sujiaying village (Contain four natural villages: Saohugou, Dachang, Shuimo and Liujiagou) etc., BeiShuiquan primary school.
		Placing files in the village committee	2014.3.17	Beigushan village (Contain two natural villages: Gushanxiaofanggou and Gushanxigou), Dayushugou village (Contain Dayushugouli natural village), Fangshengou village (Contain Fangshengoudongshan natural village) Beishuiquan village, Sujiaying village (Contain four natural villages: Saohugou, Dachang, Shuimo and Liujiagou) etc., BeiShuiquan primary school.

The first disclosure informations include: basic information (name, address, scale, content, potential impacts and mitigation measures for the project, subproject construction plan, pipeline route figure), the EIA procedures and main content, the main issues for public comment, public feedback methods and contact information of related units.

The second round of information disclosure mainly tell the public: the EIA report compiling work has been completed, the public can read it on website and village committee and feed back advices through network, telephone and fax directly.

11.5 Social evaluation information disclosure process and survey results

The social impact evaluation work and report of Hebei province new rural energy development demonstration project are undertook by Chinese Immigration Research Center in Hehai University. The information disclosure process and survey results are summarized as following:

11.5.1 Information disclosure process

In order to involve all stakeholders fully in the Project, the SA team conducted extensive public participation. For example, the socioeconomic survey was conducted during July 9-21 and August 13-21, 2013, with 797 copies of the questionnaire collected in total. In addition, 33 FGDs were held with village committee heads,

residents, women, minority people, and vulnerable groups (old people, the disabled, the poor, etc.).

With the assistance of the Hebei PMO, the SA team also conducted FGDs with the local statistics bureaus, civil affairs bureaus, poverty reduction offices, environmental protection bureaus, labor and social security bureaus, civil affairs bureaus, ethnic and religious affairs bureaus, women's federations, sanitation offices, land and resources bureaus, agriculture bureaus, township governments, etc., and in-depth interviews with some residents on the Project' s positive and negative impacts, and needs for and suggestions on the Project (Table 11.5-1)

Table 11.5-1 Summary of Public Participation Activities

Items	Quantity	Participant	Description	Time	Remark
Questionnaire survey	797	Local residents, including vulnerable groups	Learning project impacts, and their attitudes, needs and willingness to pay	July9 - July 21st; August 13th - August 22	S The SA team provided opportunities of participating in the Project and sharing information to all stakeholders.
FGD	21	Village heads, representatives of local residents and APs	Learning attitudes to and needs for the Project, women' s development	July9 - July 21st; August 13th - August 22	
The interview	200	APs and residents in the service range	Learning suggestions on the Project, current use of energy, ability to pay, etc.	July9 - July 21st; August 13th - August 22	
Participatory observation		SA team, PMOs	Learning local socioeconomic profile, etc.	July9 - July 21st; August 13th - August 22	

84.3% of the respondents have heard of biogas/solar energy , and only 15.7% are unaware or unclear. Those unaware or unclear are mostly elderly or poorly educated.. Detail is shown in Table 11.5-2.

Table 11.5-2 New energy information awareness

		Numbers	Percentage	Effective percentage	Cumulative percentage
Effective	Heard	672	84.3	84.3	84.3
	Never heard	51	6.4	6.4	90.7
	Not clear	74	9.3	9.3	100.0
	Total	797	100.0	100.0	

Although public awareness to new energy is higher in project area, form the survey, resident awareness to this project is still lower. Most residents know the project construction when the participatory survey of social evaluation group is conducted. The information disclosure activity mainly aims at the affected people. On the one hand, concerned issues and opinions of affected people are collected through discussing with the representative of affected population or village cadre, and suggestions of local government and the resettlement department on these issues are sought. On the other hand, the prepared resettlement method are informed and discussed with the affected people for selection. Their opinions are sought, the construction scheme and resettlement plan are improved. Although related departments of each subproject will publish the project information through government websites and other channels, some residents still do not understand the project progress because of the lower utilization and views of the government website.

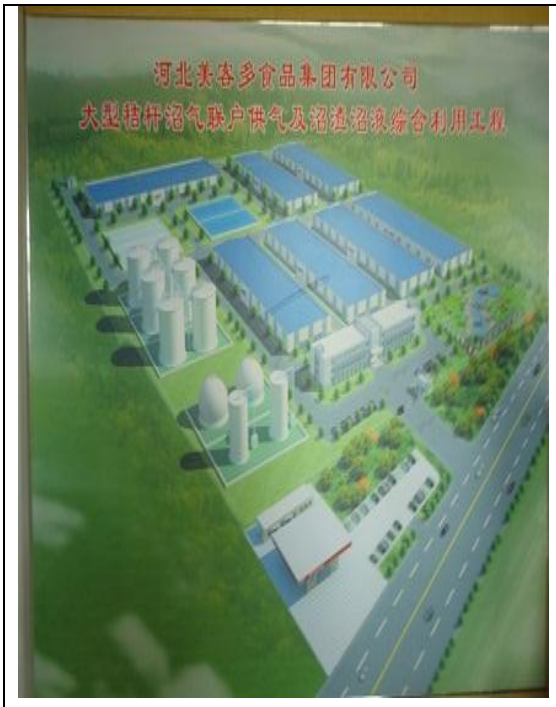


Figure 11.5-1 Project disclosure figure of Meikeduo co. in Zunhua city.

Symposiums of Linzhang Town government

	
Symposiums of Chengde Country institutions	**Scene investigation of Laoting subproject**
	
Symposiums of Guojiatun Town Yutian City	**Household surveys of Baozidian Village Zunhua City**
	
Ethnic minorities symposiums of Shimen Town Zunhua City	**Questionnaire survey of Liangwa Town Anping country**

Questionnaire survey of Houpu Village Anping country

Questionnaire survey of Qianpu Village Anping country

Among all appeal channels, the top 3 are village/community committee, media exposure and appeal with special agencies, accounting for 46.1%, 18.92% and 8.43% respectively. Only 6.91% of the respondents are unaware of any appeal channel.

Table 11.5-3 Survey sample about the awareness of different complaint approaches

Appeal approaches	proportion（%）
suggestion box	6.08
Hotline/ private telephone	2.52
E-mail	1.52
questionnaire survey opinion	2.07
Complaint to the specialized agencies	8.43
Through the judiciary	3.12
Media exposure	18.92
Net post, micro-blog etc.	2.7
Personal petition	0.49
Group visit	1.14
unknown	6.91
Village committee / residents' committees	46.1
Other approach	0

11.5.2 The main findings of the information publication

249 of the respondents highly welcome the Project and 520 welcome the Project, accounting for 96.5% in total, while only 3.5% do not welcome the Project. Most of the respondents welcome the Project because biogas is easy to use, and can reduce household expenditure and improve the living environment. Some respondents unwelcome the Project because they are unaware of the benefits of the Project and will make a judgment when it is put into operation only. Detail is shown in Table 11.5-4.

Table 11.5-4 Statistics of the project welcome degree in the project area

		Frequency	Percentage	Effective percentage	Cumulative percentage
Effective	**Very welcome**	249	31.2	31.2	31.2
	Welcome	520	65.2	65.2	96.5
	General	23	2.9	2.9	99.4
	Not welcome	5	.6	.6	100.0
	Total	797	100.0	100.0	

94.0% of the respondents would file an appeal with the village/community committee, followed by the government.1.9% would file an appeal with the construction agency, and only 0.1% choose other channel, such as the Internet and news media. It can be seen that local residents highly rely on and trust village/community committees. Details are shown in Table 11.5-5.

Table 11.5-5 Channels of information disclosure

		Frequency	Percentage	Effective Percentage	Cumulative percentage
Effective	Government sector	29	3.6	3.7	3.7
	Village committee /Residents' committees	749	94.0	94.3	98.0
	Construction units	15	1.9	1.9	99.9
	Others	1	.1	.1	100.0
	Total	794	99.6	100.0	
Deficiency	System	3	.4		
Total		797	100.0		

46% of the respondents choose “whoever is free participates in information disclosure”. It can be seen that information disclosure activities should be scheduled in consideration of the availability of local residents.. Details are shown in table 11.5-6.

Table 11.5-6 Situation of information disclosure participants

		Frequency	Percentage	Effective Percentage	Cumulative percentage
Effective	Young women	14	1.8	1.8	1.8
	Young men	103	12.9	12.9	14.7
	Older women	98	12.3	12.3	27.0
	Older men	212	26.6	26.6	53.6
	Children	3	.4	.4	54.0
	Whoever is free	367	46.0	46.0	100.0
	Total	797	100.0	100.0	

11.6 Public participation

Public participation is a very important part in the process of project

implementation. The depth and breadth of public participation determine the public awareness and acceptance degree of the project. Therefore, the WB carries out a large number of public participation activities in the preparation process before loaning to Hebei rural new energy development project, and strives to make the affected people understanding the project all-roundly and make the sense of public participation to this project increasing.

11.6.1 The implemented public participation and consultation activities

Various forms and informative public participation and consultation activities are conducted by the WB project office of Hebei province, ecological energy bureau/new energy management office in the subproject countries, related units in subproject counties, project owner unit, the township government of the subproject and resettlement planning group to increase the participation sense of the affected families and ensure the smooth implementation of the project. The implemented public participation and consultation activities are shown in Table 11.6-1.

Table 11.6-1 Public participation activities have been implemented

No.	Subproject name	participants	mode	Activities content and time												Main conclusion
				Project information notice		Survey and evaluation of project resources		Land acquisition willingness and related needs		Economic and social impact		Consultation and confirmation of compensation and resettlement policy		Individual issues in consultation		
				time	Number of people	time	Number of people	time	Number of people	time	Sent out questionnaires (copy)	time	Number of people	time	Number of people	
1	Construction of Joint-household Straw Biogas Project and Biogas Liquid and Residues Utilization Project Using IBRD Loan	Linzhang ecological agriculture Bureau, Hebei Runzezhiming Agricultural Science and Technology Co., Ltd., Linzhang town government, Luo village committee, affected villagers, Hohai university	Interviews, seminars, surveys	2012.12	10	2013.1-2013.2	630	2013.5	18	2013.7	13	2013.7	25	2013.8	3	(1)Data was ture and accurate; (2) inline with national and local policies; feasible, the affected people were satisfied; (4) suppose project construction
4	Green Energy Straw Biogas Project in Beigushan Village, Sangou Town, Chengde County	Chengde county project office, Green Energy Organic Fertilizer Co., Ltd.(Chengde), Beigushan village committee, affected villagers, Hohai university		2012.12	25	2012.10-2012.12	345	2013.2	19	2013.7	9	2013.7	25	2013.7	3	
5	Hebei Laoting Large straw biogas development and biogas residue,biogas liquid comprehensive utilization project	Laoting county project office, Hebei Jiantou energy investment co., LTD, Laoting town government, Hantuo village committee, affected villagers, Hohai university		2012.12	50	2013.1-2013.2	990	2013.5	30	2013.7	11	2013.7	25	2013.8	3	

APPENDIX I

Hebei Rural Renewable Energy Development Demonstration Project
Environmental Codes of Practice

For

Small Civil Works

Project Management Office Of Hebei Rural Renewable Energy Development Demonstration Project
Hebei Jingmiao Environmental Consulting Co., Ltd
April 2014

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1 Overview

1.1 **Project Background**

According to the requirements for environment screening and classification in Environment Evaluation under World Bank Safeguard Policies (OP4.01) and through environment screening to the type, location, sensitivity and scale of the project and the characteristic and size of potential environmental impacts, this project is determined as class B project and requires the preparation of *Environmental Codes of Practice* (ECOP), this annex is the environmental codes of practice for small civil works, which is applicable for all civil works under World Bank-financed Hebei Rural Renewable Energy Development Demonstration Project (except for EMP type works and biogas pipeline works), and is composed of environmental codes of practice for each type of civil works. In preparing this ECOP, we made reference to Detailed Rules of Hebei Province on Safe Construction, EHS Guidelines, operational policies and safeguard polices of the World Bank and other materials.

1.2 **Purpose of Preparing Environmental Codes of Practice**

The purpose of formulating ECOP is to provide a set of detailed, technically feasible and financially sustainable and operational environment countermeasures for inevitable potential adverse effects on the environment in small civil works, specifying the measures and arrangements taken by project management department, project owner, construction unit, supervision unit and environmental management department for implementing environmental management and body construction in the period of project bidding, design and construction, to eliminate or make up for as far as possible the adverse effects caused by project construction on the environment and society and to reduce such effects to an acceptable level. The specific targets include:

(1) Specifying environmental management obligation of related project departments

Project management department, project owner, design unit and environmental assessment unit conduct detailed field verification and confirmation to environmental protection target, confirming the rationality of the location selected and putting forward effective environmental impact mitigation measures.

In project bidding stage, implementing the requirements in Environmental Codes of Practice shall be clearly specified as the obligation that the bid winner must perform, the requirements in Environmental Codes of Practice shall be incorporated into the actual work design and project construction activities.

(2) Taken as operational guidance for environmental management

Environmental Codes of Practice specifies both environmental management system of small civil works project and the duties and roles of all units under environmental management system of the project, and puts forward the procedure and way for communication and exchange among departments. This document will be submitted

to work design unit winning the bid as important basis for work design, at the same time, provided to work construction unit as code of conduct for environmental management during construction period so as to effectively guarantee smooth implementation of environmental impact mitigation measures presented.

1.3 **Applicable Laws and World Bank Safeguard Policies**

(1) Environmental Protection Law of the People's Republic of China (December 26, 1989);

(2) Environmental Impact Assessment Law of the People's Republic of China (September 1, 2003);

(3) Law of the People's Republic of China on Atmospheric Pollution Prevention and Control (September 1, 2000);

(4) Law of the People's Republic of China on Water Pollution Prevention and Control (February 28, 2008);

(5) Law of the People's Republic of China on Prevention and Control of Ambient Noise Pollution (October 29, 1996);

(6) Law of the People's Republic of China on Soil and Water Conservation (March 1, 2011);

(7) Law of the People's Republic of China on Land Administration (August 29, 1998);

(8) Forest Law of the People's Republic of China (revision, 1998);

(9) Law of the People's Republic of China on the Protection of Cultural Relics (December 29, 2007);

(10) Law of the People's Republic of China on the Protection of Wildlife (November 8, 1988);

(11) Regulations of the People's Republic of China on the Protection of Wild Plants (January 1, 1997);

(12) Regulations on Basic Farmland Protection (State Council Decree No.257);

(13) City Planning Law of the People's Republic of China (April 1, 1990);

(14) Regulations on Administration of Environmental Protection in Construction Projects (State Council Decree No. 253, November 29, 1998);

(15) Classification Management Directory of Environmental Impact Assessment for Construction Projects (Ministry of Environmental Protection Decree No.2, October 1, 2008);

(16) Management Regulations on "Three Simultaneities" Supervision & Inspection and Environmental Protection Acceptance Upon Completion of Construction Projects by Ministry of Environmental Protection (trial implementation) (December 17, 2009);

(17) Measures for the Administration of Environmental Protection Acceptance Upon Completion of Construction Projects (February 1, 2002);

(18) Circular on Certain Issues Concerning Strengthening Environmental Protection Management of Small Construction Projects (Ministry of Environmental Protection [2002] No.85);

(19) World Bank Safeguard Policies;

(20) Guidelines on Environment, Health and Safety of World Bank

2 Management System for Environmental Codes of Practice

2.1 **Establishment of Management System for Environmental Codes of Practice**

In accordance with relevant provisions and the actual work needs, small civil works involved in the Hebei Rural Renewable Energy Development Demonstration Project shall set up special environmental management organization being responsible for environmental management and environmental supervision of the work.

A set of environmental management system including supervision agency, implementing agency and consulting agency is established for this project under the Project Management Office (PMO), as shown in Table 2-1 and Figure 2-1.

Table 2-1 Agency Composition of Environmental Management System

Nature of Agency	Name of Agency	Main Responsibilities
Management Agency	PMO of Hebei Rural Renewable Energy Development Demonstration Project	Assign special environment administrator to be responsible for environmental protection in the stages of project planning, design and implementation; determine that working procedures meet environmental assessment and environmental management requirements of domestic competent authorities and the World Bank; ensure that environmental protection measures in ECOP are incorporated into civil works tender and the contract and implemented smoothly, see "2.2 Duties of the Agencies Under Environmental Management System" for details; supervise smooth implementation of ECOPs in operation period.
	County implementing agency	Assign special persons in charge of environmental protection, the main task of whom are to ensure effective implementation of Environmental Codes of Practice in work implementation and operation period, and to reduce adverse impacts of the construction on the environment to the minimal or acceptable level, while at the same time making environmental benefits of the work into full play; implementing all the funds required for environmental protection; and being responsible for sorting and archiving of relevant documents, see "2.2 Duties of the Agencies Under Environmental Management System" for details.
Supervision agency	Supervision mission of the World Bank	Assign environmental specialists to supervise and inspect the implementation of Environmental Codes of Practice, see "2.2 Duties of the Agencies Under Environmental Management System" for details.

Nature of Agency	Name of Agency	Main Responsibilities
	Competent administrative departments for environmental protection at all levels	Competent administrative departments supervise and inspect whether working procedures of the project meet environmental management requirements stipulated by the government, whether pollution prevention & control measures are in compliance with environmental protection requirements in implementation process, see “2.2 Duties of the Agencies Under Environmental Management System” for details.
	Environmental monitoring agency	Conduct site supervision and inspection for pollutant discharge from pollution source and ecological destruction events during construction according to law, and participate in relevant treatment, see “2.2 Duties of the Agencies Under Environmental Management System” for details.
Implementing Agency	Civil works contractor	Implement environmental protection measures in ECOP, meet the requirements of the World Bank and local competent administrative department of environmental protection on environmental protection, prepare and submit monthly environment report during construction period, see “Duties of the Agencies Under Environmental Management System” for details.
Consulting Agency	Environmental impact assessment and consulting unit	Entrusted to prepare Environmental Codes of Practice specially designed for small civil works and all kinds of civil works projects (except EMP class work and road work), see “2.2 Duties of the Agencies Under Environmental Management System” for details.
	Design institute	Entrusted to prepare feasible research report and construction design scheme; ensure the measures and schemes in Environmental Codes of Practice to be implemented in preparation results. See "2.2 Duties of the Agencies Under Environmental Management System”.
	Environmental supervision unit	Entrusted to supervise and manage day-to-day production activities of the construction unit according to Environmental Codes of Practice under the contract, see “2.2 Duties of the Agencies Under Environmental Management System”.
Monitoring Agency	Environmental monitoring unit	Responsible for environmental monitoring in project construction and operation period; provide scientific basis for environmental pollution control, environmental management and regional environmental protection during subproject construction and operation.

Nature of Agency	Name of Agency	Main Responsibilities
	Soil and water conservation monitoring unit	Responsible for soil and water conservation monitoring work in project construction and operation period; guarantee work construction safety; timely grasp dynamic changes in soil erosion during construction; understand the implementation situation and control effects of various soil and water conservation measures; and reduce newly increased soil erosion to the lowest level.

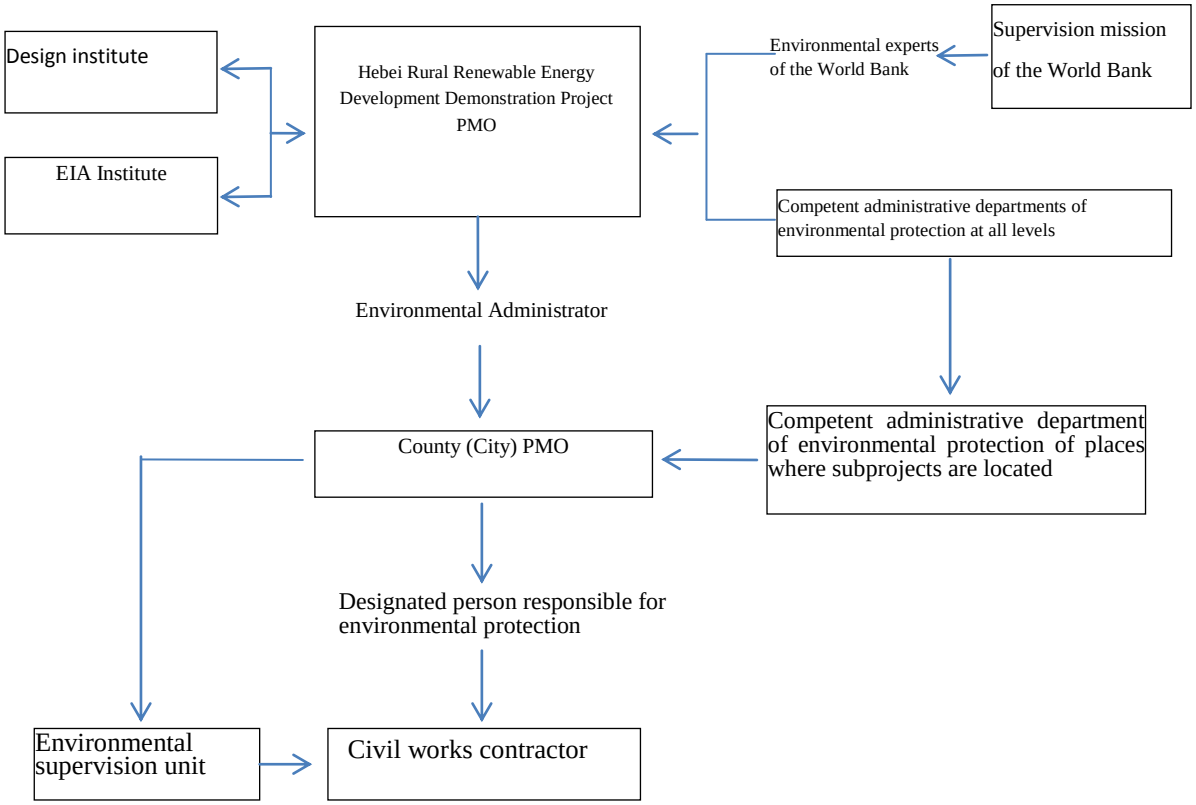

Figure 2-1 Frame Diagram for Environmental Management Organization of the Project

2.2 Duties of the Agencies Under Environmental Management System

Environmental management system involves project management agency, supervision agency, implementing agency, monitoring agency and consulting agency, these agencies together constitute complete environmental management system of the project, but each bears different working content and has different scope of duties.

The project is carried out under the organization and leadership of the provincial PMO; design institute and EIA institute accept entrustment from PMO to provide consulting services; environmental monitoring unit accepts entrustment from PMO or project contractor to monitor environmental sensitive factors and affected environmental sensitive sites in project operation

and implementation period; environmental supervision unit accepts entrustment from PMO to conduct day-to-day supervision for the implementation of environmental protection measures in civil works construction period; environmental experts of the World Bank, competent administrative departments of environmental protection at all levels and environmental monitoring agency supervise management agency and implementing agency of this project according to law to ensure the construction of the project meet relevant requirements of the Chinese government and the World Bank in working procedures, the implementation of pollution control measures and other aspects.

2.2.1 **Management Agency**

PMO

PMO is the organization responsible for overall plan of the project, including environmental protection of the project in planning, design and implementation stages, ensuring that working procedures meet environmental impact assessment and environmental management requirements of domestic competent authorities and the World Bank, and ensuring the requirements of environmental protection measures.

PMO assigns special environmental administrators (composed of leaders in charge and environmental consultants), the main responsibilities of whom are as follows:

· Check and coordinate the work of the person in charge of environmental management in each sub project.

· Arrange investigation activities of environmental experts from the World Bank, report to the World Bank and implement environmental management requirements and suggestions by the World Bank.

·Summarize semiannual report on environmental management progress, submit it to the World Bank for review, and coordinate with other relevant departments to solve major environmental problems.

·Check the implementation of environmental protection measures, at least once for every half a year.

·Prepare, supervise and implement relevant rules and regulations on environmental management.

·Implement all the funds required for environmental protection

· Urge and ensure that environmental design measures required by Environmental Codes of Practice is implemented and that work design meets the requirements of Environmental Codes of Practice.

· Supervise and ensure that work construction contract contains environmental protection measures put forward in this Environmental Codes of Practice.

·Check the implementation of environmental protection measures, at least once for every one month.

·Employ, supervise and coordinate environment supervisor.

·Organize and implement environmental management training program.

· Employ, organize, arrange and assist environmental panel of experts and other consulting work.

·Special environment work (borrow area, spoil area treatment, etc.).

·Record and sort complaints in work construction and operation process, report to the

Project Management Office, reply treatment results to the public and solve the public's complaints.

·Review environmental supervision and environmental consulting report.

· Impose a fine to the construction unit when environmental protection measures are not be properly taken.

·Prepare summary or special report for environmental management stage.

·Receive and accept inspection on environmental work.

· Other matters (document management, inter-department coordination, publicity, report, etc.).

2.2.2 **Supervision Agency**

(1)Environmental Supervision of the World Bank

According to the requirements of loan agreement signed by and between the Chinese government and the World Bank, the Bank will assign the supervision mission to conduct special inspection for work implementation every year, including the execution situation of project loan agreement, implementation situation of environmental management plan, etc., the specific work is being responsible for by environmental technology experts from the supervision mission.

(2)Competent Administrative Departments of Environmental Protection at All Levels

Competent administrative departments of environmental protection at all levels supervise and manage this project across the process according to law, including: examination and approval of environmental impact assessment report, environmental protection supervision and management in work construction, trial operation and operation period, meanwhile, competent administrative departments of environmental protection at all levels and their environmental monitoring agencies will conduct random inspection to environmental protection measures taken by the construction unit; checking on-site environmental supervision report; rectification measures should be put forward if environmental damage and the construction behavior not complying with environmental protection measures suggested according to environmental impact assessment and examination and approval requirements occur in construction process.

(3)Environmental Monitoring Agency

· Carry out relevant laws, regulations, policies and rules provided by the state and local government on environmental protection.

· Entrusted by competent department of environmental protection to conduct site supervision and inspection for the execution of environmental protection laws and regulations in work construction and operation process according to law and have them disposed in accordance with the provisions.

·Collect pollutant charge and sewage charge for waste water, waste gas, solid waste, noise, radioactive substance exceeding standards.

· Participate in investigation and handling of environmental pollution accident and disputes.

2.2.3 **Implementing Agency**

Civil works contractor is the implementing agency of the work, and also the implementing agency of environmental protection measures in construction period. During the whole process of work construction, the construction unit shall carry out all formulated environmental protection measures in the construction period, and accept supervision and inspection from project management agency and supervision agency in terms of environmental protection.

2.2.4 **Consulting Agency**

(1)EIA institute
Accept entrustment to prepare Environmental Codes of Practice and other EIA documents in combination of the actual project conditions.

(2)Design institute
Accept entrustment to prepare feasible research report and construction design scheme, and ensure that the measures and schemes in Environmental Codes of Practice are implemented into preparation results.

(3)Environmental Supervision Agency
Environmental supervision agency is entrusted by County PMO to conduct site supervision and management to the construction unit in the construction area and living camp, ensure that the construction unit complies with relevant Chinese laws and regulations on environmental protection in the construction process, and ensure that the construction unit implements all environmental protection measures provided in Environmental Codes of Practice.

The main responsibilities include:
· After accepting entrustment, environmental supervision agency shall formulate technical scheme on environmental supervision according to the requirements of consulting agencies and competent administrative department of environmental protection, and report environmental supervision staff, technical scheme and entrustment contract to competent administrative department of environmental protection for filing.
·Inspect whether environmental protection design scheme for construction project meets the requirements of consulting unit and competent administrative department of environmental protection and relevant technical specifications, and put forward written modification opinions to the construction unit and design unit.
· Examine and approve on-site environmental management plan formulated by the contractor.
· Supervise and inspect the measures on domestic sewage treatment, production wastewater treatment and soil erosion prevention, measures on exhaust gas, dust and noise control, measures on production and domestic garbage treatment, and hygiene

and disease control measures, etc. in the construction area.

·Fill in the checklist in the annex to Environmental Codes of Practice (at lease once a week).

· Put forward rectification scheme for relevant environmental protection problems encountered in the construction activities carried out by the construction unit and follow up its implementation.

· Prevent the contractor from conducting activities or behavior in violation of environmental protection.

· Once it is found that the construction behavior of civil works contractor is not compliance with environmental protection requirements, resulting in adverse environmental impacts or receiving complaints on environmental protection in the project area, it shall carry out corresponding investigation, report to the county implementing agency and seek for solution. At the same time, issue environmental rectification notice to the contractor (see Annex 3), and supervise the contractor to take appropriate corrective measures.

·Ensure the construction unit prepares and submits monthly environmental report for construction period.

· Inspect monthly environmental report, put forward disposal considerations as for various problems encountered in the work, where environmental protection measures for the construction meet ECOP requirements, monthly environmental report is reported directly to the county implementing agency for filing. Where the requirements are not met, the rectification opinion shall be given to the construction unit. Where the rectification meets the requirements of Environmental Codes of Practice, the inspection for the current month may be passed, and monthly environmental report may be completed and reported to the county implementing agency for filing; where the rectification fails to meet the requirements of Environmental Codes of Practice, it shall be reported to the implementing agency at provincial level to coordinate rectification measures.

·Observe whether the construction activities affect the normal life of the people surrounding the construction area, and determine whether the construction unit needs to take additional protection measures.

·In case the construction unit does not take appropriate measures, it is suggested that the county implementing agency imposes a fine to the construction unit

2.2.5 **Monitoring Agency**

(1)Environmental Monitoring Agency

Environmental monitoring agency is local environmental protection monitoring station entrusted by PMO to be responsible for environmental monitoring work in project construction and operation period, and provide scientific basis for environmental pollution control, environmental management as well as regional environmental protection in work construction and operation period.

(2) Soil and Water Conservation Monitoring Agency

Soil and water conservation monitoring agency is the qualified unit entrusted by PMO to be responsible for soil and water conservation monitoring work in project construction and operation period, ensuring work construction safety, timely grasping dynamic changes in soil erosion during construction, understand the implementation and control results of various water and soil conservation measures, and reduce newly increased soil erosion to the lowest level.

2.3 **Personnel Allocation Required for Environmental Management**

To better perform environmental management responsibilities, it is suggested that all management agencies allocate relevant personnel according to the requirements of Table 2-2.

Table 2-2 List of Personnel in Charge of Environmental Management

Agency	Personnel Setting and Qualification Requirements
PMO	Leader in charge: one person, shall be held concurrently by the person chiefly in charge of project management office; project environment administrator: one person, shall hold senior professional post in environmental science-related specialty
Project owner	Leader in charge: one person, in charge of the county implementing agency Designated person responsible for environmental protection of the project, shall have basic knowledge on environmental protection and management
Civil works Contractor	Site environment engineer: 1-2 persons/construction site, shall obtain corresponding operation qualification
Environmental Supervision Unit	Environmental supervisor: 1-2 persons/construction site, shall obtain corresponding qualification

3 General Requirements of Environmental Codes of Practice

In the process of project construction, civil works contractor plays a key role in the implementation of environmental management and pollution control and prevention measures, etc.. In order to enforce Environmental Codes of Practice, the contents listed in this section are applicable to general requirements of all main units during construction. The construction unit is urged to execute all environmental measures presented in ECOP under the coordination, supervision and management of all management agencies.

3.1 **Implementation of Environmental Measures in the Process of Construction Drawing Design and Bid Document Preparation**

In project implementation stage, relevant procurement activities will be carried out in accordance with the Procurement Guidelines of the World Bank. All government organizations at county/city level involved in the project shall, under the coordination, guidance and supervision of PMO, require bid preparation units to incorporate mitigation measures put forward for potential adverse environmental impacts in Environmental Codes of Practice into technical specifications of the bid document and construction drawing design. In bid documents, the tenderer is required to make the following commitments as for environmental management requirements and to have them incorporated into civil works contract.

·Civil works contractor is required to allocate 1-2 site environment engineers for each construction area in order to implement environmental protection measures across the whole construction period, to ensure work construction activities and the construction activities of subcontractor (if any) meet all the requirements of this Codes of Practice, and to ensure necessary environmental protection measures are taken in the construction process.

· In the construction process, contractor shall communicate and negotiate with the public in the area where the project locates, with bulletin board being placed at the access of each construction area to inform the public exact construction content and time. Meanwhile, contact person and phone number shall also be provided so that the public is able to make complaints and provide suggestions.

· The contractor shall actively cooperate with environmental supervision unit entrusted by the owner to carry out all environmental supervision work during construction period.

· The contractor must incorporate “Management Plan for Construction Site” into its construction scheme after signing the contract and before commencing the

construction.

· The contractor must follow relevant local regulations on safe and civilized construction.

· Civil works contractor and construction supervision unit are required to accept relevant training on environmental protection and management before commencement of the construction.

· For severe environmental impacts arising from the failure to comply with environmental protection measures put forward in Environmental Codes of Practice, environmental supervisor or civil works contractor must take timely remedial measures and inform corresponding County PMO within 24 hours. The county implementing agency shall supervise and assist civil works contractor to take remedial measures while the latter must record the implementation of the measures and report them to construction supervision unit and the county implementing agency.

· The contractor shall reserve in project contract fund the deposit relating to environmental management as per annual budget, the amount shall be accounted for about 3% of the budget.

3.2 **Preparation Before Commencement of Work**

After awarding the bid and before commencing the construction of civil works, The implementing agencys of all counties and cities shall, under the coordination, guidance and supervision of PMO, provide the text of Environmental Codes of Practice for civil works contractor and implement environmental supervision agency.

After completing bidding work and signing the contract, civil works contractor shall conduct research on construction site before commencement of work, the purpose of the research is to identify environmental restrictive factors in this work area. Prior to the construction of civil works, construction site checklist must be made and filled in to check the sensitivity of all environmental factors in construction site as an important basis for environmental protection in future civil works.

The purpose of construction site checklist is to identify relevant environmental safety problems, identify and screen out environmentally sensitive problems needing special protection, see Annex 2 to the Codes of Practice for the contents that shall be included for details.

According to the inspection results for construction site, civil works contractor shall prepare *Environmental Management Plan for Construction Site*, which shall implement the requirements of Environmental Codes of Practice (ECOP), and obtain the permission from environmental supervision agency.

3.3 **Environmental Management of the Construction Site**

In the construction of civil works, civil works contractor shall be subject to the supervision of environmental supervision agency entrusted by corresponding the county implementing agency.

Civil works contractor shall carry out various environmental protection measures according to environmental management requirements in the contract and by referring to *Environmental Management Plan for Construction Site* permitted by environmental supervisor. Environmental supervision agency shall conduct direct whole-course environmental supervision for the implementation of environmental protection measures taken by the contractor, meanwhile, competent administrative department of environmental protection of the place where the project locates and its environmental monitoring agency and the public involved in the project will carry out external environmental management and supervision.

Throughout the construction period, civil works contractor shall actively cooperate with environmental supervision agency and environmental monitoring agency in performing their duties, see "2.2 Duties of the Agencies Under Environmental Management System" for the duties of environmental monitoring agency.

The construction unit shall closely cooperate with local government departments and other departments to ensure that it is in full compliance with the requirements of the Chinese policies and regulations, and provide enough information to the public within the scope affected, especially the residents surrounding the project area who may be directly affected by project construction, the specific measures that shall be taken are as follows:

·Bulletin board is set at the entrance of the construction site, indicating project name, main construction content, construction time and other information, as well as contact information for complaints and suggestions.

· In case nighttime continuous construction is required, relevant formalities shall be dealt with and public announcement shall be given to the residents surrounding the area, the information in the announcement include duration of continuous operation and nighttime construction license issued by competent department of environmental protection.

· If municipal services (including water, electric power, telephone line and bus line) need to be interrupted due to the construction, notice shall be given at the project site and to affected residents and enterprises at lease five days in advance, indicating the duration of service interruption.

All the opinions and questions from the public shall be recorded and archived, the questions put forward by the public shall be timely answered, and the results of all

answers and replies to the opinions and questions shall be recorded and archived and subject to the inspection of supervision agency.

3.4 **Rectification Measures for Non-compliance with the Requirements of Environmental Codes of Practice**

Civil works contractor and its subcontractor (if any) must abide by the requirements presented in Environmental Codes of Practice, where environmental pollution arising from the failure to abide by environmental protection measures presented in Environmental Codes of Practice occurs:

· Civil works contractor shall immediately take measures to eliminate pollution sources and treat environmental pollution produced.

· Civil works contractor shall inform environmental monitoring agency and project management agency within 24 hours, and the latter shall assist the construction unit to take remedial measures to eliminate adverse environmental impacts.

· Civil works contractor shall record the implementation of pollution treatment measures, put forward rectification measures and submit it to environmental supervision agency and the county implementing agency for filing, and the county implementing agency shall report implementation of remedial measures to the PMO.

· Civil works contractor shall analyze in depth the cause of environmental pollution, formulate preventive measures, perfect construction design scheme and completely eradicate the reoccurrence of similar accident, the preventive measures formulated shall be recognized by environmental supervision agency and the county implementing agency and filed.

· The county implementing agency shall punish civil works contractor based on the nature of pollution accident and scope and degree of influence according to the provisions of the contract.

3.5 **Management of Environmental Management Documents**

Proper management of environmental management documents has an important significance for the implementation of Environmental Codes of Practice, Table 3-1 makes a list of main environmental management documents.

Table 3-1 List of Main Environmental Management Documents

Document Preparation Unit	List of Documents	Remarks
PMO	Inspection Record on the Implementation of Environmental Protection Measures for the Project	The inspection contents shall include record of environmental protection inspection carried out by the county implementing agency, record of environmental supervision checklist, archival of environmental rectification notice and feedback information, etc. once for every half a year
Project owner	Record on the Implementation of Environmental Protection Measures for the Project	The inspection contents shall include record of environmental supervision checklist, archival of environmental rectification notice and feedback information, etc., once a month
Environmental Supervision Agency	Checklist of Construction Site before Commencement of Work	Filled in before commencement of the construction
	Checklist of Construction Site Environment	Once a week
	Environmental Rectification Notice and Rectification Record	Periodically scheduled
	Checklist for Environmental Protection before Completion and Delivery of the Project	Checklist for environmental protection before completion and delivery of the project
Construction Unit	Monthly Environmental Report for Construction Period	Once a month
Environmental Monitoring Agency	1. Carry out monitoring plan in Environmental Management Plan, and timely submit the monitoring report to the contractor (operator) and environmental supervision engineer after completing the monitoring work; 2. Include the monitoring report into project progress report and timely submit it to PPMO and corresponding management departments (environmental protection bureau and soil and water conservation bureau) for their timely understanding of the implementation situation and effects of environmental protection measures.	The monitoring report is submitted along with project progress report of the current month

4 Environmental Codes of Practice for Construction Period

4.1 **General Requirements**

The purpose of formulating Environmental Codes of Practice for construction period is to guarantee operating personnel's health and life safety, improve their working environment and living conditions, protect ecological environment, prevent soil erosion in the process of construction, and prevent and control the pollution of construction process on the environment and the occurrence of various diseases in the process of construction.

This chapter puts forward environmental protection measures that civil works contractor shall take in the process of small civil works construction, mainly including environmental management for construction site, dust pollution control, harmful gas emission and control, water pollution control, noise pollution control, solid construction waste control, soil erosion control, etc.

General requirements of Environmental Codes of Practice for construction period are as follows:

(1) Effective measures for prevention and control of atmosphere pollution, waster pollution, noise pollution, solid waste pollution and waster loss and soil erosion and for improvement of environmental sanitation should be in place in work construction organization design.

(2) Environmental protection measures in construction organization design should be implemented in the process of construction to ensure that ambient air, surface water, acoustic environment and ecological environment quality in project area meet the requirements of functional zone, and should be subject to the supervision of environmental supervision agency and environmental management agency.

(3) Construction site must establish environmental protection, environmental hygiene management and inspection system, and shall make inspection record well.

(4) The construction unit shall take effective occupational-disease-prevention measures, provide necessary protective equipment for operating personnel and conduct regular physical examination and training for the personnel engaged in occupational-disease-inductive operation (at lease once a year).

(5) The construction unit shall make well preparation in operating personnel's dietetic hygiene, sunstroke prevention, cooling, cold protection, warmth keeping, gas poisoning

prevention and epidemic prevention in consideration of seasonal characteristics.

(6) Education training and assessment for operating personnel at construction site should include relevant laws and regulations on environmental protection and environmental sanitation, etc.

(7) The construction unit shall formulate the plan for public health emergencies at construction site in accordance with the provisions of the laws and regulations.

4.2 **Environmental Codes of Practice for Construction Site**

4.2.1 **Site Layout and Temporary Facilities Construction**

The scope of construction site includes construction area, office area and living area.

(1) The construction area at construction site should be clearly separated from office area and living area, and corresponding isolation measures should be taken to ensure neat and orderly construction area.
(2) The construction area and living area should be equipped with corresponding environmental protection facilities or take measures to mitigate adverse environmental impacts, for example, the construction area is set with wastewater sedimentation tank, dust prevention and noise reduction measures are taken, etc.; the living area is set with treatment facilities for domestic sewage, canteen wastewater and domestic garbage, etc., see "4.3 Implementation of Environmental Codes of Practice for Pollution Control" for the specific implementation requirements for reference.
(3) Enterprise name or enterprise logo shall be marked at the access of the construction site. The obvious place at main access shall be set with project profile plate, within the entrance door there should have general layout plan of construction site and system plates for safety production, fire control and security, environmental protection and civilized construction.
(4) If municipal services (including water, electric power, telephone line and bus line, etc.) need to be interrupted due to the construction, notice should be posted at project site and to affected residents and enterprises at lease five days in advance, indicating the duration of service interruption.
(5) The construction site should set such temporary facilities as office, dormitory, canteen, toilet, shower room, hot water house, meeting room, closed refuse storage area(or container) and toilet facilities, the existing houses should be utilized first, if temporary houses for construction purpose need to be built, land use should be optimized to reduce the occupation of land resources, clay bricks are not allowed for the construction of temporary facilities at construction site, and safety and fire control requirements and relevant provisions of the state should be abided by.
(6) Oil and chemical solvent and other items stored at the construction site shall set special warehouse, with warming sign being in pace, the ground should conduct

anti-seepage treatment, with absorption bags/sands/bits of wood and other emergency materials being prepared.
(7) Collective staff dormitory is strictly prohibited in the buildings not yet finished.
(8) Temporary construction facilities should be completely removed within one month upon completion of the construction project.

4.2.2 **Operating Conditions and Environmental Safety**

(1) The construction site must adopt enclosed color steel fence, with the height of no less than 2.5m, at the sensitive section, the height shall be no less than 3m.
(2) The construction site shall set bulletin board, indicating site layout and the system for safe production, fire control and security, environmental protection and civilized construction, as well as flow chart for emergency treatment.
(3) The construction unit shall take protective measures to ensure the safety of the buildings, structures and underground pipelines adjacent to construction work.
(4) Tall scaffold, tower crane and other large mechanical equipment at construction site shall keep a safe distance from overhead transmission conductor, high voltage line should use insulating materials for safety protection.
(5) Sidewalks and vehicle access surrounding the construction site shall adopt mandatory safety protection measures during the construction period, and lighting indicating device shall be installed in the nighttime.
(6) Such dangerous places as construction site entrance and exit, the places where construction hoisting machinery, temporary electricity facilities and scaffolding locate, access passage, stairs, elevator wellhead and the places storing harmful and dangerous gas and liquid shall set visible safety warning signs. The safety warning sign must comply with national standard.

(8) In different stages and seasons of construction, when climate and environment change, the construction site shall take appropriate technical safety measures to achieve civilized and safe construction.

(9) Fire extinguishing equipment shall be properly maintained, escape way shall not set or be piled up with obstacles.

4.3 **Environmental Codes of Practice for Pollution Control**

4.3.1 **Dust Pollution Control**

The main sources of construction dust are: the dust produced by the vehicles to and fro the road at construction site, the dust produced by piling up of building materials and earthwork, the dust produced in the process of earthwork, construction waste and construction garbage transportation, the dust produced due to house demolition work,

and the dust produced in the process of concrete and mortar mixing operation.

In view of the above dust pollution sources, the Codes of Practice puts forward the following dust pollution control measures:

(1)The main roads at construction site shall first of all consider the use of the existing or proposed roads at the construction site or surrounding the construction site, when building new construction road, hardening treatment should be made based on its usage. For example, the road used for heavy duty vehicle can be treated using reusable load-bearing bricks (constructional element); for general walkway, reusable permeable bricks can be laid, while at the same time, the road section producing dust shall sprinkle water for dust suppression.

(2)Material stacking at construction site should be compact, the construction road should be laid out by combining permanent road with temporary road to reduce land occupation; if the area of the construction site is narrow, and the second site needs to be chosen for material stacking and processing, waste land, refuse site or idle land should be considered first.

(3)The material storage area, processing area and large moulding storage area at construction site should be flat and solid.

(4)Fine particle materials and the granular materials that are easy to float in the sky at construction site should adopt sealed storage, handling operation should take shielding measures.

(5)Earth shall be piled up together, with covering, solidifying or greening measures being taken. For the spoil excavated, if there is a place to pile up, dig-fill balance calculation should be made in advance, or resource allocation is adopted with the earth of adjacent construction site, it shall use original soil for backfill as far as possible to achieve dig-fill balance in earthwork volume, the spoil (if any) shall be transported to designated disposing place.

(6)The bare site at office area and living area should sprinkle water for dust suppression, and take greening and beautifying measures in combination with the actual situation.

(7)The transportation of earth, waste and construction garbage must use closed vehicle. The access of the construction site shall set the facilities to wash the vehicles driving out of the site, the road between vehicle cleaning equipment and the exit of the site must pave concrete, asphalt or broken brick hardcore, to prevent bringing sediment out of the

site.

(8)Before house demolition operation, civil works contractor shall formulate demolition construction scheme and obtain approval from construction supervision unit and the county implementing agency, the demolition construction shall take such dust suppression measures as dust retention cleaning, dismantling body sprinkling, isolating fence setting. The demolition construction site shall set a place for garbage and waste storage, which shall be timely transported to designated disposing place for dumping in accordance with approved route and time.

(9)Using ready-mixed concrete and ready-mixed mortar at construction site is encouraged.

(10)Dust prevention and dust removal measures shall be taken when conducting concrete and mortar mixing operation.

(11)In case of above force four wind, earth backfill, transport and other construction that may produce dust pollution are not allowed.

4.3.2 **Harmful Gas Emission Control**

Harmful gas in the process of small civil works construction are mainly produced from exhaust gas emitted by construction machinery and transportation vehicle and cooking fume from worker canteen in living area, in view of the above waste gas, the Codes of Practice puts forward the following emission control measures:

(5) Burning of all kinds of wastes at construction site is strictly prohibited.

(5) Construction vehicle and mechanical equipment should be regularly maintained to be kept in good condition, the emission of exhaust gas should meet the emission standard stipulated by the state.

(5) The catering at construction camp shall use natural gas, electric power and other clean energy sources according to the regulations of local environmental protection department.

(4)Wood board and other wood materials used for interior decoration shall not use asphalt, coal tar type anticorrosive and moisture-proof finishing agent.

(5)Kitchen lampblack should use lampblack treatment equipment according to the requirements of local environmental protection department.

4.3.3 **Water Pollution Control**

Waste water produced in the process of small civil works construction mainly comes from construction production wastewater and the workers' domestic sewage, of which, construction production wastewater mainly include wastewater for washing concrete mixer foreground and vehicles, etc., in view of the above waste water, the Codes of Practice puts forward the following discharge control measures:

(5) Construction site mixer foreground and transport vehicle cleaning area shall set sedimentation tank. Wastewater shall not be drained directly into municipal sewage pipe network or river, but recycled or used for dust suppression through sprinkling after secondary precipitation, sediment disposal shall be conducted when the sediment in sedimentation tank reaching 1/4 depth of the tank, the sediment shall be transported to the place designated by local environmental protection department and shall not be abandoned arbitrarily.

(5) The canteen shall set oil separation tank, which shall be timely cleared away by cleaning unit entrusted, the cleaning unit must hold waste disposal qualification and business certificate approved by relevant authority.

(5) Closed waste food bin shall be set outside the canteen and timely cleared and transported.

(4)The septic tank of temporary toilet set at the construction site shall conduct anti-seepage treatment.

(5)The construction site shall set drainage ditch, sedimentation tank, canteen and washroom, sewer pipe in shower enclosure shall set filter screen, the construction sewage can be drained into municipal sewage pipe network or river only after precipitation, while at the same time neat drainage ditch and smooth drainage shall be maintained.

4.3.4 **Noise Pollution Control**

Noise pollution during the construction period are mainly produced by construction machinery and transporting vehicles, acoustic environment affecting the surrounding area of the construction site and passing through both sides of the road, in view of the characteristics of noise pollution of small civil works project, the Codes of Practice puts forward the following emission control measures:

(1)The construction time shall be strictly controlled to be during 8:00 – 20:00, of which, the construction work shall be stopped during lunch break (12:00 -14:00), noting that the in-out time of construction vehicles must comply with the requirements of local government. In case of nighttime continuous construction, public notice shall be given

to surrounding residents, relevant formalities shall be handled and mitigation measures be taken to reduce the impacts on the residents.

(2)Shielding, enclosing and greening measures shall be taken for the construction site for sound absorption and insulation purposes.

(3)Adopt advanced construction process and choose construction machinery and equipment with low noise level; necessary noise elimination, vibration isolation and vibration attenuation measures shall be taken for machinery and equipment, while at the same time daily maintenance work being conducted for machinery and equipment well.

(4)The equipment producing noise at construction site shall be set at the side far away from the residential area, such noise reduction measures as enclosing can be taken for the equipment producing noise.

(5)The speed of the vehicles transporting materials shall not exceed 20km/h when entering the construction site, honking is strictly prohibited.
(6)The equipment producing noise (air compressor, generator, etc.) shall be kept in closed type equipment room.

4.3.5 **Waste Control**

Solid wastes produced during the construction period include building waste, abandoned oil, chemical solvent and domestic garbage, etc., among them, building waste is the main solid waste, the main elements of which are: soil, construction waste, scattered mortar and concrete, masonry and concrete fragments produced due to chiseling, reinforced concrete pile head, metal and bamboo wood cutting from pile driving, waste materials produced from decoration, all kinds of packaging materials and other wastes, etc., in view of the solid wastes produced before project construction, the Codes of Practice puts forward the following waste control measures:

(1) The construction site shall set enclosed refuse storage area, with construction waste and domestic garbage being stored separately and cleaned away timely according to the regulations.

(2) The construction waste in buildings must be cleaned and transported through corresponding container or pipe, throwing high up in the air is strictly prohibited.

(3) The wastes produced due to construction, demolishing and site cleaning shall be disposed separately, of which, the reusable and renewable materials shall be recovered

separately and recycled, the rest of which shall be timely cleaned and transported by cleaning unit entrusted, the cleaning unit shall hold waste disposal qualification and business certificate approved by relevant authority.

(4) Abandoned oil and chemical solvent shall be stored in a centralized way and disposed by qualified unit entrusted, and shall not be dumped arbitrarily.

(5) The construction equipment shall be maintained to avoid being spattered by oil stain, special equipment maintenance area shall be set in the construction area to ensure that all equipment maintenance activities being carried out in designated maintenance area.

(6) The construction camp shall set enclosed refuse storage area to collect the workers' domestic garbage, which shall be timely transported and disposed in accordance with the provisions.

(7) Enclosed waste food bin shall be set outside the canteen and timely cleaned and transported.
(8) Septic tank shall be timely cleaned by cleaning unit entrusted and shall be buried with soil upon completion of the construction

(9) Upon completion of the work, solid wastes produced in the process of construction must be completely cleared away.

4.3.6 **Soil Erosion Control**

To prevent and control water erosion during the construction period, the Codes of Practice puts forward the following control measures:

(1) The existing legal borrow area and waste abandoning place determined by local sanitation department shall be utilized first, building wastes shall be abandoned arbitrarily.

(2) Newly constructed borrow area shall obtain approval from relevant authority, and attention shall be paid to protection of the side slope of the area, when taking earth, surface soil shall be cleaned and stored to be used for vegetation restoration upon completion of the construction.

(3) Intercepting ditch and headrace shall be built based on topographic condition to lead water flow formed in rainy season away so as to avoid the washout of surface

runoff to the work.

4.4 **Preservation of Cultural Relics**

According to related survey, there is no cultural relics in project construction area. In accordance with relevant provisions of Article 32 under *Law of the People's Republic of China on Protection of Cultural Relics* (October 28, 2002) "In the process of construction work or agricultural production, any unit or individual, once discovering cultural relics, shall immediately report to local administrative department of cultural relics, the relevant department, upon receipt of the report and if no special circumstance, shall rush to the site within 20 hours and put forward disposal opinion in seven days. The administrative department of cultural relics can report to local people's government and request it to notify public security organ to help protect the site; where important cultural relics are discovered, it shall immediately report to the administrative department of cultural relics of the State Council, and the latter shall put forward disposal opinions within 15 days upon receipt of the report. In accordance with the provisions of the preceding paragraph, the cultural relics found belong to the state, any unit or individual shall not plunder, privately distribute or hide.", as well as *Rules of Hebei Province on Protection of Cultural Relics* "any unit or individual, once discovering underground cultural relics in the process of work construction or production activities, shall immediately stop construction or production and protect the site, while at the same time reporting to the administrative department of cultural relics of local people's government. The administrative department of cultural relics, upon receipt of the report, shall rush to the site within 24 hours and put forward disposal opinions within three days." and "any unit or individual shall not obstruct the personnel of the administrative department of cultural relics and archaeological excavation unit to conduct archaeological investigation, exploration and excavation. Before the end of archaeological excavation, any unit or individual shall not continue construction or production activities within archaeological excavation area without authorization. After the end of archaeological excavation, the administrative department of cultural relics organizing excavation work shall immediately notify in writing its disposal opinions to the construction unit.", this Environmental Codes of Practice puts forward the following administration requirements for cultural relics accidentally found during the construction period:

(1) If cultural relics are discovered during the construction period, the construction work shall be stopped immediately and the site shall be well protected rather than disposed arbitrarily, while at the same time immediately reporting to local administrative department of cultural relics.

(2) After the administrative department of cultural relics puts forward disposal opinions, the construction unit shall formulate special construction scheme for the section containing cultural relics according to the opinions issued by the administrative department of cultural relics, and may start construction only after obtaining the

consent from relevant department, before the end of archaeological excavation, any unit or individual shall not continue construction or production activities in archaeological excavation area without authorization.

(3) Any unit or individual shall not plunder, privately distribute or hide the cultural relics discovered.

(4) See Figure 4-1 Disposal Process for Cultural Relics Discovered During Construction Period for details.

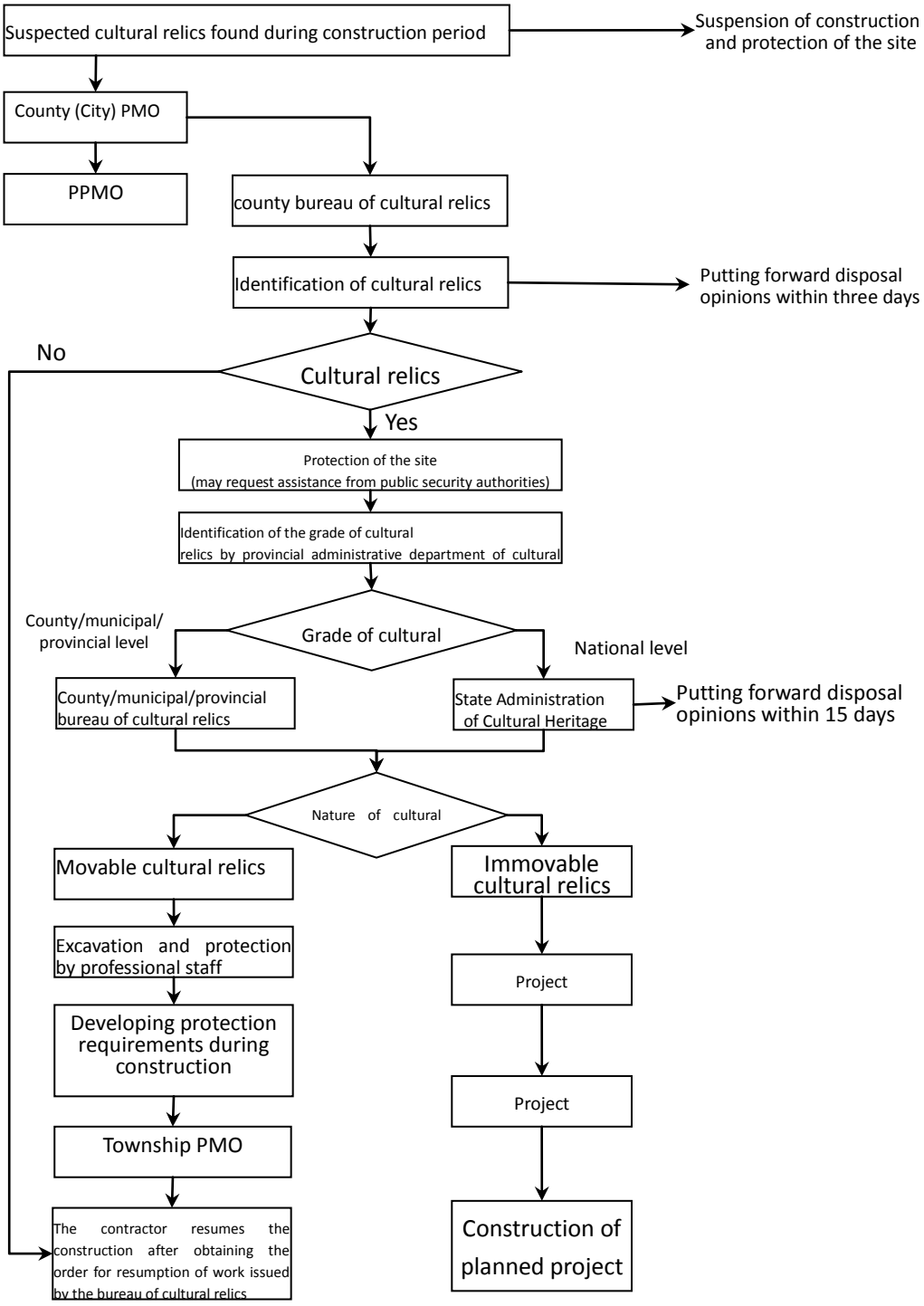

Figure 4-1 Procedure Chart for Disposal of Cultural Relics Found During Construction Period

4.5 **Cemetery Protection**

If it is found in the survey that some cemetery needs to be relocated, compensation shall be given in accordance with relevant requirements in General Report on Resettlement Plan for Hebei Rural Renewable Energy Development Demonstration Project.

4.6 **Vegetation Protection**

To protect vegetation within and surrounding project area as well as ecological environment, the Codes of Practice puts forward the following vegetation protection measures:

(1) Cutting down trees outside construction area arbitrarily is prohibited.
(2) Reasonably optimizing the layout of the construction site, reducing the scope of construction activity area as far as possible and minimizing the damage of vegetation caused due to project implementation.
(3) For the vegetation damaged or bare soil caused due to construction, effective measures must be timely taken to avoid soil erosion. For example, covering gravels, planting fast-growing grass, etc.
(4) After the end of construction, original vegetation site destroyed must be restored or reasonably greened, when conducting ecological restoration and greening for vegetation, native species shall be adopted instead of introducing alien species.

4.7 **Risk Prevention**

The construction unit shall pre-establish accident prevention plan and set corresponding responsible person, once accident occurs, it shall be timely disposed and reported to environmental supervision unit and the county implementing agency.

4.8 **Occupational Health**

(1) The construction site shall set warning signs or warning instructions at operating post, equipment and place vulnerable to occupational hazards.
(2) Regularly conduct occupational health training and physical exam for personnel engaged in poisonous and harmful operation, and guide operating personnel to correctly use occupational-disease-prevention equipment and individual labor protection articles (at least once a year).
(3) The construction unit shall provide safety helmet, safety belt and safety shoes matching with the type of work that construction personnel are engaged in and other individual labor protection articles.
(4) The construction site shall adopt low noise equipment, promote the use of automatic and closed type construction process, and reduce mechanical noise. When

operating, the operating personnel shall wear ear plugs to protect hearing.
(5) Anticorrosive and waterproof operation in basement where good natural ventilation cannot be guaranteed shall be equipped with mandatory ventilation facilities. The operating personnel shall wear respirator or protective facial mask in the workplace with toxic or harmful gases.
(6) In the workplace with dust, sprinkling and other facilities shall be taken to reduce dust concentration, the operating personnel shall wear dust protecting mask; when conducting welding operation, the operating personnel shall wear protective mask, safety goggles, gloves and other personal protective equipment.
(7) When conducting high temperature operation, the construction site shall be equipped with sunstroke prevention and cooling items, with work-and-rest timetable being reasonably arranged.

4.9 **Traffic Safety**

The traffic accident has become one of the reasons causing the most injuries and deaths in the world. All the project staff must maintain traffic safety on the way to and fro workplace as well as operating equipment on free road or public road. The safety measures to prevent and control injuries and deaths due to traffic accidents shall be designed to protect project workers, road users and injured people due to traffic accidents. The safety measures taken according to the size and nature of project activities shall include the following contents:

(1) Emphasize on safe driving for drivers and regularly carry out safety education & training.
(2) Limit driving time, the drivers shall take turns in driving to avoid fatigue driving. Driving on dangerous road and in dangerous time shall be avoided to reduce the occurrence of accidents as far as possible.
(3) Periodically maintain vehicles and use the parts approved by the manufacturer, timely purchase parts for vehicle maintenance and avoid serious accidents due to equipment failure or premature failure of parts.
(4) Achieve separation of pedestrians and vehicles
(5) Adopt traffic safety restrictions and alert pedestrians and vehicles to note dangerous traffic conditions through road signs and signals; cooperate with local community and competent authority to improve road signs and enhance its visibility so as to enhance traffic safety.
(6) Carry out traffic safety and pedestrian safety education in the communities surrounding project construction and the communities near school.
(7) Coordinate with emergency personnel to ensure appropriate first aid in case any accident occurs.
(8) Use the materials purchased locally as far as possible to shorten transportaion distance.
(9) Improve driving skills, drivers must obtain driving license.

4.10 **Hygiene & Disease Control**

(1) Staff meals, drinking water and rest area at construction site shall conform to hygiene standards.
(2) Dormitory, canteen, bathroom and toilet shall be equipped with ventilation and lighting facilities, daily maintenance shall be responsible for by special person.
(3) The dormitory at construction site shall adopt open-type window, the beds in the dormitory shall not exceed two layers, a wide bed for a number of people is strictly prohibited.
(4) The canteen shall obtain effective sanitary license issued by competent authority, all kinds of appliances are standard and clean. The canteen workers shall hold effective health certificate.
(5) The canteen shall be set at the place far away from toilet, refuse storage area, toxic and harmful pollution sources.
(6) The canteen shall set independent food preparation room and storage room, the lower part of door leaf shall set rat guard no less than 0.2m.
(7) Toilet, sanitation facilities, drainage ditch and damp area shall be disinfected on a daily basis.
(8) The living area shall set closed container, with daily fly killing and timely cleaning.
(9) The construction site shall health center, equipped with health kit, commonly used drugs and bandage, tourniquet, net collar, stretcher and other emergency equipment.
(10) When the construction personnel develop infectious diseases (statutory infectious diseases include: atypical pneumonia, plague, cholera, viral hepatitis, bacterial and amebic dysentery, typhoid and paratyphoid fever, HIV/AIDS, gonorrhea, syphilis, polio, measles, pertussis, diphtheria, epidemic cerebrospinal meningitis, scarlet fever, epidemic hemorrhagic fever, rabies, leptospirosis, brucellosis, anthrax, epidemic and endemic typhus, epidemic encephalitis B, kala-azar, malaria, dengue fever, tuberculosis, schistosomiasis, filariasis, hydatid disease, leprosy, influenza, epidemic parotitis, rubella, neonatal tetanus, acute hemorrhagic conjunctivitis, infectious diarrhea disease), food poisoning and acute occupational poisoning, it shall be timely reported to the epidemic prevention department and competent department in charge of construction of the place where the project locates, and disposed in accordance with relevant regulations of the epidemic prevention department.

Annex 1 Checklist of Construction Site before Commencement of Work

Serial No.	Environmental Problem	Check Result (Marked with "√)	Remark
1	Whether the project involves natural habitat, material culture resources, involuntary resettlement and other World Bank safeguard policies	Yes □ No □ Not Involve □	
2	Whether there are important vegetation and trees within the scope of project land occupation	Yes □ No □ Not Involve □	
3	Whether project construction road will cause significant impacts on going out of surrounding residents	Yes □ No □ Not Involve □	
4	Whether there are the public (residential community, school, hospital, office area, etc.) vulnerable to the impacts of work construction nearby the project	Yes □ No □ Not Involve □	
5	May cause the deterioration in the quality of life of nearby town	Yes □ No □ Not Involve □	
6	Whether project construction needs to interrupt municipal services (including water, electric power, telephone, bus line, etc.)	Yes □ No □ Not Involve □	
7	Whether project construction needs demolition	Yes □ No □ Not Involve □	
8	Whether rainy season will be affected by flood	Yes □ No □ Not Involve □	
9	Whether land outside project areas is temporarily occupied	Yes □ No □ Not Involve □	
10	Whether electric power, telecommunications and other municipal service lines are involved within and nearby the scope of project construction	Yes □ No □ Not Involve □	
11	Whether there is surface water body within and nearby the scope of project construction	Yes □ No □ Not Involve □	
Others		Yes □ No □ Not Involve □	

Annex 2 Checklist of Construction Site Environment

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
I. General Requirements	1.1 Whether effective measures for preventing and controlling atmospheric pollution, water and soil pollution and noise pollution as well as for improving environmental health are in place in construction organization design of the project					
	1.2 Whether environmental protection, environmental health management and inspection system for construction site are established					
	1.3 Whether environmental protection, environmental health management and inspection for construction is recorded					
	1.4 Whether operating personnel are provided with necessary protective equipment and effective occupational-disease-prevention measures are taken					
	1.5 Whether the personnel engaged in occupational-disease-inductive operation are provided with regular physical exam and training (with relevant physical exam certificate and training record)					
	1.6 Whether diet health, sunstroke prevention, cooling, cold protection, warmth keeping, gas poisoning prevention and epidemic prevention for operating personnel are in place in combination of seasonal characteristics					
	1.7 Whether education training and assessment for operating personnel at construction site contain laws and regulations relating to environmental protection and environmental health (with related records and documents)					
	Others (shall specify)					
II. Site Layout and Temporary Facilities Construction	2.1 Whether the construction area at the construction site is clearly separated from office area and living area and relevant isolation measures are taken					
	2.2 Whether the construction area is neat and orderly					
	2.3 Whether the access of the construction site is marked with enterprise name or enterprise logo, whether the visible place of main access is set with project profile plate meeting the					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
	requirements?					
	2.4 Whether the public is informed in advance when the construction needs to interrupt municipal services (including water, electric power, telephone, bus line, etc.)					
	2.5 Whether the existing building and infrastructure are utilized as temporary facilities of the construction site					
	2.6 Whether newly built temporary house is reasonable in land occupation and meets safety and fire control requirements (with related certificates)					
	2.7 Whether the construction of temporary facilities uses clay bricks					
	2.8 Whether oil, chemical solvent and other items stored at the construction site set special warehouse and warning signs.					
	2.9 Whether anti-seepage treatment is made for the ground of oil and chemical warehouse, and whether such emergency treatment materials as absorption bas/sands/bits of wood are in pace in the warehouse					
	2.10 Whether collective staff dormitory is set in unfinished building					
	2.11 Whether temporary facilities are demolished within one month upon completion of the construction work					
	Others (shall specify)					
III. Operating Conditions and Environmental Safety	3.1 Whether enclosed color steel fence with the height of no less than 2.5m is set at the construction site, whether the height of sensitive section is no less than 3.m					
	3.2 Whether the construction site sets qualified bulletin board, indicating environmental protection and civilized construction system, and disposal process for emergencies, etc.					
	3.3 Whether the construction unit takes protective measures to ensure the safety of buildings, structures and underground pipelines adjacent to construction work					
	3.4 Whether tall scaffolding, tower crane and other large machinery and equipment at construction site keep a safe distance from overhead transmission conductor, whether high voltage line adopts insulating material for safety protection					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
	Inspect Item		Yes	No	Not Involve	
	3.5 Whether mandatory safety protection measures are taken for sidewalks and vehicle access surrounding construction work, whether lighting indicating device is set in the nighttime					
	3.6 Whether visible safety warning sign meeting national standard is set at dangerous section of the construction site					
	3.7 Whether the construction site adopts corresponding safety technology measures based on season change to achieve civilized and safe construction conditions					
	3.8 Whether fire extinguishing equipment is kept in good condition, and whether escape way is without obstruction					
	Others (shall specify)					
IV. Dust Pollution Control	4.1 Whether construction site road reasonably utilizes the existing or proposed road in and surrounding the site					
	4.2 Whether hardening treatment is made based on its usage when constructing new road, and whether the road section producing dust controls dust by sprinkling					
	4.3 Whether materials are piled up together at construction site					
	4.4 Whether the second location selected to pile up materials is reasonable					
	4.5 Whether site material storage area, processing area and large moulding storage area are flat and solid					
	4.6 Whether fine particle granular materials and the materials easy to float in the air at construction site adopt sealed storage, whether shielding measures are taken for their handing and transportation					
	4.7 Whether covering, solidifying or greening measures are taken for earthwork piled up together					
	4.8 Whether spoil is utilized or transported to designated disposal sites					
	4.9 Whether bare ground at office area and living area of the construction site controls dust by sprinkling and is greened and beautified based on the actual situation					
	4.10 Whether earth, waste and construction garbage are transported using closed vehicles					
	4.11 Whether the facilities washing vehicles are set at the access					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
	of the construction site, whether the road between vehicle washing facilities and the exit of the site is paved with concrete, asphalt, straw matress or broken brick hardcore to avoid bringing silt out of the site					
	4.12 Whether the construction site uses ready-mixed concrete and ready-mixed mortar					
	4.13 Whether dust prevention and dust removal measures are taken when conducting concrete and mortar mixing operation					
	4.14 Whether earth backfill, transportation and other construction that may produce dust pollution are prohibited in the weather with force four wind					
	Others (shall specify)					
v. Harmful Gas Emission Control	5.1 Whether all kinds of wastes are burned at construction site					
	5.2 Whether construction vehicles and mechanical equipment are kept in good condition, whether the exhaust gas emitted meets the emission standard provided by the state					
	5.3 Whether decoration materials adopt building materials qualified through the verification of legal detection unit (with certificate of conformance)					
	5.4 Whether wood board and other wood materials used for interior decoration are prohibited from using asphalt, coal tar class anticorrosive and moisture-proof finishing agent.					
	5.5 Whether the kitchen in living area is installed with lampblack treatment facilities as required					
	Others (shall specify)					
VI. Water Pollution Control	6.1 Whether sedimentation tank is set at the place washing mixer foreground and transport vehicles at construction site					
	6.2 Whether wastewater is directly drained into municipal sewage pipe network or river					
	6.3 Whether wastewater is recycled or used for dust suppression through sprinkling after secondary precipitation					
	6.4 Whether sediment disposal is conducted when sediment in sedimentation tank reaching 1⁄4 depth of the tank, whether sediment in sedimentation tank is cleared and transported to					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
	designated place					
	6.5 Whether the canteen sets separation tank, whether qualified cleaning unit is entrusted to timely clear it away					
	6.6 Whether closed waste food bin is set outside the canteen and is cleared away in a timely manner					
	6.7 Whether septic tank of temporary toilet set at construction site conducts anti-seepage treatment					
	6.8 The construction site shall set drainage ditch, whether waste water is drained into municipal sewage pipe network or river after precipitation, whether drainage ditch is smooth					
	Others (shall specify)					
VII. Noise Pollution Control	7.1 Whether the requirements of construction time is strictly followed					
	7.2 Whether surrounding residents are informed of nighttime continuous construction, whether related formalities for nighttime continuous construction are handled					
	7.3 Whether shielding, closing and greening measures for noise absorption and noise insulation purposes are taken for the construction site					
	7.4 Whether low noise equipment are adopted and maintenance for the equipment is well conducted					
	7.5 Whether the equipment producing noise are set at the side far away from residential community					
	7.6 Whether noise reduction measures such as enclosing are taken to the equipment producing noise					
	7.7 Whether such measures as speed limit and no honking are taken for construction vehicles					
	7.8 Whether the equipment (air compressor, electric generator, etc.) producing noise are placed in enclosed equipment room					
VIII. Waste Control	8.1 Whether the construction site sets enclosed refuse storage area, whether construction waste and domestic garbage are stored separately and cleared away and disposed according to the provisions					
	8.2 Whether corresponding container or pipe transportation are adopted for the removal of construction waste in buildings					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
	8.3 Whether wastes produced from construction, demolition and site cleaning are disposed separately, recovered and recycled					
	8.4 Whether construction waste cleaning unit holds waste disposal qualification and business license approved by relevant authority					
	8.5 Whether abandoned oil and chemical solvent are stored in a centralized way, and entrusted to qualified unit for disposal					
	8.6 Whether construction equipment has obvious oil spatter					
	8.7 The construction camp shall set enclosed refuse storage area to collect the workers' domestic garbage, which shall be timely cleared away as required.					
	8.8 Septic tank shall be timely cleared and buried with land upon completion of the construction					
	8.9 Whether solid wastes produced in the process of construction are completely cleared away upon completion of the construction					
	Others (shall specify)					
IX. Soil Erosion and Control	9.1 Whether utilize the existing legal borrow area and the waste abandoning place determined by local sanitation department					
	9.2 Whether newly built borrow area obtains approval from relevant authority, whether protective measures are taken to the side slope of borrow area					
	9.3 Whether surface soil is cleaned and stored to ensure that it is used for vegetation restoration upon completion of the construction					
	9.4 Whether intercepting ditch and headrace are built to lead water flow formed in rainy season away to avoid the washout of surface runoff to work					
	Others (shall specify)					
X. Protection of Cultural Relics	10.1 In case cultural relics or suspected cultural relics is found during construction period, the construction shall be immediately stopped and the site shall be well protected, while at the same time reporting to local administrative department of cultural relics for disposal, the construction can be resumed only after disposal of relevant department					
	Others (shall specify)					
Protection etation	11.1 Whether such behavior as cutting down trees outside					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
	construction site exists					
	11.2 Whether the layout of construction site is reasonable (judging from the point of the damage caused by work implementation to vegetation)					
	11.3 Whether effective measures are taken for the vegetation damaged and bare soil caused due to the construction to avoid soil erosion and loss (adopting such measures as covering with gravels, planting fast-growing grass, etc.)					
	11.4 Whether original vegetation area destroyed is restored or reasonably greened upon completion of the construction					
	11.5 Whether alien species are introduced when conducting ecological restoration and greening for vegetation					
	Others (shall specify)					
XII. Risk Prevention	12.1 Whether accident prevention plan is formulated.					
	Others (shall specify)					
XIII. Occupational Health	13.1 Whether warning signs or warning instructions are set at operating post, equipment and place vulnerable to occupational hazards					
	13.2 Whether operating personnel wear ear plugs for hearing protection when conducting high noise construction work					
	13.3 Whether anticorrosive and waterproof operation in basement where good natural ventilation cannot be guaranteed are equipped with mandatory ventilation facilities. Whether the operating personnel wear respirator or protective mask in the workplace with toxic or harmful gases					
	13.4 Whether the operating personnel wear dust mask in the workplace with dust					
	13.5 Whether the operating personnel wear protective mask, goggles, gloves and other personal protective equipment when conducting welding operation					
	13.6 Whether the construction site is equipped with sunstroke prevention and cooling supplies when conducting high temperature operation, and the work-and-rest timetable shall be reasonably arranged					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project						
Name of Subproject			Name of Work Site			
Contract Number and Name			Inspect Result (Marked with"√")			Notes
Inspect Item			Yes	No	Not Involve	
	Others (shall specify)					
XIV. Hygiene and Disease Control	14.1 Whether staff meals, drinking water and rest area at construction site are in compliance with health standards (with health certificate)					
	14.2 Whether dormitory, canteen, bathroom and toilet are equipped with ventilation and lighting facilities, and maintained by special personnel					
	14.3 Whether construction site dormitory meets the requirement of setting open type window, the beds in the dormitory shall not exceed two layers, a wide bed for a number of people is strictly prohibited					
	14.4 Whether the canteen obtains effective sanitary license issued by relevant authority, whether canteen workers hold effective health certificate					
	14.5 Whether the canteen is located far away from toilet, refuse storage area, toxic and harmful pollution sources					
	14.6 Whether the canteen sets independent food preparation room and storage room, whether the lower part of door leaf sets rat guard no less than 0.2m					
	14.7 Whether toilet, sanitation facilities, drainage ditch and damp area are regularly disinfected (with related records)					
	14.8 Whether the living area sets closed container with regular fly killing and timely clearing					
	14.9 Whether the construction site sets health center, equipped with health kit, commonly used drugs and bandage, tourniquet, neck collar, stretcher and other emergency equipment					
	14.10 When construction personnel develop infectious diseases, food poisoning and acute occupational poisoning, whether it is timely reported to the epidemic prevention department and competent department in charge of construction of the locality, and disposed according to relevant regulations stipulated by the epidemic prevention department					
	Others (shall specify)					
Saf fic	15.1 Whether safe driving is emphasized on drivers and safety					

Checklist of Construction Site Environment for Small Civil works Under Hebei Rural Renewable Energy Development Demonstration Project					
Name of Subproject		Name of Work Site			
Contract Number and Name		Inspect Result (Marked with"√")			Notes
Inspect Item		Yes	No	Not Involve	
	education & training is carried out regularly				
	15.2 Whether driving time is limited, and drivers take turns in driving; whether driving on dangerous road and in dangerous time is avoided				
	15.3 Whether the parts used for vehicle maintenance are approved by the manufacturer, and whether vehicle parts are purchased timely for maintenance purpose				
	15.4 Whether separation of people and vehicles are achieved				
	15.5 Whether cooperate with local community and competent authority to improve road signs and strengthen the visibility of road signs				
	15.6 Whether traffic safety and pedestrian safety education are carried out in the communities surrounding project construction and the communities nearby school				
	15.7 Whether materials are purchased locally as far as possible				
	15.8 Whether drivers operating the vehicles hold driving license				
	Others (shall specify)				
Others (shall specify)					

The construction stage when inspecting: _____

Date of inspection: _____Time of inspection: _____

Weather record:_____

Signed by on-site inspector: _____ Signed by environmental supervisor: _____

Description: ① The problem observed, unqualified situation described, corrective and preventive actions and suggestions put forward can be filled in remark.

② If it is found through on-site inspection that measures are unqualified and need to be improved, environmental supervisor shall immediately issue "Environmental Rectification Notice" to the contractor and record the serial number of "Environmental Rectification Notice" in Remark. The detailed corrective actions carried out by the contractor shall be recorded separately.

③ This form is a general checklist of construction site environment for small civil works under THE PROJECT, as for the specific subproject and environmental problems, local environmental situation and construction content can be combined to make appropriate adjustment to this form and to adopt appropriate environmental protection measures.

Annex 3 Environmental Rectification Notice

Environmental Rectification Notice
Serial No.:_____ Contract number and name: _____ Name of subproject:_____ Name of work site:_____ Current construction stage: _____
The problems existing in on-site inspection: Inspected by: _____Date: _____
The contractor analyzes the reasons and formulates rectification plan: Responsible person on contractor side: _____Date:_____
Opinion of environmental supervisor: Responsible person on environmental supervisor side: _____Date:_____
Opinion of competent department of environmental protection (when necessary): Contact person:_____Date:_____
Modification deadline: Completed as of _____ Responsible person on contractor side: _____Date: _____ Responsible person on environmental supervisor side:_____Date: _____
Conclusion after review: Reviewed by: _____Date: _____

APPENDIX II

THE WORLD BANK
Working for a World Free of Poverty

Hebei Rural Renewable Energy Development Demonstration Project

Environmental Codes of Practice

For

Biogas Pipeline Laying works

Project Management Office Of Hebei Rural Renewable Energy Development Demonstration Project
Hebei Jingmiao Environmental Consulting Co., Ltd

April 2014

1 Overview

1.1 **Project Background**

According to the requirements for environment screening and classification in Environment Evaluation under World Bank Safeguard Policies (OP4.01) and through environment screening to the type, location, sensitivity and scale of the project and the characteristic and size of potential environmental impacts, this project is determined as class B project and requires the preparation of *Environmental Codes of Practice* (ECOP), this appendix is the environmental codes of practice for biogas pipeline laying works, which is applicable for all biogas pipeline laying works under World Bank-financed Hebei Rural Renewable Energy Development Demonstration Project (except for EMP type works and biogas pipeline works), and is composed of environmental codes of practice for each type of biogas pipeline laying works. In preparing this ECOP, we made reference to Detailed Rules of Hebei Province on Safe Construction, EHS Guidelines, operational policies and safeguard polices of the World Bank and other materials.

1.2 **Purpose of Preparing Environmental Codes of Practice**

The purpose of formulating ECOP is to provide a set of detailed, technically feasible and financially sustainable and operational environment countermeasures for inevitable potential adverse effects on the environment in biogas pipeline laying works, specifying the measures and arrangements taken by project management department, project owner, construction unit, supervision unit and environmental management department for implementing environmental management and body construction in the period of project bidding, design and construction, to eliminate or make up for as far as possible the adverse effects caused by project construction on the environment and society and to reduce such effects to an acceptable level. The specific targets include:

(2) Specifying environmental management obligation of related project departments

Project management department, project owner, design unit and environmental assessment unit conduct detailed field verification and confirmation to environmental protection target, confirming the rationality of the location selected and putting forward effective environmental impact mitigation measures.

In project bidding stage, implementing the requirements in Environmental Codes of Practice shall be clearly specified as the obligation that the bid winner must perform, the requirements in Environmental Codes of Practice shall be incorporated into the actual work design and project construction activities.

(2) Taken as operational guidance for environmental management

Environmental Codes of Practice specifies both environmental management system of biogas pipeline laying works project and the duties and roles of all units under environmental management system of the project, and puts forward the procedure and

way for communication and exchange among departments. This document will be submitted to work design unit winning the bid as important basis for work design, at the same time, provided to work construction unit as code of conduct for environmental management during construction period so as to effectively guarantee smooth implementation of environmental impact mitigation measures presented.

1.3 **Applicable Laws and World Bank Safeguard Policies**

(1) Environmental Protection Law of the People's Republic of China (December 26, 1989);

(2) Environmental Impact Assessment Law of the People's Republic of China (September 1, 2003);

(3) Law of the People's Republic of China on Atmospheric Pollution Prevention and Control (September 1, 2000);

(4) Law of the People's Republic of China on Water Pollution Prevention and Control (February 28, 2008);

(5) Law of the People's Republic of China on Prevention and Control of Ambient Noise Pollution (October 29, 1996);

(6) Law of the People's Republic of China on Soil and Water Conservation (March 1, 2011);

(7) Law of the People's Republic of China on Land Administration (August 29, 1998);

(8) Forest Law of the People's Republic of China (revision, 1998);

(9) Law of the People's Republic of China on the Protection of Cultural Relics (December 29, 2007);

(10) Law of the People's Republic of China on the Protection of Wildlife (November 8, 1988);

(11) Regulations of the People's Republic of China on the Protection of Wild Plants (January 1, 1997);

(12) Regulations on Basic Farmland Protection (State Council Decree No.257);

(13) City Planning Law of the People's Republic of China (April 1, 1990);

(14) Regulations on Administration of Environmental Protection in Construction Projects (State Council Decree No. 253, November 29, 1998);

(15) Classification Management Directory of Environmental Impact Assessment for Construction Projects (Ministry of Environmental Protection Decree No.2, October 1, 2008);

(16) Management Regulations on "Three Simultaneities" Supervision & Inspection and Environmental Protection Acceptance Upon Completion of Construction Projects by Ministry of Environmental Protection (trial implementation) (December 17, 2009);

(17) Measures for the Administration of Environmental Protection Acceptance Upon Completion of Construction Projects (February 1, 2002);

(18) Circular on Certain Issues Concerning Strengthening Environmental Protection Management of Small Construction Projects (Ministry of Environmental Protection [2002] No.85);

(19) World Bank Safeguard Policies;

(20) Guidelines on Environment, Health and Safety of World Bank

2 Management System for Environmental Codes of Practice

2.1 **Establishment of Management System for Environmental Codes of Practice**

In accordance with relevant provisions and the actual work needs, biogas pipeline laying works involved in the Hebei Rural Renewable Energy Development Demonstration Project shall set up special environmental management organization being responsible for environmental management and environmental supervision of the work.

A set of environmental management system including supervision agency, implementing agency and consulting agency is established for this project under the Project Management Office (PMO), as shown in Table 2-1 and Figure 2-1.

Table 2-1 Agency Composition of Environmental Management System

Nature of Agency	Name of Agency	Main Responsibilities
Management Agency	PMO of Hebei Rural Renewable Energy Development Demonstration Project	Assign special environment administrator to be responsible for environmental protection in the stages of project planning, design and implementation; determine that working procedures meet environmental assessment and environmental management requirements of domestic competent authorities and the World Bank; ensure that environmental protection measures in ECOP are incorporated into biogas pipeline laying works tender and the contract and implemented smoothly, see "2.2 Duties of the Agencies Under Environmental Management System" for details; supervise smooth implementation of ECOPs in operation period.
	County implementing agency	Assign special persons in charge of environmental protection, the main task of whom are to ensure effective implementation of Environmental Codes of Practice in work implementation and operation period, and to reduce adverse impacts of the construction on the environment to the minimal or acceptable level, while at the same time making environmental benefits of the work into full play; implementing all the funds required for environmental protection; and being responsible for sorting and archiving of relevant documents, see "2.2 Duties of the Agencies Under Environmental Management System" for details.
Supervision agency	Supervision mission of the World Bank	Assign environmental specialists to supervise and inspect the implementation of Environmental Codes of Practice, see "2.2 Duties of the Agencies Under Environmental Management System" for details.

Nature of Agency	Name of Agency	Main Responsibilities
	Competent administrative departments for environmental protection at all levels	Competent administrative departments supervise and inspect whether working procedures of the project meet environmental management requirements stipulated by the government, whether pollution prevention & control measures are in compliance with environmental protection requirements in implementation process, see “2.2 Duties of the Agencies Under Environmental Management System” for details.
	Environmental monitoring agency	Conduct site supervision and inspection for pollutant discharge from pollution source and ecological destruction events during construction according to law, and participate in relevant treatment, see “2.2 Duties of the Agencies Under Environmental Management System” for details.
Implementing Agency	Biogas pipeline laying works contractor	Implement environmental protection measures in ECOP, meet the requirements of the World Bank and local competent administrative department of environmental protection on environmental protection, prepare and submit monthly environment report during construction period, see “Duties of the Agencies Under Environmental Management System” for details.
Consulting Agency	Environmental impact assessment and consulting unit	Entrusted to prepare Environmental Codes of Practice specially designed for biogas pipeline laying works and all kinds of biogas pipeline laying works projects (except EMP class work and road work), see “2.2 Duties of the Agencies Under Environmental Management System” for details.
	Design institute	Entrusted to prepare feasible research report and construction design scheme; ensure the measures and schemes in Environmental Codes of Practice to be implemented in preparation results. See "2.2 Duties of the Agencies Under Environmental Management System”.
	Environmental supervision unit	Entrusted to supervise and manage day-to-day production activities of the construction unit according to Environmental Codes of Practice under the contract, see “2.2 Duties of the Agencies Under Environmental Management System”.
Monitoring Agency	Environmental monitoring unit	Responsible for environmental monitoring in project construction and operation period; provide scientific basis for environmental pollution control, environmental management and regional environmental protection

Nature of Agency	Name of Agency	Main Responsibilities
		during subproject construction and operation.
	Soil and water conservation monitoring unit	Responsible for soil and water conservation monitoring work in project construction and operation period; guarantee work construction safety; timely grasp dynamic changes in soil erosion during construction; understand the implementation situation and control effects of various soil and water conservation measures; and reduce newly increased soil erosion to the lowest level.

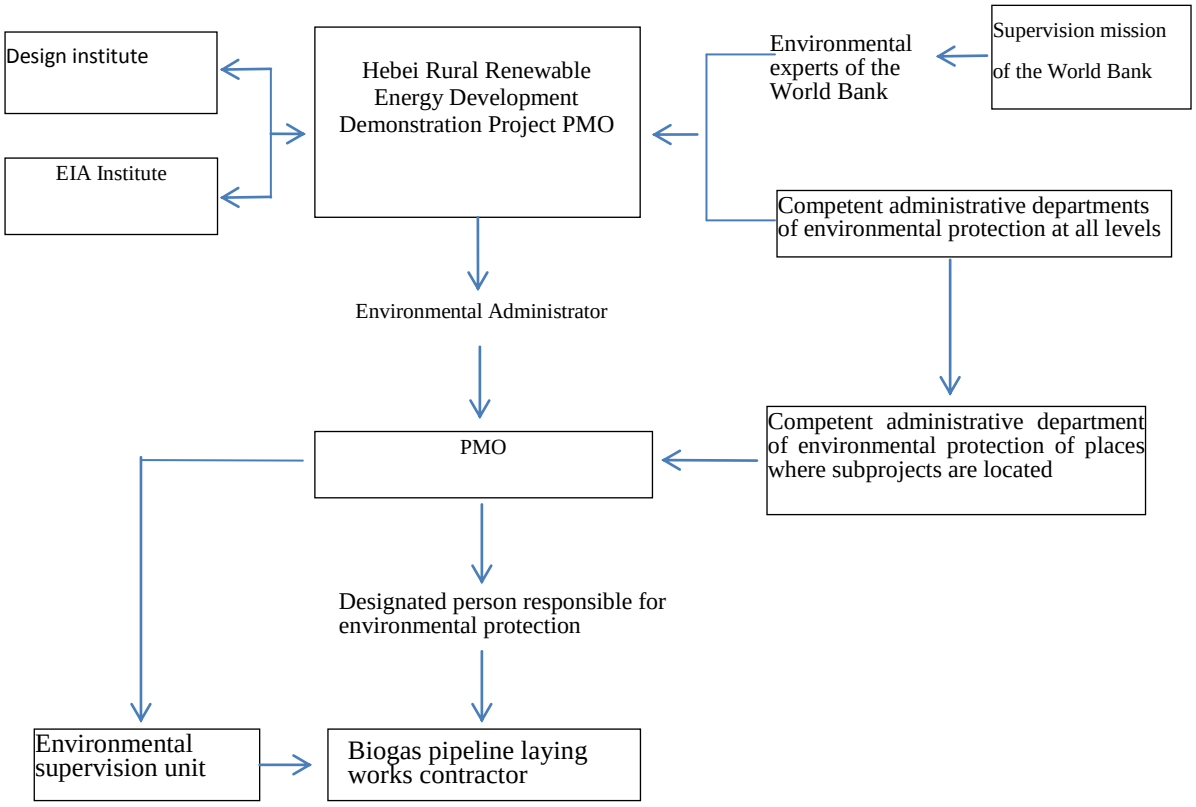

Figure 2-1 Frame Diagram for Environmental Management Organization of the Project

2.2 Duties of the Agencies Under Environmental Management System

Environmental management system involves project management agency, supervision agency, implementing agency, monitoring agency and consulting agency, these agencies together constitute complete environmental management system of the project, but each bears different working content and has different scope of duties.

The project is carried out under the organization and leadership of the provincial PMO; design institute and EIA institute accept entrustment from PMO to provide consulting services; environmental monitoring unit accepts entrustment from PMO or project contractor to monitor

environmental sensitive factors and affected environmental sensitive sites in project operation and implementation period; environmental supervision unit accepts entrustment from PMO to conduct day-to-day supervision for the implementation of environmental protection measures in biogas pipeline laying works construction period; environmental experts of the World Bank, competent administrative departments of environmental protection at all levels and environmental monitoring agency supervise management agency and implementing agency of this project according to law to ensure the construction of the project meet relevant requirements of the Chinese government and the World Bank in working procedures, the implementation of pollution control measures and other aspects.

2.2.1 **Management Agency**

PMO

PMO is the organization responsible for overall plan of the project, including environmental protection of the project in planning, design and implementation stages, ensuring that working procedures meet environmental impact assessment and environmental management requirements of domestic competent authorities and the World Bank, and ensuring the requirements of environmental protection measures.

PMO assigns special environmental administrators (composed of leaders in charge and environmental consultants), the main responsibilities of whom are as follows:

· Check and coordinate the work of the person in charge of environmental management in each sub project.

· Arrange investigation activities of environmental experts from the World Bank, report to the World Bank and implement environmental management requirements and suggestions by the World Bank.

·Summarize semiannual report on environmental management progress, submit it to the World Bank for review, and coordinate with other relevant departments to solve major environmental problems.

·Check the implementation of environmental protection measures, at least once for every half a year.

· Prepare, supervise and implement relevant rules and regulations on environmental management.

·Implement all the funds required for environmental protection

· Urge and ensure that environmental design measures required by Environmental Codes of Practice is implemented and that work design meets the requirements of Environmental Codes of Practice.

· Supervise and ensure that work construction contract contains environmental protection measures put forward in this Environmental Codes of Practice.

·Check the implementation of environmental protection measures, at least once for every one month.

·Employ, supervise and coordinate environment supervisor.

·Organize and implement environmental management training program.

· Employ, organize, arrange and assist environmental panel of experts and other consulting work.

·Special environment work (borrow area, spoil area treatment, etc.).

·Record and sort complaints in work construction and operation process, report to the Project Management Office, reply treatment results to the public and solve the public's complaints.
·Review environmental supervision and environmental consulting report.
· Impose a fine to the construction unit when environmental protection measures are not be properly taken.
·Prepare summary or special report for environmental management stage.
·Receive and accept inspection on environmental work.
· Other matters (document management, inter-department coordination, publicity, report, etc.).

2.2.2 **Supervision Agency**

(1)Environmental Supervision of the World Bank

According to the requirements of loan agreement signed by and between the Chinese government and the World Bank, the Bank will assign the supervision mission to conduct special inspection for work implementation every year, including the execution situation of project loan agreement, implementation situation of environmental management plan, etc., the specific work is being responsible for by environmental technology experts from the supervision mission.

(2)Competent Administrative Departments of Environmental Protection at All Levels

Competent administrative departments of environmental protection at all levels supervise and manage this project across the process according to law, including: examination and approval of environmental impact assessment report, environmental protection supervision and management in work construction, trial operation and operation period, meanwhile, competent administrative departments of environmental protection at all levels and their environmental monitoring agencies will conduct random inspection to environmental protection measures taken by the construction unit; checking on-site environmental supervision report; rectification measures should be put forward if environmental damage and the construction behavior not complying with environmental protection measures suggested according to environmental impact assessment and examination and approval requirements occur in construction process.

(3)Environmental Monitoring Agency

· Carry out relevant laws, regulations, policies and rules provided by the state and local government on environmental protection.
· Entrusted by competent department of environmental protection to conduct site supervision and inspection for the execution of environmental protection laws and regulations in work construction and operation process according to law and have them disposed in accordance with the provisions.
·Collect pollutant charge and sewage charge for waste water, waste gas, solid waste, noise, radioactive substance exceeding standards.
· Participate in investigation and handling of environmental pollution accident and disputes.

2.2.3 **Implementing Agency**

Biogas pipeline laying works contractor is the implementing agency of the work, and also the implementing agency of environmental protection measures in construction period. During the whole process of work construction, the construction unit shall carry out all formulated environmental protection measures in the construction period, and accept supervision and inspection from project management agency and supervision agency in terms of environmental protection.

2.2.4 **Consulting Agency**

(1)EIA institute
Accept entrustment to prepare Environmental Codes of Practice and other EIA documents in combination of the actual project conditions.

(2)Design institute
Accept entrustment to prepare feasible research report and construction design scheme, and ensure that the measures and schemes in Environmental Codes of Practice are implemented into preparation results.

(3)Environmental Supervision Agency
Environmental supervision agency is entrusted by County PMO to conduct site supervision and management to the construction unit in the construction area and living camp, ensure that the construction unit complies with relevant Chinese laws and regulations on environmental protection in the construction process, and ensure that the construction unit implements all environmental protection measures provided in Environmental Codes of Practice.

The main responsibilities include:
· After accepting entrustment, environmental supervision agency shall formulate technical scheme on environmental supervision according to the requirements of consulting agencies and competent administrative department of environmental protection, and report environmental supervision staff, technical scheme and entrustment contract to competent administrative department of environmental protection for filing.
·Inspect whether environmental protection design scheme for construction project meets the requirements of consulting unit and competent administrative department of environmental protection and relevant technical specifications, and put forward written modification opinions to the construction unit and design unit.
· Examine and approve on-site environmental management plan formulated by the contractor.
· Supervise and inspect the measures on domestic sewage treatment, production wastewater treatment and soil erosion prevention, measures on exhaust gas, dust and

noise control, measures on production and domestic garbage treatment, and hygiene and disease control measures, etc. in the construction area.

·Fill in the checklist in the annex to Environmental Codes of Practice (at lease once a week).

· Put forward rectification scheme for relevant environmental protection problems encountered in the construction activities carried out by the construction unit and follow up its implementation.

· Prevent the contractor from conducting activities or behavior in violation of environmental protection.

· Once it is found that the construction behavior of biogas pipeline laying works contractor is not compliance with environmental protection requirements, resulting in adverse environmental impacts or receiving complaints on environmental protection in the project area, it shall carry out corresponding investigation, report to the county implementing agency and seek for solution. At the same time, issue environmental rectification notice to the contractor (see Annex 3), and supervise the contractor to take appropriate corrective measures.

·Ensure the construction unit prepares and submits monthly environmental report for construction period.

· Inspect monthly environmental report, put forward disposal considerations as for various problems encountered in the work, where environmental protection measures for the construction meet ECOP requirements, monthly environmental report is reported directly to the county implementing agency for filing. Where the requirements are not met, the rectification opinion shall be given to the construction unit. Where the rectification meets the requirements of Environmental Codes of Practice, the inspection for the current month may be passed, and monthly environmental report may be completed and reported to the county implementing agency for filing; where the rectification fails to meet the requirements of Environmental Codes of Practice, it shall be reported to the implementing agency at provincial level to coordinate rectification measures.

·Observe whether the construction activities affect the normal life of the people surrounding the construction area, and determine whether the construction unit needs to take additional protection measures.

·In case the construction unit does not take appropriate measures, it is suggested that the county implementing agency imposes a fine to the construction unit

2.2.5 **Monitoring Agency**

(1)Environmental Monitoring Agency

Environmental monitoring agency is local environmental protection monitoring station entrusted by PMO to be responsible for environmental monitoring work in project construction and operation period, and provide scientific basis for environmental pollution control, environmental management as well as regional environmental protection in work construction and operation period.

(2) Soil and Water Conservation Monitoring Agency

Soil and water conservation monitoring agency is the qualified unit entrusted by PMO to be responsible for soil and water conservation monitoring work in project construction and operation period, ensuring work construction safety, timely grasping dynamic changes in soil erosion during construction, understand the implementation and control results of various water and soil conservation measures, and reduce newly increased soil erosion to the lowest level.

2.3 **Personnel Allocation Required for Environmental Management**

To better perform environmental management responsibilities, it is suggested that all management agencies allocate relevant personnel according to the requirements of Table 2-2.

Table 2-2 List of Personnel in Charge of Environmental Management

Agency	Personnel Setting and Qualification Requirements
PMO	Leader in charge: one person, shall be held concurrently by the person chiefly in charge of project management office; project environment administrator: one person, shall hold senior professional post in environmental science-related specialty
Project owner	Leader in charge: one person, in charge of the county implementing agency Designated person responsible for environmental protection of the project, shall have basic knowledge on environmental protection and management
Biogas pipeline laying works Contractor	Site environment engineer: 1-2 persons/construction site, shall obtain corresponding operation qualification
Environmental Supervision Unit	Environmental supervisor: 1-2 persons/construction site, shall obtain corresponding qualification

2.4 Environmental management tasks at different stages of this project

Environment management task Environment management task (EMT) varies from project implementation stages, as shown in Figure 2-2. The most important work of environment management plan is to make sure all EP measures are put into practice, including ① measures incorporated into environment management plan during project design and contract stage; ② check efficiency and implementation status of EP measures by monitoring construction unit's work; ③project acceptance, daily supervision during operation period, check mechanism, report mechanism and file mechanism of environment management plan. Timeliness is reflected by checking daily work.

2.5 Workflow of implementation of Environmental protection practice in the process of Construction

In the process of construction, task of environmental supervisor is to check whether the environmental protection measures meet the requirements of ECOP. Environmental supervisor shall check the construction site at least once a week, fill in the "Construction inspection checklist of Environmental protection" and archive it. Propose the reform program according to the environmental issues and follow up its implementation, report to PMO managers and WB experts

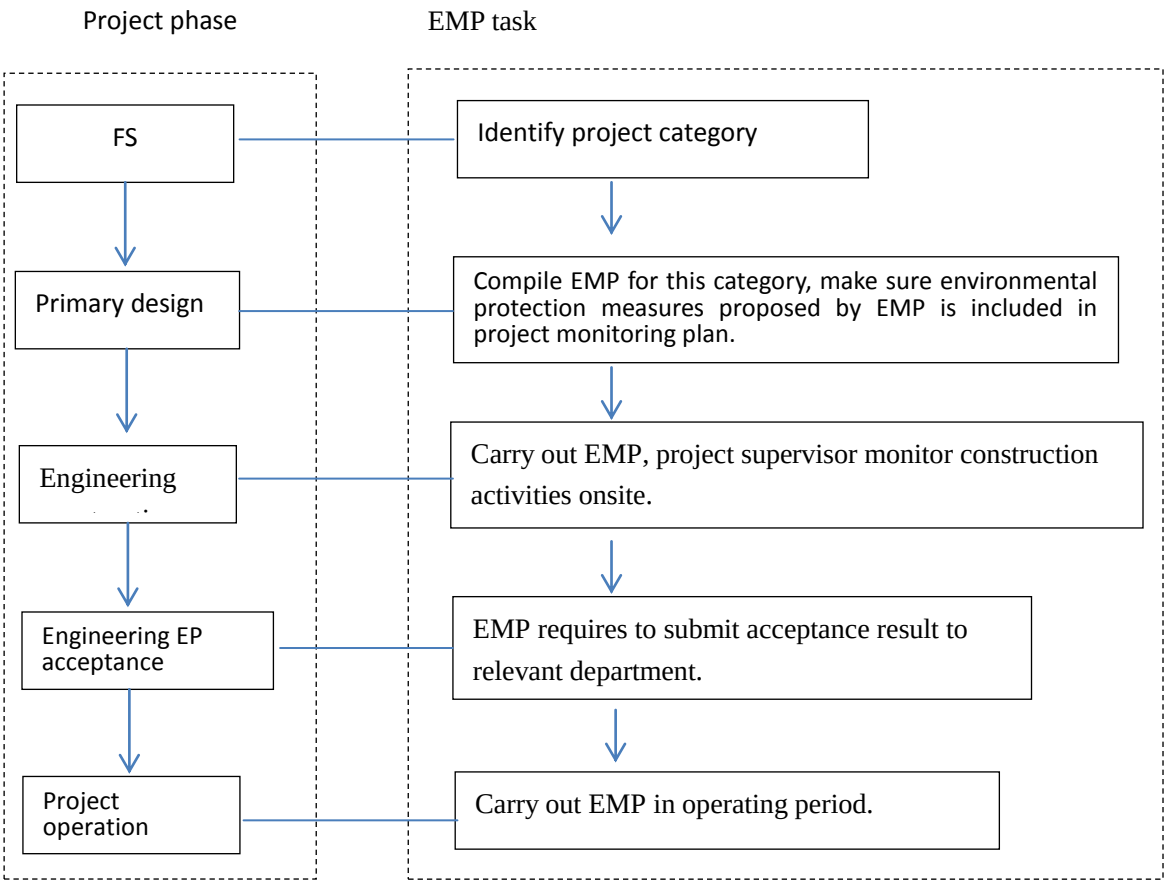

Figure 2-2 Environment management task

every six months. Refer to Figure 2-3 for the environmental supervisor workflow in construction.

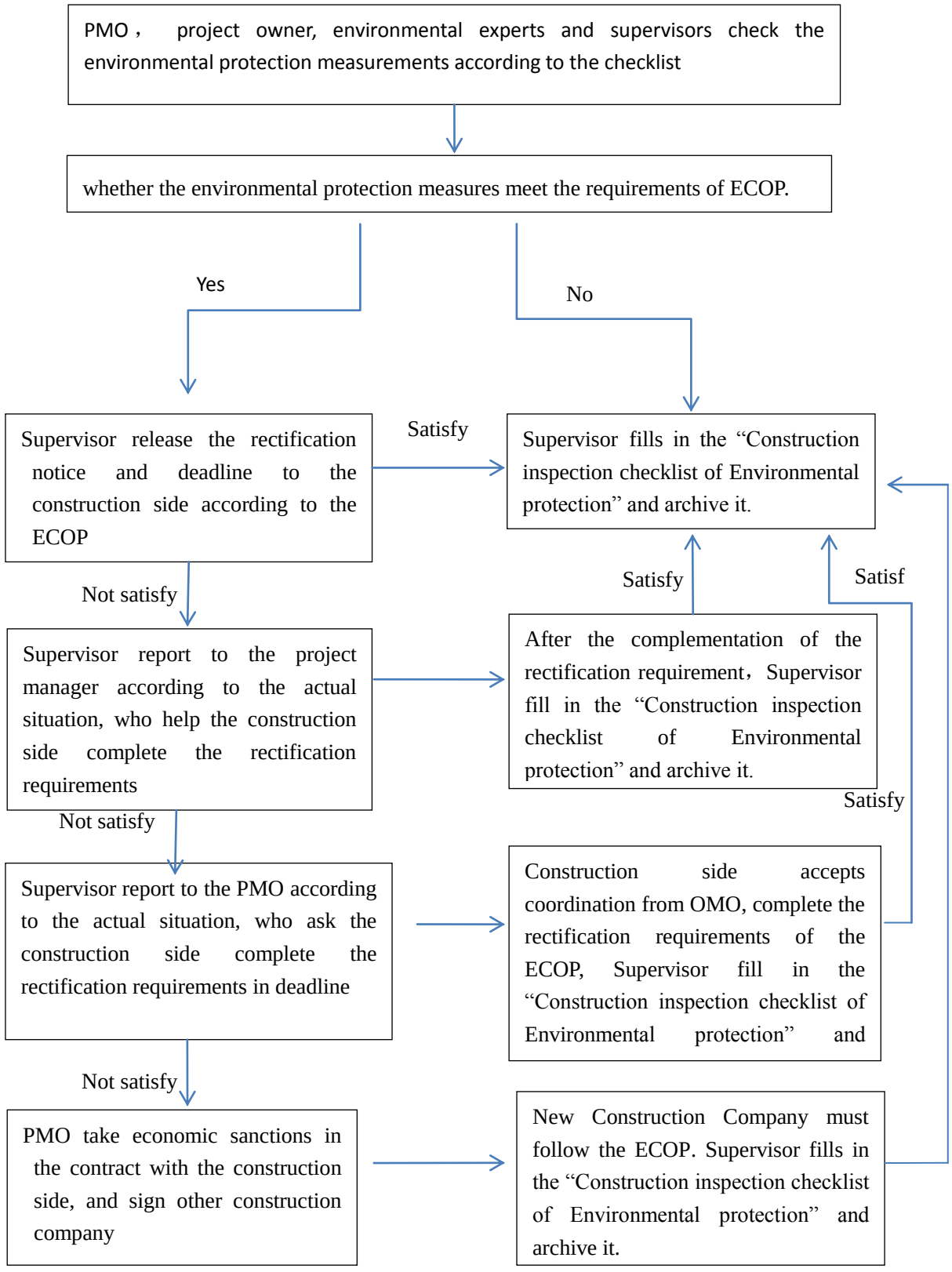

Figure 2-3 Environmental supervisor workflow in construction

2.6 **Document management**

In the implementation process of ECOP, all parts (including WB, PMO, project owner,

construction company, EIA company and environment supervisors)have to make corresponding document management. Refer to Table2-3 for detailed requirements.

Table 2-3 Document management requirements

Organization Name	Document management
① construction company	Record construction situation weekly, archive and report to environment supervisor； Fill in the construction site checklist together with environment supervisor before the construction, archive and report to environment supervisor； After receive the rectification notice, complete the rectification in 3 days (in 10 days if need the coordination of PMO）, archiving.
② environment supervisor	Record construction situation weekly, archive and report to project owner； Fill in the construction site checklist together with construction company before the construction, archive and report to project owner； In case of emergency or unexpected situations, record the embodiments taken by the construction company, archive and report to environment supervisor； Propose the reform program according to the environmental issues and follow up its implementation, release the rectification notice, checklist, and archive them.
③ EIA company	Write the ECOP, archive its first draft, draft for review and draft for approval.
④ project owner	Write and archive environmental management regulations for subproject; Archive EIA draft for approval and its approval; Write and archive environmental management training plan for subproject; Organize thematic research or relevant investigations, make archiving of these files; Make records of the complaints occurred during the construction and operation, make archiving of these files; Record and archive the reports from the environment supervisor every three months, archive and report to PMO(in report form); Read and sign the construction site checklist reported by the construction company and environment supervisor, check the environmental sensitive issues and archive it. Archive the reported environmental rectification notice.
⑤ PMO	Supervise the implementation of ECOP, archive; Record and archive the reports from the project owner every 6 months, archive and report to WB; Consult and solve major environmental issues, record and archive the specific measures adopted.

⑥ WB	Record and archive the reports from the PMO.

3 General Requirements of Environmental Codes of Practice

In the process of project construction, biogas pipeline laying works contractor plays a key role in the implementation of environmental management and pollution control and prevention measures, etc.. In order to enforce Environmental Codes of Practice, the contents listed in this section are applicable to general requirements of all main units during construction. The construction unit is urged to execute all environmental measures presented in ECOP under the coordination, supervision and management of all management agencies.

3.1 **Implementation of Environmental Measures in the Process of Construction Drawing Design and Bid Document Preparation**

In project implementation stage, relevant procurement activities will be carried out in accordance with the Procurement Guidelines of the World Bank. All government organizations at county/city level involved in the project shall, under the coordination, guidance and supervision of PMO, require bid preparation units to incorporate mitigation measures put forward for potential adverse environmental impacts in Environmental Codes of Practice into technical specifications of the bid document and construction drawing design. In bid documents, the tenderer is required to make the following commitments as for environmental management requirements and to have them incorporated into biogas pipeline laying works contract.

·Biogas pipeline laying works contractor is required to allocate 1-2 site environment engineers for each construction area in order to implement environmental protection measures across the whole construction period, to ensure work construction activities and the construction activities of subcontractor (if any) meet all the requirements of this Codes of Practice, and to ensure necessary environmental protection measures are taken in the construction process.

· In the construction process, contractor shall communicate and negotiate with the public in the area where the project locates, with bulletin board being placed at the access of each construction area to inform the public exact construction content and time. Meanwhile, contact person and phone number shall also be provided so that the public is able to make complaints and provide suggestions.

· The contractor shall actively cooperate with environmental supervision unit entrusted by the owner to carry out all environmental supervision work during construction period.

· The contractor must incorporate “Management Plan for Construction Site” into its construction scheme after signing the contract and before commencing the construction.

· The contractor must follow relevant local regulations on safe and civilized construction.

· Biogas pipeline laying works contractor and construction supervision unit are required to accept relevant training on environmental protection and management before commencement of the construction.

· For severe environmental impacts arising from the failure to comply with environmental protection measures put forward in Environmental Codes of Practice, environmental supervisor or biogas pipeline laying works contractor must take timely remedial measures and inform corresponding County PMO within 24 hours. The county implementing agency shall supervise and assist biogas pipeline laying works contractor to take remedial measures while the latter must record the implementation of the measures and report them to construction supervision unit and the county implementing agency.

· The contractor shall reserve in project contract fund the deposit relating to environmental management as per annual budget, the amount shall be accounted for about 3% of the budget.

3.2 **Preparation Before Commencement of Work**

After awarding the bid and before commencing the construction of biogas pipeline laying works, The implementing agencys of all counties and cities shall, under the coordination, guidance and supervision of PMO, provide the text of Environmental Codes of Practice for biogas pipeline laying works contractor and implement environmental supervision agency.

After completing bidding work and signing the contract, biogas pipeline laying works contractor shall conduct research on construction site before commencement of work, the purpose of the research is to identify environmental restrictive factors in this work area. Prior to the construction of biogas pipeline laying works, construction site checklist must be made and filled in to check the sensitivity of all environmental factors in construction site as an important basis for environmental protection in future biogas pipeline laying works.

The purpose of pre-approaching construction site checklist is to identify relevant environmental safety problems, identify and screen out environmentally sensitive problems needing special protection, see Annex 1 to the Codes of Practice for the contents that shall be included for details.

According to the inspection results for construction site, biogas pipeline laying works contractor shall prepare *Environmental Management Plan for Construction Site*, which shall implement the requirements of Environmental Codes of Practice (ECOP), and obtain the permission from environmental supervision agency.

3.3 **Environmental Management of the Construction Site**

In the construction of biogas pipeline laying works, biogas pipeline laying works contractor shall be subject to the supervision of environmental supervision agency entrusted by corresponding the county implementing agency.

Biogas pipeline laying works contractor shall carry out various environmental protection measures according to environmental management requirements in the contract and by referring to *Environmental Management Plan for Construction Site* permitted by environmental supervisor. Environmental supervision agency shall conduct direct whole-course environmental supervision for the implementation of environmental protection measures taken by the contractor, meanwhile, competent administrative department of environmental protection of the place where the project locates and its environmental monitoring agency and the public involved in the project will carry out external environmental management and supervision.

Throughout the construction period, biogas pipeline laying works contractor shall actively cooperate with environmental supervision agency and environmental monitoring agency in performing their duties, see "2.2 Duties of the Agencies Under Environmental Management System" for the duties of environmental monitoring agency.

Construction company should work closely with local government departments and other relevant departments to ensure a full compliance with the national policies and regulations. Refer to chapter4~14for detailed environmental protection measures.

3.3.1 Whole-process environmental supervision

The main tasks of environmental supervision include:

Responsible for the supervision of the construction activities and other relevant activities of the construction company, ensure the compliance with environmental requirements, environmental investments and environmental protect objectives, responsible for the coordination of relationship with departments like land management and environmental monitoring departments.

Provide daily supervision and guidance for construction company, ensure the compliance with ECOP requirements;

Track and monitor the implementation of environmental measures taken by the construction company to avoid or mitigate the negative environmental influence;

In case of finding not satisfied environmental requirements or complaints from surrounding residents, environmental supervisor should take immediate investigation, report to project owner or local environmental protection departments, and try to find solutions. Rectification notice should be given to the construction company (Annex 3), and rectification measures should be taken accordingly.

Stop any construction activity or behavior that might violate environmental requirements;

Provide environmental protection training for construction company, to avoid or mitigate

the negative environmental influence;

Record construction situation weekly, Fill in the construction site checklist(Annex 2)， and put it into “Construction site Environmental supervision reports ”, report to PMO regularly.

After the construction while before the environmental inspection, take an environmental supervision, fill in the pre-environmental inspection checklist (Annex 4), and archive it.

3.3.2 Environmental protection department supervision and Public opinion

In the whole process of construction, construction company should work closely with local government departments and other relevant departments to ensure a full compliance with ECOP. Provide sufficient information to the public that live within the environmental influence scope, especially the information of the construction behaviors that might influence public safety, or things prejudicial to public interest, or sensitive areas, or construction temporary dumps. Local environment protection departments should make spot-checks on construction environmental protection measures, receive checklist of construction site environment supervision, and take administration measures accordingly; arrange emergency measures in case of abnormal environmental conditions.

Construction company make sure that public be noticed in advance about the construction company’s name, environmental management coordinator’s name, their phone numbers, possible environmental influence and lasting time, preventive measures, etc.. Meanwhile, construction company must provide an open and transparent public participation model, provide counseling hotline and respondents office to receive public consultation and advice. Take immediate investigation according to the environmental issues raised by the public; guarantee to solve the environmental problems within the shortest time.

3.4 Rectification Measures for Non-compliance with the Requirements of Environmental Codes of Practice

Biogas pipeline laying works contractor and its subcontractor (if any) must abide by the requirements presented in Environmental Codes of Practice, where environmental pollution arising from the failure to abide by environmental protection measures presented in Environmental Codes of Practice occurs:

· Biogas pipeline laying works contractor shall immediately take measures to eliminate pollution sources and treat environmental pollution produced.

· Biogas pipeline laying works contractor shall inform environmental monitoring agency and project management agency within 24 hours, and the latter shall assist the construction unit to take remedial measures to eliminate adverse environmental impacts.

·Biogas pipeline laying works contractor shall record the implementation of pollution treatment measures, put forward rectification measures and submit it to environmental supervision agency and the county implementing agency for filing, and the county implementing agency shall report implementation of remedial measures to the PMO.

· Biogas pipeline laying works contractor shall analyze in depth the cause of environmental pollution, formulate preventive measures, perfect construction design scheme and completely eradicate the reoccurrence of similar accident, the preventive measures formulated shall be recognized by environmental supervision agency and the county implementing agency and filed.

· The county implementing agency shall punish biogas pipeline laying works contractor based on the nature of pollution accident and scope and degree of influence according to the provisions of the contract.

4 Construction site and equipment management

4.1Construction site management

(1)The measures of the Construction site cleanup pollution control should be taken as follows:

Dust suppression sprinkler should be used to reduce dust pollution;

Construction waste should be removed timely. Closed transport vehicles should be used for the transportation of earthworks, slag and construction garbage.

The excavation of roadbed and pipeline should be strictly controlled to avoid destruction of the surrounding vegetation. The felling of trees outside the construction area should be prohibited.

(2) The measures of the ecology restoration should be taken as follows:

Construction site vegetation should be restored to an extent, at least to the state before construction.

The arable topsoil stripped in the process of construction should be stacked in a relatively flat area, with bagged soil around as landing，and dust-proof network cover; There should be temporary gutters and grit chamber. The arable topsoil should be used for ecological restoration in the end of the construction.

(3) The measures of the construction noise control should be taken as follows:

The construction time should be strictly controlled. For construction sites within the scope of 150 meters from the residential areas, machines of large noise were prohibited working during 22:00~06:00.

Mobile or temporary sound barriers and other measures should be taken for sensitive points close to construction site (50meters or less).

Construction site should keep as far as possibler from school, hospital etc. construction work time of big noise machine should be consulted with school nearby. No construction during exam.

(4)Construction mark settings:

On the construction mark, there should be information such as construction and engineering schedules, service interruptions, temporary traffic detour routs and bus lines, relocation, etc..

Construction activities at night should be prohibited.

When continuous construction at night must be needed, the relevant formalities and announcements to surrounding residents should be made.

When the construction need to interrupt with municipal services (including water, electricity, telephone and bus routes, etc.), at least five days of announcements should be made to affected public, with the beginning and ending of interrupt service time.

（5）Construction hoarding setting:

For the construction activities that last more than 30 days, there should be hoarding; the material of the hoarding should be hard sheet material, its height should be greater than 2 meters for construction sites in general area, greater than 2.5 meters for construction sites in key area.

The hoarding should be straight, uniform, clean appearance and no damage. Its appearance should be coordinated with the surrounding environment.

For construction that occupy the road, the hoarding should be within 5 meters of the road intersection sight, the hoarding should be straight metal plate, do not block the sight of the vehicle drivers and pedestrians to ensure the safe passage of traffic. Stacks of all kinds of construction materials are prohibited around the hoarding within the range of 5 meters sight.

Prohibit the use of hoarding as retaining walls or other support facilities.

There should be hoarding for the pipeline works in key areas.

(6)Road bar setting:

For the pipeline construction activities that last more than 30 days, there should be road bars.

Prohibit the use of safety ropes with red white flags or other materials instead of road bars.

The road bars should be continuous, firm and closely linked, uniform and clean, no damage.

For the roads that keep traffic, when the open or raise of the under wells covers is needed, there should be road bars around.

The long side section of the base channel steel of the road bars should face the construction site. If construction passage is needed, the width of the passage should be greater than 0.6 meter.

Construction company should be lateral printed on the road bars, and the use of road bars with wrong construction company name on it is prohibited.

There should be road bars around for the construction works that under exterior painting or cleaning, all equipment, tools and materials should be within the road bars.

The road bars should not be removed untill temporary traffic measures are taken or the completion of the construction.

In key areas, pipeline construction should be conducted by sections, whole line excavation operations should be prohibited.

(7)Temporary road setting:

Constructions that occupy the city roads should have approval formalities issued by the public security department of transportation and the highways department, set temporary roads according to the relevant specifications.

Keep strict compliance with the licensing regulations. Prohibit occupy of road without authorization, or constructions beyond the licensing.

For those that need to occupy city roads and have influence on traffic, temporary roads should be set according to relevant provisions.

For those that need to occupy city roads that nearby the entry of business, corporate, office or residential buildings, there should be firm, smooth, continuous sidewalk with security fence.

In the condition that the construction need to excavate pipeline trenching pits or pits on the city roads, and the work can’t be finished in the same day, flat coated steel construction method should be used

When the width of the pipeline trenching is larger than 0.8meter, there should be metal profiles supports beneath the flat coated steel.

The metal profiles supports scheme should pass the safety demonstration, and get the approval of the construction company; the thickness of the flat coated steel should be greater than 0.03meter. The edges of steel plates and slope frame should be polished, to ensure the safety of pedestrians.

4.2 Construction equipment management

(1) Oil leaking control measures:

Advanced equipment should be used in order to reduce the oil drops and leaking effectively.

Solid-state absorbing material (such as cotton, sawdust, oil-absorbing paper) should be used to avoid the generation of more waste water.

The maintenance of construction equipment should be concentrated at repair points of individual road section s to facilitate the collection of oily water.

There should be advection sedimentation tank at mechanical maintenance sites. Oily water should be treated with acid-base balance, precipitation, grease traps, slag removal, etc. before discharge. After the construction, the sedimentation tank should be buried and greened.

The ground of the mechanical maintenance sites should be sclerosis and anti-seepage treated, to avoid soil pollution by the dripping oil.

Build equipment repairs & maintenance records; keep regular maintenance of the equipment.

(2)Equipment operation noise control measures:

All equipment should comply with the relevant national standards, low noise machines should be used in construction.

Kept good maintenance and repair of all kind of equipment, in order to maintain their good running (to reduce noise and vibration)

(3) Equipment exhaust gas control meaqsures:

All equipment complied with national health protection standards for construction equipment and transport vehicles, to ensure that gas emissions comply with the relevant national standards.

(4) Solid waste control measures:

Abandoned hazardous waste such as oil and chemical solvents should be stored centrally in accordance with their nature, and qualified departments should be entrusted for the processing; clear signs for hazardous waste temporary dumps should be set up, and follow the “hazardous waste storage pollution control standards”(GB18597-2001).

Recyclable hazardous waste should be recovered by the material supplier, the according responsibilities should be clarified in the material procurement contracts.

Qualified departments should be entrusted for the processing of sporadic hazardous waste (oil gloves, gauze top, etc.).

The oil leaked into the soil should be collected using scraping device, sequestrated and transported to qualified departments for centralized treatment.

When the maintenance of construction equipment can’t be concentrated at repair point of individual road sections, solid-state absorbing material (such as cotton, sawdust, oil-absorbing paper) should be used, and transported to qualified departments for centralized treatment.

5 Ambient air quality management

The main pollution in construction is dust and vehicle exhausts.

5.1Construstion dust

There should be sprinkle dust suppression and watering in dry seasons, to reduce dust pollution.

Bare slope should be covered with dust suppression network or have water spray measures, in order to avoid dust pollution.

Soil of pipeline excavation should be daily cleaned.

The slag stack height should not be higher than the hoarding or road bars.

Vehicles carrying powder should be covered and cleaned before leaving the construction site.

When transporting powdered materials, it must be wetted.

Any remaining dust material must be wetted and cleaned after the removal of the stacks.

Dusty road surface must be hardened and watered.

The amount of water used for dust suppression should not affect the local surface water or local community water use.

Construction must be finished in specified time, in order to reduce air pollution.

Construction materials in transportation should be properly covered and bounded firmly. Ensure that vehicle carrying earthwork or slag is not overloaded, to prevent spills.

When choosing the location of the material stack, the wind direction should be considered, avoid treating powder materials at upwind direction of the sensitive objectives.

Dust suppression measures should be taken for material stacks.

A reasonable route for solid waste transportation should be determined, try to choose routes with flat surface to avoid bumps and dust emission.

There must be watering operation during demolition work.

There should be marks that instructing speed limits on the construction roads which construction vehicles must comply with.

5.2 vehicle exhausts

Construction equipment and vehicles with good operation conditions should be chosen.

Construction equipment and vehicles exhausting fuel should be operated under normal conditions.

Kept good maintenance and repair of all kind of equipment, in order to maintain their good running.

6 Sound environment quality management

Noise during the construction is mainly operation noise of vehicles and construction equipment (such as excavators, bulldozers, cranes, generators, etc.). in order to reduce the noise impact during construction, the following measures should be taken:

Select advanced and reliable low-noise equipment;

Construction time 6:00-12:00, 14:00-22:00 should be strictly controlled. Construction activities at night should be prohibited. When continuous construction at night must be needed, the relevant formalities and announcements to surrounding residents should be made.

Arrange construction time reasonably, to avoid large noise machines operation at the same time and same construction site. Noise time should be shortened.

Damping base was installed for fixed machines with large vibration;

Efforts should be made to increase the environmental awareness of managers and construction works. Keep abreast of the local customs and habits, so to make reasonable arrangements for the transport time. In environmental sensitive areas such as residential, speed limit, whistle ban and other measures should be taken to reduce noise.

Large noise equipment should be located as far as possible away from the residential side of the construction side. For construction sites within 5 meters of the residential, schools, hospitals, there should be noise reducing hoardings.

Operators wore earplugs to protect hearing, the construction site used low-noise equipment

Kept good maintenance and repair of all kind of equipment, in order to maintain their good running (to reduce noise and vibration)

Strengthen the management requirements on construction intensity, equipment and vehicle operations, etc.

7 Water environment quality management

For construction sites with hoardings, there should be lateral gutters (connected with the drainage system) at the inside of the entrance.

Gutters for vehicle washing should be designed according to the size of vehicle. The surface of the gutters should be smooth treated with ready-mixed mortar products. Strong bearing capacity metal plate should be placed on the notch.

Sedimentation tanks with enough capacity should be set. The sedimentation tanks require regular desilting, and the sludge should be treated according to the solid waste treatment.

Domestic sewage must be drained into septic tank, and properly handled afterward.

Construction must be finished in specified time, to reduce the production of waste water.

Waste water that discharged into surface water or sewer must comply with the national water environmental protection laws ang regulations.

There should be specific personnel who responsible for the cleaning of the ducts, dark wells and sedimentation tanks, in key areas 3 times per month, in general areas 1 time per month.

Prohibit the direct discharge of mud or muddy water into the city pipes.

Public roads/ places, entrance, temporary fence, etc. should be kept clean.

Waste water discharge point must be clearly positioned.

8 Ecology protection management

Construction site layout should be reasonably arranged, to reduce the scope of the construction activities, and reduce the vegetation damage.

Construction materials such as stones, sand, cement, etc., should be transported according to the use, to reduce the vegetation damage.

After the project is completed, construction site should be timely cleaned, greened, restore the vegetation to maximum extent.

According to the construction site check list, there should be no felling of trees. Set temporary protection fence for the existing trees.

No signs except identification label can be added on the trees, no construction material or equipment should be located in the tree protection scope.

There should be temporary drainage in construction site. For surface flow destroyed by construction, there should be flood divert channel, which can divert the flood during the rainy season, to avoid runoff erosion to the project.

Under the premise of construction quality, try to shorten the earthwork construction time, maintain the stability of cut or fill slopes, to reduce the impact outside the construction range.

Finish the ecology restoration of the construction site before the construction inspection.

Ecological restoration should follow the following principles:

① Stripped surface soil should be used for the restoration of ecology.

② A combination of grass, bushes and trees should be used during greening; no empty land should be leaved, in order to prevent the invasion of alien species.

③ No alien species should be used

Areas need ecological restoration includes:

① The disturbed areas around the red line of construction main road;

② Land within the range of construction site；

③ Sidewalk opened up for construction;

④ Borrow soil and slag fields.

9 Solid waste management

According to relevant laws and regulations, solid wastes such as construction waste, slag and domestic garbage etc. should be properly collected and treated.

Construction waste should be made comprehensive utilization; the remaining part should be stacked at specific field, and transported to local landfill.

When cleaning construction waste, closed container of lifting should be used, volley throwing should be prohibited.

Construction waste should be separately stored and cleaned according to relevant provisions of the garbage management.

Appropriate amount of water should be applied during the construction waste clearance.

Domestic waste should be collected by the crash cans in the construction site, and then transported to the local landfill.

The stripped mellow surface soil can be used for ecological restoration, the remaining waste earthwork can be used as mat soil of the roadbed and channel.

Incineration of toxic or hazardous substances is not allowed, hazardous substances should be treated according to relevant requirements.

10 Public participation

Construction company should provide enough information to the affected public, especially to those who are directly affected by the construction, the main measures to be taken are as follows:

At the entrance of the construction site, there should be bulletin board with information (such as project name, construction content, start and finish time, etc.)on it.

Specialists of EIA should be consulted to answer public questions on environmental protection.

When continuous construction at night is needed, the relevant formalities and announcements should be made to surrounding residents.

When the construction need to interrupt with municipal services (including water, electricity, telephone and bus routes, etc.), at least five days of announcements should be made to affected public, with the beginning and ending of interrupt service time.

All recording of comments, questions and answers, response, etc., should be archived, and accept the supervision of oversight bodies.

11 Environment supervision plan

In the environment supervision plan, the duties of the environmental supervisor were outlined, according to the requirements of both project quality and environmental quality.

11.1 Scope of environment supervision

Areas along the biogas pipeline laying works, mainly the areas polluted by the construction activities.

11.2 Content of environment supervision

Review the implementation of ECOP environmental protection measures in the engineering design plan, construction drawing design.

Help the construction company to complete the environmental training for the manager and works.

Review the environmental protection clauses in the project contract.

Supervise the environmental quality of water, sound and air, as well as the environmental measures taken in the construction. Make stage acceptance according to the standards.

Make system recording of the environmental impact, the effects of environmental protection measures and the implementation of environmental protection.

Reflect the unexpected problems occurred in the environmental protection and construction, propose suggestions and solutions.

Responsible for the environmental supervision work plan and summary.

11.3 Environmental supervision Framework

(1)Establish and improve environmental protection system

Requires full-time environmental staff make quality management in accordance with the quality requirements of both environment and project in the supervision. Accept supervision from PMO, project owner, environmental experts and EPA.

(2) Formulate environmental management measures and implementing rules

Formulate environmental management measures and implementing rules according to project characteristics.

(3) Establish environmental supervision work system

① work record, ， namely “supervision diary”, descrip patrol inspection and environmental problems, analysis the cause and responsibility unit of the problem, initial treatment advice etc..

② reports: Main channels of communication, including the monthly, quarterly and half-yearly progress assessment of the environmental supervisor, and the “ monthly environmental report” of the construction contractor.

③File notification: Environmental supervisor and construction contractor communicate by document delivery and conformation letter, emergency notification can be verbal, but afterwards still need to be confirmed in writing papers;

④Regular Environmental meeting: hold environmental meeting once a month to

review the work of environmental protection, raise problems and rectification requirements, form implementation plans.

12 Occupational Health and Hygiene & Disease Control

12.1Occupational Health

(8) The construction site shall set warning signs or warning instructions at operating post, equipment and place vulnerable to occupational hazards.
(9) Regularly conduct occupational health training and physical exam for personnel engaged in poisonous and harmful operation, and guide operating personnel to correctly use occupational-disease-prevention equipment and individual labor protection articles (at least once a year).
(10) The construction unit shall provide safety helmet, safety belt and safety shoes matching with the type of work that construction personnel are engaged in and other individual labor protection articles.
(11) The construction site shall adopt low noise equipment, promote the use of automatic and closed type construction process, and reduce mechanical noise. When operating, the operating personnel shall wear ear plugs to protect hearing.
(12) Anticorrosive and waterproof operation in basement where good natural ventilation cannot be guaranteed shall be equipped with mandatory ventilation facilities. The operating personnel shall wear respirator or protective facial mask in the workplace with toxic or harmful gases.
(13) In the workplace with dust, sprinkling and other facilities shall be taken to reduce dust concentration, the operating personnel shall wear dust protecting mask; when conducting welding operation, the operating personnel shall wear protective mask, safety goggles, gloves and other personal protective equipment.
(14) When conducting high temperature operation, the construction site shall be equipped with sunstroke prevention and cooling items, with work-and-rest timetable being reasonably arranged.

12.2 Hygiene & Disease Control

(11) Staff meals, drinking water and rest area at construction site shall conform to hygiene standards.
(12) Dormitory, canteen, bathroom and toilet shall be equipped with ventilation and lighting facilities, daily maintenance shall be responsible for by special person.
(13) The dormitory at construction site shall adopt open-type window, the beds in the dormitory shall not exceed two layers, a wide bed for a number of people is strictly prohibited.
(14) The canteen shall obtain effective sanitary license issued by competent authority, all kinds of appliances are standard and clean. The canteen workers shall hold effective health certificate.
(15) The canteen shall be set at the place far away from toilet, refuse storage area, toxic and harmful pollution sources.
(16) The canteen shall set independent food preparation room and storage room, the lower part of door leaf shall set rat guard no less than 0.2m.

(17) Toilet, sanitation facilities, drainage ditch and damp area shall be disinfected on a daily basis.
(18) The living area shall set closed container, with daily fly killing and timely cleaning.
(19) The construction site shall health center, equipped with health kit, commonly used drugs and bandage, tourniquet, net collar, stretcher and other emergency equipment.
(20) When the construction personnel develop infectious diseases (statutory infectious diseases include: atypical pneumonia, plague, cholera, viral hepatitis, bacterial and amebic dysentery, typhoid and paratyphoid fever, HIV/AIDS, gonorrhea, syphilis, polio, measles, pertussis, diphtheria, epidemic cerebrospinal meningitis, scarlet fever, epidemic hemorrhagic fever, rabies, leptospirosis, brucellosis, anthrax, epidemic and endemic typhus, epidemic encephalitis B, kala-azar, malaria, dengue fever, tuberculosis, schistosomiasis, filariasis, hydatid disease, leprosy, influenza, epidemic parotitis, rubella, neonatal tetanus, acute hemorrhagic conjunctivitis, infectious diarrhea disease), food poisoning and acute occupational poisoning, it shall be timely reported to the epidemic prevention department and competent department in charge of construction of the place where the project locates, and disposed in accordance with relevant regulations of the epidemic prevention department.

13 Preservation of Cultural Relics

According to related survey, there is no cultural relics in project construction area. In accordance with relevant provisions of Article 32 under *Law of the People's Republic of China on Protection of Cultural Relics* (October 28, 2002) "In the process of construction work or agricultural production, any unit or individual, once discovering cultural relics, shall immediately report to local administrative department of cultural relics, the relevant department, upon receipt of the report and if no special circumstance, shall rush to the site within 20 hours and put forward disposal opinion in seven days. The administrative department of cultural relics can report to local people's government and request it to notify public security organ to help protect the site; where important cultural relics are discovered, it shall immediately report to the administrative department of cultural relics of the State Council, and the latter shall put forward disposal opinions within 15 days upon receipt of the report. In accordance with the provisions of the preceding paragraph, the cultural relics found belong to the state, any unit or individual shall not plunder, privately distribute or hide.", as well as *Rules of Hebei Province on Protection of Cultural Relics* "any unit or individual, once discovering underground cultural relics in the process of work construction or production activities, shall immediately stop construction or production and protect the site, while at the same time reporting to the administrative department of cultural relics of local people's government. The administrative department of cultural relics, upon receipt of the report, shall rush to the site within 24 hours and put forward disposal opinions within three days." and "any unit or individual shall not obstruct the

personnel of the administrative department of cultural relics and archaeological excavation unit to conduct archaeological investigation, exploration and excavation. Before the end of archaeological excavation, any unit or individual shall not continue construction or production activities within archaeological excavation area without authorization. After the end of archaeological excavation, the administrative department of cultural relics organizing excavation work shall immediately notify in writing its disposal opinions to the construction unit.", this Environmental Codes of Practice puts forward the following administration requirements for cultural relics accidentally found during the construction period:

(5) If cultural relics are discovered during the construction period, the construction work shall be stopped immediately and the site shall be well protected rather than disposed arbitrarily, while at the same time immediately reporting to local administrative department of cultural relics.

(6) After the administrative department of cultural relics puts forward disposal opinions, the construction unit shall formulate special construction scheme for the section containing cultural relics according to the opinions issued by the administrative department of cultural relics, and may start construction only after obtaining the consent from relevant department, before the end of archaeological excavation, any unit or individual shall not continue construction or production activities in archaeological excavation area without authorization.

(7) Any unit or individual shall not plunder, privately distribute or hide the cultural relics discovered.

(8) See Figure 13-1 Disposal Process for Cultural Relics Discovered During Construction Period for details.

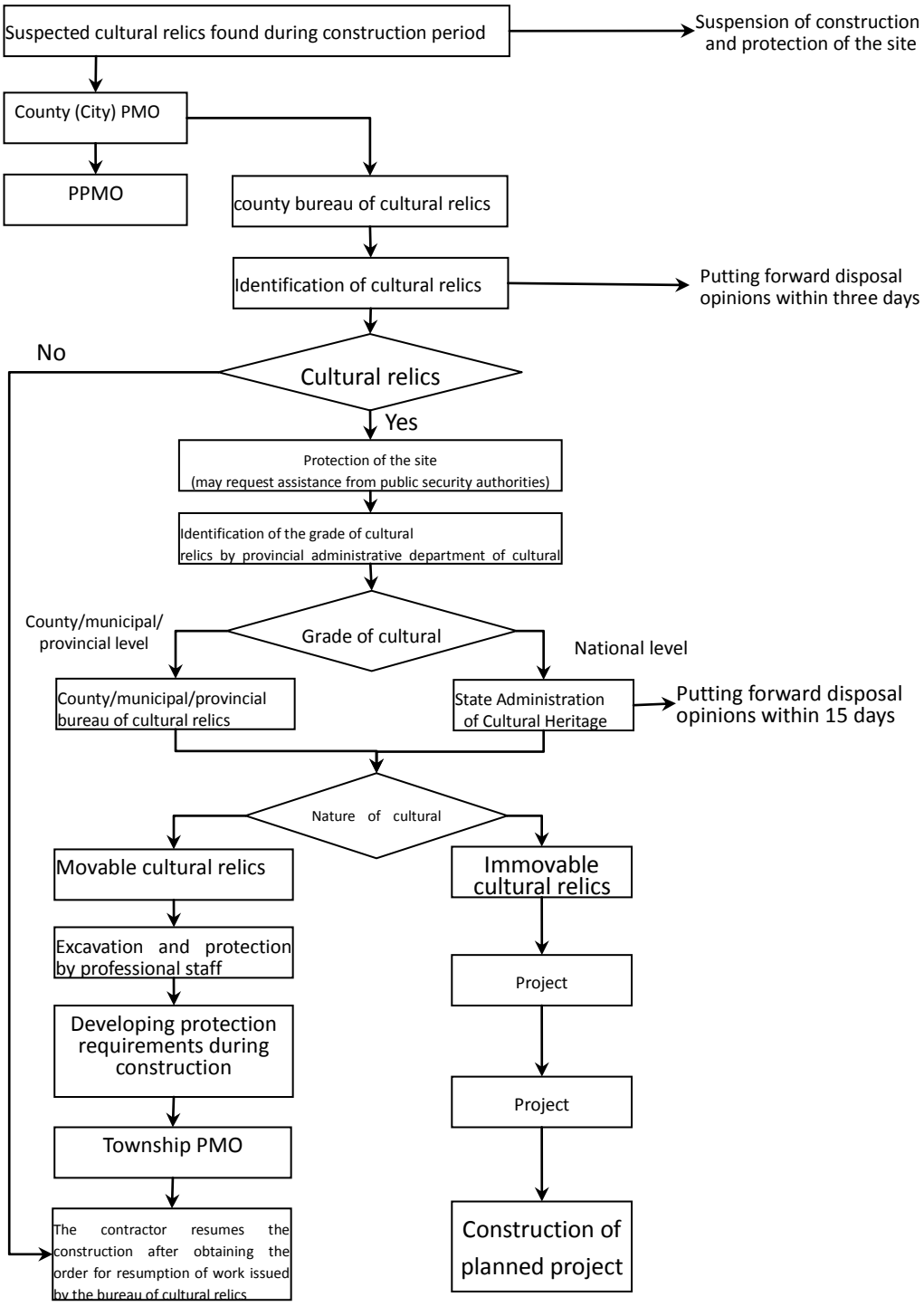

Figure 13-1 Procedure Chart for Disposal of Cultural Relics Found During Construction Period

14 Environmental protection training and education

Environmental training and education should include the following contents:

Before the project starts, project owners should assign environmental specialists for the environmental training of construction contractors and construction supervisors.

Construction contractors should hold environmental training and assessment for the workers, about laws and regulations of environmental protection, environmental sanitation.

Construction contractors should organize training and drills for the workers, about the environmental emergency contingency plans.

The construction contractors should organize regular occupational health examinations for the workers engage in toxic or hazardous work. The construction contractors should hold topic training for them to guide the proper use of personal protective equipment and occupational labor protection products.

Annex 1 Pre-Approaching Construction Site Checklist

Name of subproject: Contract Number and subproject location：

Name of work site: Weather：

Date： Time：

Inspected by:

No.	Environment issues	Yes	No	N/A	Remarks/ recommended action
1	The project is located in the national/ provincial/ county experimental nature reserve? (if yes, the project should be canceled)				
2	The project is located in the national/ provincial/ county nature reserve? (if yes, the project should have permission of relevant departments)				
3	The project land acquisition will cause a significant deterioration or alter of the natural environment in protected areas, proposed protected areas or areas with unique ecological significance				
4	The project will cause a temporary, or permanent, or any other form of influence to the cultural relics identified by nation/ province/ affected population informal discussion.				
5	There is known cultural relics heritage in aspects of archeology, history or culture (including tombs, catacombs, etc.)				
6	There is endangered species in project area (aquatic or terrestrial)				
7	There is natural habitat in project area				
8	There is wetlands, saturated soil zone in project area? (permanent or temporary)				
9	The project construction will cause short-term impact on the village infrastructure, service, or relevant resource use rights?				
10	There are many environmental protection objectives in the project area (hospital, School, villages, etc.)				
11	This project involves tree transplanting				

12	There are known existing power supply facilities (wires, poles, and transformers), communication facilities, and water supply or drainage facilities in the project area				
13	There is conflict between borrowed construction detour and local traffic				
14	Others (shall specify)				

Annex 2 Construction Site Checklist

Inspect Item				Inspect Result (Marked with"√")			Notes
				Yes	No	Not Involve	
Biogas pipeline laying ECOP			(1)The project has complete land use formalities				
			(2)The project made a survey of existing pipelines, in order to avoid the disrupting of existing pipeline in the process of construction.				
			Others (shall specify)				
Construction site management	Construction site environmental impact control	Surface clean up	(1)The construction company paid attention to dust suppression and watering, to reduce dust pollution				
			(2) The construction company removed construction wastes timely, and used close transport vehicles in the transportation of earth, construction muck and garbage.				
		Roadbed construction	(1) The excavation of roadbed and pipeline was strictly controlled to avoid destruction of the surrounding vegetation. The felling of trees outside the construction area was prohibited.				
		Slop repair	(1)The bare slope was timely repaired, in order to reduce exposure time.				
			(2)Bare slope was covered with dust suppression network or had water spray measures, in order to avoid dust pollution.				
		Vegetation restoration	(1) Construction site vegetation was restored to an extent, at least to the state before construction.				
			(2) The arable topsoil stripped in the process of construction was stacked in a relatively flat area， with bagged soil around as landing，and dust-proof network cover; There were temporary gutters and grit chamber. The arable topsoil was used for ecological restoration in the end of the construction.				
		Water conservancy facilities cross	(1) Dry season was chosen for construction, and construction time was shortened to reduce the disturbance of water body.				
			(3) The equipment was maintained to reduce the occurrence of leaking.				
			(4) The stack of construction materials like asphalt, oil, chemicals, etc. was prohibited nearby the water bodies.				

Inspect Item				Inspect Result (Marked with"√")			Notes
				Yes	No	Not Involve	
		ing works					
		Construction noise	（1）The construction time was strictly controlled. For construction sites within the scope of 150 meters from the residential areas, machines of large noise were prohibited working during 22:00~06:00.				
			（2）Mobile or temporary sound barriers and other measures were taken for sensitive points close to construction site (50meters or less).				
			(3) Construction was far from school, hospital etc. construction work time of big noise machine was consulted with school nearby. No construction during exam.				
		others	Burning of all types of waste was prohibited in construction site.				
	Construction site environmental control	Surface cleanup	(1) Sprinkler was used to reduce dust pollution.				
			(2) Construction waste was removed timely.				
	Road environmental impact control	Road dust	(1) Construction sidewalk was hardened according to its use.				
			(2) There was daily maintenance and cleaning for Construction sidewalk, sprinkler was used in dust sections.				
		Noise control	(1) Transport vehicles were maintained according to requirements of the "Construction equipment management".				
			(2) Comply with the requirements of "Construction traffic management".				
		Ecological	(1) Construction site vegetation was restored to an extent, at least to the state before construction.				
			(2) The arable topsoil stripped in the process of construction was stacked in a relatively flat area， with				

Inspect Item				Inspect Result (Marked with"√")			Notes
				Yes	No	Not Involve	
		impact control	bagged soil around as landing，and dust-proof network cover; There were temporary gutters and grit chamber. The arable topsoil was used for ecological restoration in the end of the construction.				
			(3) Protective treatment, pavement restoration and greening were made for the occupied or destroyed local roads.				
	Others (shall specify)						
Construction equipment management	Oil drop and leaking pollution control		(1) Advanced equipment was used in order to effectively reduce the oil drops and leaking, as well as the maintenance time.				
			(2) In the inevitable oil drop and leaking, solid-state absorbing material (such as cotton, sawdust, oil-absorbing paper) was used, in order to avoid excessive wastewater.				
			(3) The maintenance of construction equipment was concentrated at repair point of individual road section to facilitate the collection of oily water.				
	Equipment noise noise control		(1)Aall equipment complied with the relevant national standards, low noise machines were used in construction.				
			(1) Damping base was installed for fixed machines with large vibration;				
			(2) Kept good maintenance and repair of all kind of equipment, in order to maintain their good running (to reduce noise and vibration)				
	Equipment exhaust gas control		(1)All equipment complied with national health protection standards for construction equipment and transport vehicles, to ensure that gas emissions comply with the relevant national standards.				
	Solid waste control		(1) Abandoned hazardous waste such as oil and chemical solvents were stored centrally in accordance with their nature, and qualified departments were entrusted for the processing; clear signs for hazardous waste temporary dumps were set up, and follow the "hazardous waste storage pollution control standards"(GB18597-2001).				
			(2) Recyclable hazardous waste were recovered by the material supplier, the according responsibilities were clarified in the material procurement contracts.				
			(3) Qualified departments were entrusted for the processing of sporadic hazardous waste (oil gloves, gauze top, etc.).				
			(4) The oil leaked into the soil was collected using				

Inspect Item				Inspect Result (Marked with"√")			Notes
				Yes	No	Not Involve	
			scraping device, sequestrated and transported to qualified departments for centralized treatment.				
			(5)when the maintenance of construction equipment can't be concentrated at repair point of individual road sections, solid-state absorbing material (such as cotton, sawdust, oil-absorbing paper) was used, and transported to qualified departments for centralized treatment.				
	Others (shall specify)						
Chemical storage requirements			(1) When the paint, gasoline and diesel were delivered to the construction site, their package was carefully inspected. If there was leaking, the goods would be rejected.				
			(2) Dedicated storehouse was set for the storage of fuel and chemical solvents, etc., warning signs were setup; ground anti-seepage treatment was done, emergency incidents such as adsorption bags/ sand/ sawdust and other materials were prepared.				
			(3) Emergency plans were formulated, training for workers were made pre- construction.				
			Others (shall specify)				
Construction material field Environmental protection	Borrow fields environmental impact control	General requirements	(1) Earthwork balance was kept; if borrowing earth was needed, urban construction waste soil was preferred, single borrow pits was avoided.				
		Ecological impact control	(1) Surface soil stripped during construction was stacked in a relatively flat area, with bagged soil around as landing，and dust-proof network cover; was used for land reclamation.				
		Landscape control	(1)environmental protection measures were taken according to "landscape impact control" requirements				
	slag field	General	(1) Excess earthwork was firstly considered for recycling use in situ or transported to other construction sites, or borrows pits' restoration, to avoid single waste				

Inspect Item				Inspect Result (Marked with"√")			Notes
				Yes	No	Not Involve	
		requirements	earthwork field.				
			(3) local waste slag fields were investigated				
		Dust control	(1) Waste slag fields were layer-compacted, to avoid dust pollution.				
			(2) Dust suppression sprinkles were used to avoid dust pollution.				
		Ecological impact control	(1)Surface soil stripped during construction was stacked in a relatively flat area, with bagged soil around as landing，and dust-proof network cover; was used for land reclamation.				
		Landscape control	(1)environmental protection measures were taken according to "landscape impact control" requirements				
	Others (shall specify)						
Soil and water conservation control	Construction site control		(1) There were temporary water-block ditches outside the low-lying land in rainy season.				
			(2) There was dust network coverage on the stacks of surface soil and materials, to avoid rain erosion and pollution of surrounding environment.				
			(3) Construction duration was reasonably arranged, in order to shorten temporary land use time; timely vegetation or restoration was done.				
	Sidewalk control		(1) For new construction sidewalk, engineer protection and drainage works were made.				
			(2) Construction duration was reasonably arranged, in order to shorten temporary land use time;				
	Borrow earthwork field cont		(1) Necessary drainage measures were made before borrow earthworks; there was settling basin at the exports of drainage; on the side of borrow earthwork outer slope platform and upslope, there was intercepting ditches that connected with drainage ditches,				
			(2) Timely vegetation or restoration was made to avoid soil erosion; surface soil was used for restoration, land				

Inspect Item			Inspect Result (Marked with"√")			Notes
			Yes	No	Not Involve	
	rol	consolidation measures were taken..				
		(3) There was temporary coverage on the newly vegetated slope , to prevent slope erosion.				
		(4) Timely vegetation or restoration was made on the borrow earthwork field.				
	(5) Others (shall specify)					
Ecology restoration		(1)Stripped surface soil was used for the restoration of ecology.				
		(2)A combination of grass, bushes and trees was used during greening; no empty land was leaved, in order to prevent the invasion of alien species.				
		(3)No alien species was used.				
		Others (shall specify)				
Cultural relics protection		(1) If cultural relics are discovered during the construction period, the construction work shall be stopped immediately, while at the same time immediately reporting to local administrative department of cultural relics.				
		(2) The construction unit shall formulate special construction scheme for the section containing cultural relics according to the opinions issued by the administrative department of cultural relics, and may start construction only after obtaining the consent from relevant department,				
		(3)Removable cultural relics were surrendered to local administrative department of cultural relics proactively.				
		Others (shall specify)				
Construction traffic control		(1)Construction duration was reasonably arranged, in order to shorten temporary land use time;				
		(2) Closed transport vehicles were used for the transportation of earthworks, slag and construction garbage.				
		(3) If there was residential in 50 meters of the construction sidewalk, the transportation of construction materials in the night was prohibited.				
		(4) Rush hour was avoided, to prevent traffic congestion and accidents.				
		(5)There was specified routs for construction vehicles, , private driving route was prohibited, in order to prevent damaging the farmland and woodland.				
		Others (shall specify)				

Inspect Item		Inspect Result (Marked with"√")			Notes
		Yes	No	Not Involve	
Public participation	(1) Construction duration was reasonably arranged, in order to shorten temporary land use time;				
	(2) Specialists of EIA were consulted to answer public questions on environmental protection.				
	(3) When continuous construction at night was needed, the relevant formalities and announcements to surrounding residents were made.				
	(4) When the construction need to interrupt with municipal services (including water, electricity, telephone and bus routes, etc.), at least five days of announcements should be made to affected public, with the beginning and ending of interrupt service time.				
	(5) All recording of comments, questions and answers, response, etc., should be archived, and accept the supervision of oversight bodies.				
	Others (shall specify)				
Social environment impact control	(1) Land acquisition and demolition subsidy costs were promptly assigned to the relevant individuals or group according to national and Hebei Province subsidy standards; reasonable allocation of arable land and resettlement of labor was made to implement the policy.				
	(2) Rush hour was avoided, to prevent traffic congestion and accidents.				
	(3) Protective treatment, pavement restoration and greening were made for the occupied or destroyed local roads, compensation was payed to local government , in order to safeguard the legitimate interests of the government and residents.				
	Others (shall specify)				
Landscape impact control	(1) Planting measures were made for the surface of soil filling, cutting slop and retaining wall, to strengthen its compatibility with the surrounding landscape.				
	(2)Efforts were made to increase the environmental awareness of managers and construction works; arbitrary disposal of living and production waste was prohibited.				
	(3) Waste slag and building materials were stacked in predetermined area.				
	(4) After the completion of the project, the construction company cleaned up the oil and garbage in the spoil field, access roads and other sites, restored the original vegetation and landscape, in harmony with surrounding				

Inspect Item		Inspect Result (Marked with"√")			Notes
		Yes	No	Not Involve	
	natural environment.				
	Others (shall specify)				
Occupational Health	（1）Warning signs and warning instructions were set at operating post, equipment and place vulnerable to occupational hazards				
	(5) The construction company organized regular occupational health examinations for the workers engaged in toxic or hazardous work, The company hold topic training for them to guide the proper use of personal protective equipment and occupational labor protection products.				
	(3)The operating personnel wore protective mask, goggles, gloves and other personal protective equipment when conducting welding operation				
	(4) Operators wore earplugs to protect hearing, the construction site used low-noise equipment				
	(5) Anticorrosive and waterproof operation where good natural ventilation cannot be guaranteed were equipped with mandatory ventilation facilities. The operating personnel wore respirator or protective mask in the workplace with toxic or harmful gases				
	(6)The operator wore dust mask in dust workplace.				
	Others (shall specify)				
Hygiene and Disease Control	(1) Toilet, sanitation facilities, drainage ditch and damp area were regularly disinfected (with relevant records)				
	(2)The construction site set health center, equipped with health kit, commonly used drugs and bandage, tourniquet, neck collar, stretcher and other emergency equipment				
	(3)When construction personnel develop infectious diseases, food poisoning and acute occupational poisoning, the information is timely reported to the epidemic prevention department and competent department in charge of construction of the locality, and disposed according to relevant regulations stipulated by the epidemic prevention department				
	Others (shall specify)				
Others (shall specify)					

Inspect Item	Inspect Result (Marked with"√")			Notes
	Yes	No	Not Involve	
The construction stage when inspecting: _____				
Date of inspection: _____Time of inspection: _____				
Weather record:_____				
Signed by on-site inspector: _____ Signed by environmental supervisor: _____				
Description: ① The problem observed, unqualified situation described, corrective and preventive actions and suggestions put forward can be filled in remark.				
② If it is found through on-site inspection that measures are unqualified and need to be improved, environmental supervisor shall immediately issue "Environmental Rectification Notice" to the contractor and record the serial number of "Environmental Rectification Notice" in Remark. The detailed corrective actions carried out by the contractor shall be recorded separately.				
⑤ This form is a general checklist of construction site environment for biogas pipeline laying works under THE PROJECT, as for the specific subproject and environmental problems, local environmental situation and construction content can be combined to make appropriate adjustment to this form and to adopt appropriate environmental protection measures.				

Annex 3 Environmental Rectification Notice

Environmental Rectification Notice
Serial No.:_____ Contract number and name: _____ Name of subproject:_____ Name of work site:_____ Current construction stage: _____
The problems existing in on-site inspection: Inspected by: _____Date: _____
The contractor analyzes the reasons and formulates rectification plan: Responsible person on contractor side: _____Date:_____
Opinion of environmental supervisor: Responsible person on environmental supervisor side: _____Date:_____
Opinion of competent department of environmental protection (when necessary): Contact person:_____Date:_____
Modification deadline: Completed as of _____ Responsible person on contractor side: _____Date: _____ Responsible person on environmental supervisor side:_____Date: _____
Conclusion after review: Reviewed by: _____Date: _____

Annex 4 Pre-Environmental Inspection Checklist

Name of subproject: Contract Number and subproject location：

Name of work site:_

Current construction stage：

Date： Time：

Weather：

Inspected by:

Item	Implemented or not			Remarks/recommended action
	Yes	No	N/A	
1. All construction wastes was cleared up and transported to local landfill				
2. Ecological restoration measures were taken on temporary waste soil(slag) field				
3.The traffic condition of the road used for construction transportation got worse				
4. The temporary sedimentation tank and grit chamber were removed				
5. Land remediation, rehabilitation or greening measures were taken on the temporary sedimentation tank and grit chamber lands				
6. The temporary chute and gutters were removed and appropriate ecological restoration measures were taken				
7. The stripped mellow surface soil was used for ecological restoration				
8. arelevant training and education were carried out				
9. The local public were satisfied with the biogas				

Item	Implemented or not			Remarks/recommended action
	Yes	No	N/A	
pipeline works				

*Any existing local" not implemented" records may be indicators of irregularities that need to be improved. In that condition, environmental supervisor should give the construction company an environmental rectification notice with serial number.

APPENDIX III

THE WORLD BANK
Working for a World Free of Poverty

Hebei Rural Renewable Energy Development Demonstration Project

Environment Management Plan Summary (EMP)

Project Management Office Of Hebei Rural Renewable Energy Development Demonstration Project

Hebei Jingmiao Environmental Consulting Co., Ltd

April 2014

Attachment 1 Summary of the Common Environmental Impact Management Plan

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
Design Phase	Questions for location	The location of gas station： Compliance with local urban construction planning; Gas station is not built in prohibited areas As in the construction zone near the building ban, on perennial or downwind side of the leading wind in the forbidden construction zone The stable engineering geological conditions The local land use planning, etc The discharge of Biogas plants waste water is prohibited in Sensitive waters and waters with special features There is a convenient transportation,water and power supply conditions The reserved room for expansion The Requirements for the location of gas station The site selection of gas station, should be consistent with urban planning, requirements of environmental protection and fire safety The fire-protection distance between the the key constructs outside and the facilities inside of the gas station,such as the pipe orifice of flowing-through pipe, must comply with the specification requirements, and in accordance with the level of gas stations The first leve of gas stations should not be built in the urban area.If the fire-protection distance between the the key constructs outside and the facilities inside of the gas station comply with the specification requirements, be consistent with urban planning,	The Project Management Office(PMO) ,design units	Provincial PMO, Municipal Environmental Protection Agencies

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
		requirements of environmental protection and fire safety, the second and third of gas stations is allowed. It is favorable for the gas station in the urban area be close to the city road, but near the intersection of urban trunk road is unfavorable. The distance from the gas storage well group, gas dispenser and compressor to railways must be no less than 22 meters,to the urban road must be no less than 6 meters. The distance from the gas storage well group, gas dispenser and compressor to second-class civil construction protection must be no less than 14 meters,to thrid-class civil construction protection must be no less than 6 meters. The distance from the gas storage well group to Urban sub-trunk and Branch road is no less than 10 meters, the height difference between gas storage well group and High-voltage line must be 1.5 times higher than the High voltage pole The distance from the gas dispenser and compressor to Urban sub-trunk and Branch road is no less than 5 meters, high-voltage line should not crosse the gas station.		
	Water Pollution	It is inappropriate that the capacity of sump is less than 50% of the maximum daily emissions. The building,wall and pipes of anaerobic reactor should be treat by impervious materials for corrosion resistance. The solid waste storage facilities must be located away from the surface water bodies (not less than 400m) The sump shoud be designed to facilitate the removal of scum and sediment		
	Air Pollution	The building,wall and pipes of anaerobic reactor should be treat by impermeable material for tightness.		

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
	Safety and health personnel	The anaerobic reactor should be equipped with safety devices and measures to prevent the ultra-positive or ultra-negative pressure The anaerobic reactor should be equipped with manhole, mud tubes, etc. The electrical equipment should not be installed in the place where is hot, humid, dusty, inflammable and corrosion.		
Construction Phase	Water Pollution	After precipitation, the wastewater of excavation and mortar mixing can be reused for watering dust at construction site. Ensure that the construction wastewater discharge is reasonable, the wastewater of construction machinery cleaning can be reused. Dredg drainage trough regularly. The repair of construction machinery, vehicles should go to professional service points, because the oily wastewater is avoided at the construction site. The maintenance of machinery and equipment before use is necessary avoiding spills or leaks. Cement is used as impermeable material in sewage reservoir, and the geotextile in reservoir If the groundwater level high ,anti-float measures should be adopted in underground, semi-underground structures avoiding surface water flows into pit. Sealing measures are necessary when a pipeline through the volume of cell body,such as embedded casing. Joints should be set up in volume pool and sealing film is required to add when the volume of volume pool is too large.	Construction units	Provincial PMO, Municipal Environmental Protection Agencies
	Air Pollution	Watering regularly on the road that generate dust easily. The materials storage and processing area of construction site should be flat and hard.		

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
		The shelter measures Gigalight, fine particulate bulk material should be stored in airtight,and the blocking measures should be adopted in handling and transporting operations. Dust suppression sprinkler is necessary properly for exposed surface at the construction site. The vehicle should slow down into the nearby construction site. The vehicles use in transporting earthworks, sediment transport and construction garbageation should take tightness measures.		
	Noise pollution	Construction workers should comply with the relevant provisions of People's Republic of China on the construction noise to avoid the adverse environmental effects. All construction activities should stop from 22:00 to 06:00 in the next morning and lunch break from 12:00 to 14:00 if a residential area exist in the 300 meters range of construction site The access roads should be away from the sensitive points,such as schools, neighborhoods and hospitals.Traffic at night should be prohibited if a residential area exist in the 50 meters range of road. If the construction site near school, the construction should be prohibited during school hours because the severe noise from construction machinery;If the construction site near the dense residential areas, the construction should be prohibited at night. Workers' working hours should be arranged in accordance with occupational health standards.Workers should be protected by equipments,such as earplugs and helmets.		
	Solid Waste Pollution	Construction waste should be in accordance with the relevant provisions of the garbage management, recycling as much as possible, removal regularly.Construction waste is prohibited to throw freely , it should be removal by closed vehicle.		

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
		After garbage collection by trash bag set at construction site,then remove to Municipal Solid Waste Landfill in the project area. Spoil (residue) don't set a separate field for reducing land occupation:on the one hand can be used to backfill the land formation, on the other hand used to bed the nearest road subgrade. Spoil do not set up a separate spoil field, reduce land occupation; Don't incinerate incinerate toxic and hazardous substances at construction site, and the disposal of toxic and hazardous substances should in accordance with the requirements of the relevant provisions.		
	Soil and Water Conservation	After construction, excavation site should backfill earth and restore vegetation. In order to achieve the best recovery effect of vegetation restoration, the vegetation restoration should be completed in the month before the rainy season. Excavation projects carried out should be avoided in the rain. Excavated section of the slope should be laid sandbags, sand bar or straw, reduce soil erosion, reduce sediment load of the river. Bare ground caused by excavation should be restore vegetation as soon as possible, avoiding soil erosion due to wind, water or surface runoff during the rainy season; If the abandoned earthworks and side foot pile of stones can not be used for the construction of the building, should be moved to the designated location or dumping areas, compacted in layers and plant vegetation timely. The Topsoil excavation should be piled separately, can be used as raw materials for ditch berm or restore soil for farmland.		
	Opportunity discovery	Train the construction workers to identify underground heritage, train and raise the their awareness about protecting cultural heritage.		

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
		Report immediately if you find any cultural heritage during the construction phase . Construction contractor construction should be stopped immediately and take appropriate measures to protect the site, and report this found to the local cultural heritage protection authority The resume construction work should be done after the cultural heritage protection authorities completed the survey and did not have any objection.		
Operation Phase Operation	Water Pollution	Design appropriate sewage collection and treatment systems for sewage produced by livestock. Fermentation pond must design in accordance with the appropriate technical specification strictly; the measurement of the permeation rate of soil layers is necessary for the decision on important technical parameters, such as the decision on soil permeability coefficient about the construction sites of fermentation pond. Fermentation pond discharge wastewater into surface water bodies is not allowed except great collapse occurred due to the size of the storm event.Generally, in this particular case, there will be enough water to diluted the wastewater produced by fermentation pond reducing the impact of the receiving water. And the wastewater must meet " Disharge standard of pollutants for livestock and poultry breeding" (GB18596-2001). In accordance with GB18596-2001, the maximum allowable daily discharge of water pollutants concentrations is: COD:400 mg/l,BOD_5:150 mg/l, SS: 200 mg/l, NH_3-N: 80 mg/l; Total Phosphorus (as P): 8 mg/l, fecal coliform: 10000 cells /ml, ascarid eggs: 2 cells /L。 The berm of fermentation pond should in accordance with the appropriate design and construction standards strictly, to ensure that even in the worst weather conditions will not appear berm collapse, ensure that the berm collapse will not appear in the worst weather	Construction units	Provincial PMO, Municipal Environmental Protection Agencies

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
Phase		conditions. Must strictly enforce the digester design and operation of technology, management practices. The design of biogas digester must enforce the appropriate Specifications for the design and management. Conduct environmental and health education in the region where resident use organic fertilizer as a crop fertilizer, so that the public understand the hazards arised by slurry discharging directly into water bodies. The biogas effluent from digester should be stored in the storage pond reuse as rinse water or irrigation water. It is recommended that a centralized wastewater pretreatment plant about livestock wastewater, excess water can be supplied to pre-treatment plant for processing when livestock sewage is greater than the amount of digester effluent required.		
	Air Pollution	Projects should take management measures to reduce the emissions of malodorous gases and air pollution. The management measures include taking the reasonable collection rate, stampeing on the fermentation pond, preparating biogas using the gas produced by livestock,etc. Control the transshipment process of fermentation pond strictly for preventing or minimizing emissions of toxic gases as much as possible. According to 'Integrated emission standard of air pollutants'（GB16297-1996）, the maximum allowable concentration of NOx is 240mg / m^3,other pollutant concentration should meet the "Design of Industrial Enterprises health standards" (TJ36-79). The maximum allowable concentration of harmful substances at residential atmosphere (partial		

Project Phases	Environmental issues	Mitigation and protective measures	Implementing Agency	Supervisory Agency
		pollutants) are: CO_2: 0.04mg / m³,H_2S: 0.01mg / m³, NH_3: 0.2mg / m³. Ensure that a scale-designed sewage collection and processing systems were set for livestock wastewater. The strict management was necessary for collection and transportion of manure to prevent the leakage of pipeline or truck. Planting trees in the project critical treatment facilities and the surrounding area to absorb or reduce volatile gases, toxic gases, dust and odor. Enforce the design and operation technology, management practices about digester strictly. Train and educate the project staff so that they understand the environmental risks of improper operation of digester. Develop a monitoring plan for the air quality, especially the area around the digester. Execute the "Ambient Air Quality Standard" (GB3095-2012) and "industrial enterprises to design health standards" (TJ36-79) strictly.		
	Noise pollution	The device which generate noise must be placed in a closed room. For greater noise machinery and equipment, the basis for shock or vibration bearings were required to set up, and the damping materials were required,too. Maintain the production equipment regularly, and control the production equipment at the best working conditions possibly and low noise level. Idle facilities must be turned off or throttling damping state. Noise should follow the "Emission standard for industrial enterprises noise at boundary " (GB12348-2008).		
	Soil pollution	Use protective equipment or stamped feeding facilities to prevent feed from wind and rain		

Project Phases	Environmental issues	Mitigation and protective measures		Implementing Agency	Supervisory Agency
		erosion. Livestock waste transportation appliance should adopt reliable sealed, leak-proof measures Try to keep the waste dry, remove waste by scraping not watering. The land use must be done after the livestock manure treated harmless As fertilizers, the amount of organic fertilizer or soil conditioner can not exceed the demand of crop for growth nutrients land needed in that year. The anaerobic fermentation technology can be used to compost solid organic fertilizer, which technology cna kill pathogens and ascaris eggs. Manure receiving pool, biogas residue/liquid pool, biogas residue drying fields etc. that need anti-seepage treatment, the permeability coefficient should be less than 10^{-10}cm/s			
	Environmental risks	the leak of biogas	Gas storage cabinets must have safety devices to prevent excessive inflation and exhaust, vent pipe should be located flame arrester. The hazardous gas detection is required When the digester vent cleaning and maintenance. Personnel engaged in special trades, must have professional skills, pass safety training and induction operation with certificate. The operator must wear the appropriate PPE during induction for better safety and health protection. The operators should take notice of slips or falls from a height When they tour or operate in the top of building in rain or snow weather. Check and replace safety and fire protection facilities and equipment regularly according to the instruction book of requirements. The maintenance of lightning, explosion-proof devices about buildings and		Provincial PMO, Municipal Environmental Protection Agencies

Project Phases	Environmental issues	Mitigation and protective measures		Implementing Agency	Supervisory Agency
			structures should comply with the requirements of the meteorological and fire departments. Contingency plans of fire, flammable, explosive, natural disasters or other unexpected events should be developed early. Ventilation is nessary in the place where have harmful gases, flammable gases, odors, dust and damp environment . Never wipe the equipment operation site when the cleaning machine working and the mechanical and electrical equipment operating , the wash water shall not be splashed to cable head and the moto of mechanical and electrical equipment. Storage tank should maintain safe distance from fire.		
		the leak of Biogas fluid	Secondary or concomitant pollution about biogas fluid leak case caused by an accident should be included in accident risk contingency plans, and response timely. After the accident, replace the soil of leaking area, store up the contaminated soil at the designated location,designated stockpiling of contaminated soil, according to the demand of biological growth, and use the contaminated soil with the use of the planting soil proportionally for reducing soil erosion.		
		Excessive application of organic fertilizer	Use special organic fertilizer according to plant varieties and fertilize scientifically in accordance with the nutrition that biological required. Enhance soil quality monitoring of bio-fertilizer application area and fertilize scientifically in accordance with the environmental monitoring program strictly.		

Project Phases	Environmental issues	Mitigation and protective measures		Implementing Agency	Supervisory Agency
			In order to meet crop needs without producing toxicity problems, the recommended bio-fertilizer application quantity is: liquid bio-fertilizer 0.475 t/hm²•a, solid bio-gas fertilizer 0.789 t/hm² •a.		

Attachment 2 Environmental Management Plan for Sensitive Points

Subproject	Environmental Sensitive Points		Environmental pollution mitigation measures	Implementing agency	Supervision agency
Anping	construction period	Ordinary country roads	Construction period shall be shortened if approaching road occupies the country road. The season after autumn shall be selected for construction and busy season shall be avoided	Contractor, supervision unit	PIUs
	operation period	——	——	——	——
Yutian	construction period	Huangjiashan Village, Xingshuyu Village, Shangzhuang Village, Xiaolizhuang Village, Ruanzhuangzi Village, Xingjiawu Village, Sijiaoshan Village, Guangongling Village	Pipe network construction shall be performed in the daytime and rest period of surrounding residents shall be avoided. Construction can't be executed at 22:00~06.00 Quality control for pipe network project shall be strengthened and pipeline testing shall be enhanced to ensure the quality of gas supply pipelines	Contractor, supervision unit	Project implementation unit(PIU), environment protection bureau(EPB)
		Ordinary country roads	Operation shall be performed during the period with small passenger and traffic flow if the way of excavation is adopted. Temporary bridge shall be erected during the construction to facilitate passing of vehicles and passengers. Construction period shall be shortened, busy season shall be avoided	Contractor, supervision unit	PIUs
	operation period	Residence at both sides of the pipe network	Routing inspection for gas pipe network shall be strengthened according to the safety management plan to prevent safety accident Advocacy of gas safety knowledge and emergency drill shall be strengthened to avoid gas leaks and accidents.	PIUs	EPB
Zunhua	construction peri	Wangjiapu Village, Qujiapu Village, Xiaocaoge Village	Pipe network construction shall be performed in the daytime and rest period of surrounding residents shall be avoided. Construction can't be executed at 22:00~06.00	Contractor, supervision unit	PIUs, EPB

	od		Quality control for pipe network project shall be strengthened and pipeline testing shall be enhanced to ensure the quality of gas supply pipelines		
		ditch	The way of direct excavation shall be adopted when crossing the ditch. Function of most ditches is agricultural irrigation and of few ditches is natural discharge. Construction shall avoid agricultural irrigation season when crossing the ditch with function of agricultural irrigation, and construction wastes can't be stacked in the ditch during the construction. Time restoration shall be made after the construction and use function of the ditch can't be affected. Construction shall avoid rainy season when crossing the ditch with function of natural discharge, and construction wastes can't be stacked in the ditch during the construction. Time restoration also shall be made after the construction and use function of the ditch also can't be affected.	Contractor, supervision unit	PIUs, EPB
		province road S356	The way of underground bury is adopted , permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Pipelines shall have a square crossing with the Expressway and the angle can't be less than 60° when they have an oblique crossing. When pipelines cross the road, protective casing shall be embedded and casing strength shall meet requirements for class I load of the road; top of protective casing shall be no less than 1.5 m from ground of the road subbase; pipelines can't cross the river through bridge of the road; at least 20 m safe distance shall be kept between center line of the pipelines and land boundary line of the road.	Contractor, supervision unit	PIUs, related administrative departments
		Daqin railway	Crossing engineering shall be performed in the way of pipe jacking; moreover, permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Included angle between jacking pipelines in longitudinal	Contractor, supervision unit	PIUs

			axis with railway shall be 90°, and protective casing shall be embedded. The gas pipeline manhole shall be arranged outside the railway transportation safety protection zone; supervision of protective casing when crossing the railway shall be undertaken by the corresponding qualified supervision unit		
	operation period	Residence at both sides of the pipe network	Routing inspection for gas pipe network shall be strengthened according to the safety management plan to prevent safety accident Advocacy of gas safety knowledge and emergency drill shall be strengthened to avoid gas leaks and accidents.	PIUs	EPB
Linzhang	construction period	Jia Village, Xidiqiu Village, Beizhang Village, Shuangmiao Village	Pipe network construction shall be performed in the daytime and rest period of surrounding residents shall be avoided. Construction can't be executed at 22:00~06.00 Quality control for pipe network project shall be strengthened and pipeline testing shall be enhanced to ensure the quality of gas supply pipelines	Contractor, supervision unit	PIUs, EPB
		Ordinary Country road and Province road	Construction period shall be shortened if approaching road occupies the country road. The season after autumn shall be selected for construction and busy season shall be avoided	Contractor, supervision unit	PIUs, EPB
		province road S212	The way of Crossing engineering is adopted , permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Pipelines shall have a square crossing with the Expressway and the angle can't be less than 60° when they have an oblique crossing. When pipelines cross the road, protective casing shall be embedded and casing strength shall meet requirements for class I load of the road; top of protective casing shall be no less than 1.5 m from ground of the road subbase; pipelines can't cross the river through bridge of the road; at least 20 m safe distance shall be kept between center line of the pipelines and land boundary line of the road.	Contractor, supervision unit	PIUs, related administrative departments
	operation	Residence at both sides of the pipe network	Routing inspection for gas pipe network shall be strengthened according to the safety management plan to prevent safety accident	PIUs	EPB

	period		Advocacy of gas safety knowledge and emergency drill shall be strengthened to avoid gas leaks and accidents.		
Chengde	construction period	Province road S145	The way of Crossing engineering is adopted , permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Pipelines shall have a square crossing with the Expressway and the angle can't be less than 60° when they have an oblique crossing. When pipelines cross the road, protective casing shall be embedded and casing strength shall meet requirements for class I load of the road; top of protective casing shall be no less than 1.5 m from ground of the road subbase; pipelines can't cross the river through bridge of the road; at least 20 m safe distance shall be kept between center line of the pipelines and land boundary line of the road.	Contractor, supervision unit	PIUs, related administrative departments
		Beijing-Shenzhen Expressway	The way of paving along the Expressway culvert is adopted, permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Included angle between pipelines and expressway shall be no less than 70 °. Pipelines can't cross under bridge of the Expressway	Contractor, supervision unit	PIUs, related administrative departments
		Laoniu River	Way of directional drilling is adopted when pipe network crosses rivers. Construction wastes and wastewater shall be collected in strict accordance with environmental management regulations. Stacking wastes in river is not allowed. Discharging any pollutant into river is prohibited. Waste mud produced by directional drilling when pipe network crosses rivers shall be backfilled along with soil	Contractor, supervision unit	PIUs, EPB
	operation period	——	——	——	——
Laoting	construction peri	Dongdazhuang Village, Wantuo Village, Shao Village, Donggaoge Village,	Pipe network construction shall be performed in the daytime and rest period of surrounding residents shall be avoided. Construction can't be executed at 22:00~06.00	Contractor, supervision unit	PIUs, EPB

	od	Dongzhuang Village, Laomumiao Village, Xigong Village, Donggong Village	Quality control for pipe network project shall be strengthened and pipeline testing shall be enhanced to ensure the quality of gas supply pipelines		
		Yucai Primary School	the way of direct excavation shall be adopted. Construction shall be performed in the period except for the school time. Construction can't be executed in the school time unless permission of the school is obtained.	Contractor, supervision unit	PIUs, EPB
		Xiaochang River	Way of directional drilling is adopted when pipe network crosses rivers. Construction wastes and wastewater shall be collected in strict accordance with environmental management regulations. Stacking wastes in river is not allowed. Discharging any pollutant into river is prohibited. Waste mud produced by directional drilling when pipe network crosses rivers shall be backfilled along with soil	Contractor, supervision unit	PIUs, EPB
		Tanggang Expressway, Coastal Expressway	The way of paving along the Expressway culvert is adopted, permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Included angle between pipelines and expressway shall be no less than 70 °. Pipelines can't cross under bridge of the Expressway	Contractor, supervision unit	PIUs, related administrative departments
		province road S044	The way of Crossing engineering is adopted , permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Pipelines shall have a square crossing with the Expressway and the angle can't be less than 60° when they have an oblique crossing. When pipelines cross the road, protective casing shall be embedded and casing strength shall meet requirements for class I load of the road; top of protective casing shall be no less than 1.5 m from ground of the road subbase; pipelines can't cross the river through bridge of the road; at least 20 m safe distance shall be kept between center line of the pipelines and land boundary line of the road.	Contractor, supervision unit	PIUs, related administrative departments
		Ordinary country road and Province road	.Construction period shall be shortened if approaching road occupies the country road. The season after autumn shall be selected for	Contractor, supervision unit	PIUs, EPB

			construction and busy season shall be avoided		
	operation period	Residence at both sides of the pipe network	Routing inspection for gas pipe network shall be strengthened according to the safety management plan to prevent safety accident Advocacy of gas safety knowledge and emergency drill shall be strengthened to avoid gas leaks and accidents.	PIUs	EPB
Guye	construction period	Bijiadian town FAngezhuang Town Wangnianzhuang Village Dazhuangtuo Village Fangezhuang Village	Pipe network construction shall be performed in the daytime and rest period of surrounding residents shall be avoided. Construction can't be executed at 22:00~06.00 Quality control for pipe network project shall be strengthened and pipeline testing shall be enhanced to ensure the quality of gas supply pipelines	Contractor, supervision unit	PIUs, EPB
		ditch	The way of direct excavation shall be adopted when crossing the ditch. Function of most ditches is agricultural irrigation and of few ditches is natural discharge. Construction shall avoid agricultural irrigation season when crossing the ditch with function of agricultural irrigation, and construction wastes can't be stacked in the ditch during the construction. Time restoration shall be made after the construction and use function of the ditch can't be affected. Construction shall avoid rainy season when crossing the ditch with function of natural discharge, and construction wastes can't be stacked in the ditch during the construction. Time restoration also shall be made after the construction and use function of the ditch also can't be affected.	Contractor, supervision unit	PIUs, EPB
		South outer ring road	permission letter of related administrative departments shall be obtained to prevent damage of the engineering to roadbed. Pipelines shall have a square crossing with the Expressway and the angle can't be less than 60° when they have an oblique crossing. When pipelines cross the road, protective casing shall be embedded and casing strength shall meet requirements for class I load of the road; top of protective casing shall be no less than 1.5 m	Contractor, supervision unit	PIUs, related administrative departments

			from ground of the road subbase; pipelines can't cross the river through bridge of the road; at least 20 m safe distance shall be kept between center line of the pipelines and land boundary line of the road.		
	operation period	Residence at both sides of the pipe network	Routing inspection for gas pipe network shall be strengthened according to the safety management plan to prevent safety accident Advocacy of gas safety knowledge and emergency drill shall be strengthened to avoid gas leaks and accidents.	PIUs	EPB

Attachment 3 Summary of Social environment Management Plan

Type	Actions	Targets	Agencies responsible	Funding	Stage	Monitoring indicators
1. Developing livelihood restoration programs	1) Preparing the RAP 2) Implementing the RAP 3) Conducting resettlement M&E	APs	PMOs, owners, external M&E agency	Owners	2013—	See the RAP
2. Reducing or exempting initial pipeline installation charges	Including subsidies in the project budget	Biogas users	PMOs, owners	Owners	Construction	Initial pipeline installation charges
3. Fixing biogas prices reasonably	1) Holding a public hearing 2) Offering reduction, exemption or subsidies to the poor	Local residents, cooperatives	PMOs, owners, PMO	Municipal finance	From design to operation	1)Time and frequency of public hearing, participants 2)Preferential policies for the poor
4. Establishing a stalk collection and transport mechanism	1) Cooperating with local agricultural cooperatives; 2) Entering into collection and transport agreements; 3) Establishing a comprehensive rural waste collection and transport system	Local residents, cooperatives	PMOs, owners, PMOs, sanitation office	Owners, public finance	From design to operation	1)Agreements; 2)Local labor employed for collection and transport; 3)Improvement of the rural environment
5. Offering jobs to women	1) Making service jobs first available to women during construction 2) Making cleaning and service jobs first available to women during operation; 3) Ensuring that women receive equal pay	Local women	PMOs, owners, labor and social security bureaus	Owners	Construction & operation	1) Number of local women employed at the construction stage; 2) Number of local women employed at the

	for equal work					operation stage; 3) Remuneration
6. Protecting rights and interests of women	1) Considering women's needs and suggestions at the design stage; 2) Ensuring that women can sign to receive compensation fees; 3) Giving skills training to women in consideration of their needs and habits	Affected women	Design agency, RAP agency, land and resources bureau, women's federation, township governments, village committees	Public finance	Construction	1) Records of women's needs and suggestions; 2) Percentage of women signing; 3) Modes of public participation, and percentage of women; 4) Time and venue of training, and percentage of women
7. Giving publicity to new energy sources and safe biogas use	1) Giving publicity on safe biogas use at least twice a year 2) Giving publicity to new energy sources by various means; 3) Giving publicity in consideration of women's needs and habits	Local residents	PMOs, agriculture bureau, PMOs, women's federation, township governments, village committees	Agriculture bureaus and PMOs	Construction & operation	1) Frequency of publicity, and percentage of women 2) Quantity of publicity materials
8. Maintenance of household biogas appliances	1) Establishing specialized maintenance teams; 2) Checking and maintaining appliances regularly	Local residents	PMOs, owners	Owners	Operation	1) Establishment and staffing of teams; 2) Frequency of maintenance

APPENDIX IV

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Working for a World Free of Poverty

Hebei Rural Renewable Energy Development Demonstration Project

Environment Monitoring Plan (EMMP)

Project Management Office Of Hebei Rural Renewable Energy Development Demonstration Project
Hebei Jingmiao Environmental Consulting Co., Ltd
April 2014

Table 1 Monitoring plan for the project acceptance

No.	Monitoring Project	Monitoring sites	Monitoring indicators	Standard and Specification	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring frequency	Expenses (RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
1	Harmless health indicators of biogas residues and fluid	The outlet of aerobic fermentation tank	Biogas residues: mortality of roundworm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascarid ovum, japonicum egg, hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal：total As, total Hg, total Pb, total Pb, total Cd, total Cr	"Technology code for land application rates of livestock and poultry manure"（GB/T25246-2010） Organic Fertilizer (NY 525 – 2011)	24	Once after completion	Leting60 Zunhua60 Chengde60 Anping60 Yutian60 Linzhang76	Owners entrust a qualified agency In the form of a contract	Owners	City / County Environmental Protection Agency
2	Odor	project boundary, Deodorizer exhaust	Odor concentration, Ammonia, Hydrogen sulfide	"Emission standards for odor pollution"（GB 14554-93）	12					
3	Hot water boiler flue	Boiler exhaust	SO_2、NOx、Dust, blackness	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	12					
4	Straw crushing dust	project boundary	TSP	"Integrated emission standards of air pollutants"（GB16297-1996）	4					

No.	Monitoring Project	Monitoring sites	Monitoring indicators	Standard and Specification	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring frequency	Expenses (RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
5	Noise	project boundary	Equivalent sound level A	“Emisson standard for industrial enterprises noise at boundary”（GB12348-2008）	4					
6	（Anping）Water of Sewage treatment statio, water quality, Sludge（collect data sewage of treatment plant）	Effluent departmen t of Grill	The value of fecal cdiform bacteria,COD_{Cr},BOD_5,total phosphorus,NH_3-N,SS, Sludge characteristics and pollutant indicators	“Discharge standard of pollutants for municipal wastewater treatment plant”（GB18918—2002）	0					
7	(Yutian)water of waste water treatment station in Yutian project	Inlet and outlet of waste water treatment station	Water quality: BOD_5, COD_{Cr}, SS, Number of faecal coliform bacteria, Number of ascaris eggs	Standards for irrigation water quality (GB5084-2005)	4					
8	（Linzhang） methane alternator	Exhaust of generator	SO_2,NOx,Dust, blackness	SO_2,Dust, blackness Refer “Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers”（GB 13271-2001） NOx Refer emission limits of small gas-fired generation facilities power generation facilities in table 1.1.2 of ” General EHS Guidelines”, scilicet natural gas ≥3 MWh <15MWh	16					

No.	Monitoring Project	Monitoring sites	Monitoring indicators	Standard and Specification	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring frequency	Expenses (RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
	Total of six sub-projects(RMB: thousand yuan)						376			

Table 2 Monitoring plan of operation period

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
Biogas residues: mortality of round worm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascaridovum, japonicum egg,	"Technology code for land application rates of livestock and poultry manure" （GB/T 25246-2010）	Waste Gas	odor	Taking one sample in the Vertical wind of project boundary according to the standard	Odor concentration, ammonia, hydrogen sulfide;	The secondary standard of "Emission standards for odor pollution"（GB 14554-93）	Once a year	6	54	Owners entrust a qualified agency In the form of a contract	Owners	City / County Environmental Protection Agency
			Flue gas of gas hot water boiler	exhaust of hot water boiler	Soot	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	Once a year	8				
					SO_2							
					NOx							
					Blackness							
		water quality		Taking one sample in the anaerobic reactor effluent and the outfall of project respectively	The value of fecal cdiform bacteria,COD_{Cr},BOD_5, Total phosphorus,NH_3-N,SS	The water quality requirements of Anping County sewage treatment plant	Once a year	12				
				Taking one sample in Inlet and outlet of Anping county sewage	Water quality:The value of fecal cdiform bacteria,COD_{Cr},BOD_5, Total	Primary standard in table 1 of "Discharge standard of pollutants for municipal wastewater treatment plant"（GB18918-2002）; Sludge	Once a year	0				

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal：total As, total Hg, total Pb, total Pb, total Cd, total Cr	Organic Fertilizer (NY 525 – 2011)			treatment plant respectively,(Reference the monitoring data of sewage treatment plant ） Sludge outlet	phosphorus,NH_3-N,SS Sludge:Sludge characteristics and pollutant indicators	discharge standards						
		Solid Waste		The outlet of Aerobic fermentation tank			Once a year	24				
		Noise		The site boundary of Gas station and Gas Filling Station	Equivalent sound level A	“Emisson standard for industrial enterprises noise at boundary”（GB12348-2008）	Once a year(Monitor respectively each day and night)	4				
Operation Phase	Yutian project	Waste Gas	Odor	Taking one sample in the Vertical wind of project boundary	Odor concentration, ammonia, hydrogen sulfide;	The secondary standard of “Emission standards for odor pollution”（GB 14554-93）	Once a year	6	52	Owners entrust a qualified agency In the form	Owners	City / County Envir

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
				according to the standard						of a contract		onmental Protection Agency
			Flue of gas boiler	exhaust of hot water boiler	Soot	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	Once a year	8				
					SO_2							
					NOx							
					Blackness							
		wastwater		Wastewater treatment station	Water quality: BOD_5, COD_{Cr}, SS, Number of faecal coliform bacteria, Number of ascaris eggs	Standards for irrigation water quality (GB5084-2005)	Once a year	12				
		Solid Waste		The outlet of Aerobic fermentation tank	Biogas residues: mortality of roundworm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascarid ovum, japonicum egg, hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal：total As, total Hg, total	"Technology code for land application rates of livestock and poultry manure"（GB/T25246-2010）	Once a year	24				

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
					Pb, total Pb, total Cd, total Cr	Organic Fertilizer (NY 525 – 2011)						
		Noise		The boundary of Gas station	Equivalent sound level A	"Emisson standard for industrial enterprises noise at boundary"（GB12348-2008）	Once a year(Monitor respectively each day and night)	2				
Operation Phase	Zunhua project	Waste Gas	Odor	Taking one sample in the Vertical wind of project boundary according to the standard	Odor concentration, ammonia, hydrogen sulfide;	The secondary standard of "Emission standards for odor pollution"（GB 14554-93）	Once a year	6	40	Owners entrust a qualified agency In the form of a contract	Owners	City / County Environmental Protection Agency
			Flue gas of gas hot water boiler	The exhaust of hot water boiler	Soot	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	Once a year	8				
					SO_2							
					NOx							
					Blackness							
		Solid Waste		The outlet of aerobic fermentation tank	Biogas residues: mortality of roundworm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascarid ovum,	"Technology code for land application rates of livestock and poultry manure"（GB/T25246-2010）	Once a year	24				

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
					japonicum egg, hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal: total As, total Hg, total Pb, total Pb, total Cd, total Cr	Organic Fertilizer (NY 525 – 2011)						
		Noise		The site boundary of Gas station	Equivalent sound level A	"Emisson standard for industrial enterprises noise at boundary" （GB12348-2008）	Once a year(Monitor respectively each day and night)	2				
Operation Phase	Linzhang project	Waste Gas	Odor	Taking one sample in the Vertical wind of project boundary according to standard	Odor concentration, ammonia, hydrogen sulfide;	The secondary standard of "Emission standards for odor pollution"（GB 14554-93）	Once a year	6	48	Owners entrust a qualified agency In the form of a contract	Owners	City / County Environmental Protection Agency
			Flue gas of gas hot water boiler	The exhaust of hot water boiler	Soot	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	Once a year	8				
					SO_2							
					NOx							
					Blackness							
			The exhaust	The exhaust of	Soot	"Emission standard of air pollutants for coal--burning	Once a year	8				
					SO_2							

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
			of gas turbine	generator	NOx Blackness	oil-burnig gas-fired boilers"（GB 13271-2001）						
		Solid Waste		The outlet of aerobic fermentation tank	Biogas residues: mortality of roundworm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascarid ovum, japonicum egg, hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal：total As, total Hg, total Pb, total Pb, total Cd, total Cr	"Technology code for land application rates of livestock and poultry manure"（GB/T25246-2010） Organic Fertilizer (NY 525 – 2011)	Once a year	24				
		Noise		The site boundary of Gas station	Equivalent sound level A	"Emisson standard for industrial enterprises noise at boundary"（GB12348-2008）	Once a year(Monitor respectively each day and night)	2				
Operation Operation	Chengde project	Waste G	Odor	Taking one sample in the Vertical wind of project	Odor concentration, ammonia, hydrogen sulfide;	The secondary standard of "Emission standards for odor pollution"（GB 14554-93）	Once a year	6	4o	Owners entrust a qualified agency In	Owners	City / Cou

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
Operation Operation Operation Operation Operation		as		boundary according to the standard						the form of a contract		nty Environmental Protection Agency
			Flue gas of gas hot water boiler	The exhaust of hot water boiler	Soot	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	Once a year	8				
					SO_2							
					NOx							
					Blackness							
		Solid Waste		The outlet of aerobic fermentation tank	Biogas residues: mortality of roundworm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascarid ovum, japonicum egg, hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal：total As, total Hg, total Pb, total Pb, total Cd, total Cr	"Technology code for land application rates of livestock and poultry manure"（GB/T25246-2010） Organic Fertilizer (NY 525 – 2011)	Once a year	24				
		Noise		The site boundary of Gas station	Equivalent sound level A	"Emisson standard for industrial enterprises noise at boundary"（GB12348-2008）	Once a year(Monitor respectively	2				

Phase	Subprojects	Monitoring object		Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
							each day and night)					
Operation	Leting project	Waste Gas	Odor	Taking one sample in the Vertical wind of project boundary according to the standard	Odor concentration, ammonia, hydrogen sulfide;	The secondary standard of "Emission standards for odor pollution"（GB 14554-93）	Once a year	6	40	Owners entrust a qualified agency In the form of a contract	Owners	City / County Environmental Protection Agency
			Flue gas of gas hot water boiler	The exhaust of hot water boiler	Soot	"Emission standard of air pollutants for coal--burning oil-burnig gas-fired boilers"（GB 13271-2001）	Once a year	8				
					SO_2							
					NOx							
					Blackness							
		Solid Waste		The outlet of Aerobic fermentation tank	Biogas residues: mortality of roundworm ova, The value of fecal cdiform bacteria,fly Biogas fluid: subsiding rate of ascarid ovum, japonicum egg, hookworm egg, The value of fecal cdiform bacteria, mosquito,fly Heavy metal：total As, total Hg, total Pb, total Pb, total	"Technology code for land application rates of livestock and poultry manure"（GB/T25246-2010）	Once a year	24				

Phase	Subprojects	Monitoring object	Monitoring sites	Monitoring indicators(Observations)	Standard and Specification	Monitoring frequency	Reference single monitoring costs (RMB: thousand yuan)	Reference Individual monitoring costs(RMB: thousand yuan)	Monitoring bodies	Responsibility agency	Supervised agency
				Cd, total Cr	Organic Fertilizer (NY 525 – 2011)						
		Noise	The site boundary of Gas station and Gas Filling Station	Equivalent sound level A	“Emisson standard for industrial enterprises noise at boundary” （GB12348-2008）	Once a year(Monitor respectively each day and night)	4				

Table3 Soil and Water Conservation Monitoring Plan

Sub-Project	Monitoring area	Monitoring sites	Monitoring content	Monitoring content	Monitoring frequency	costs(RMB: million yuan)	Monitoring bodies	Responsibility agency	Supervised agency
Chengde project	Gas station and Gas Filling Station	Laid a ground monitoring points in the region in breeding farms; Select a representative area in the green area, laid a vegetation monitoring points, monitoring growth and survival of vegetation.	（1）The monitorion of main factor affecting soil erosion The monitoring content including rainfall, slope gradient, bulldozers height and volume, vegetation type and coverage, the quantity and quality of soil and water conservation facilities, the investigation about causes of soil erosion, and monitoring landform background values of the soil erosion original. （2）Soil and water conservation and ecological change monitoring in project area The monitoring content including the changes of topography, the covers area of construction project and area of surface disturbance, the number and size of digging and filling, debris and stacking area, and grass coverage in the project site. （3）Dynamic monitoring of soil erosionin project area The dynamic monitoring of soil erosion in project area including area, changes of the extent and amount, and the harm and tendency of the surrounding area about soil erosion. ①Dynamic monitoring of soil erosion control in the area of responsibility During the construction process, the work surface is changing constantly, and the prevention of responsibility will change with the the work surface. Therefore, the dynamic monitoring of soil erosion in area of responsibility is a priority. ②monitoring of Disturbed area Recording the disturbance area and soil erosion by excavation, backfill face, bulldozers and other types of area. ③Dynamic monitoring of soil erosion (erosion modulus)	a combination of methods Ground observation method, Survey monitoring method, and Inspections monitoring method	Survey the amount of soil erosion and vegetation cover of the original landscape in the pre-construction comprehensivly; Monitor and record once at least every 10 days about water conservation measures being implemented; Monitor and record once at least every month about disturbance of surface area, the intercept effect of soil and water conservation measures; Monitor and record	0.18	Owners entrust a qualified agency In the form of a contract	Owners	City / County Environmental Protection Agency

	Pipeline area	Laid a ground monitoring points in the middle of the gas pipeline; select a representative area and laid a vegetation monitoring sites in the green area to	Do the real-time monitoring anout different types of disturbance areas, the soil loss of temporary bulldozers field area mianly, Analysis, calculate,and master the changes of soil erosion, and laid a foundation for the prevention of soil erosion. ④Monitoring of the hazards about soil erosion Monitoring the construction site mainly, recording its the harm degree of to the soil erosion caused by construction in the surrounding area. （4）Monitoring of the control effect about Soil and Water Conservation Monitor rhe effect of various types of control measures, the role of controling erosion and improving ecological environment, etc.Including the monitoring of combat effect by using soil and water conservation measures and plant measures mainly . ① Monitoring of the control effect about Engineering measures Including the number and quality of implementation; stability, soundness, operation of Protection Project; the effect of slag and soil conservation ②Monitoring of the control effect by using Plant measures Including the grass acreage, survival, preservation, growth conditions and coverage at different stages, surface grass recovery after disturbance; the effect of slag and soil conservation by using plant measures ② Monitoring of the control effect by using temporary measures Monitoring of the quantity and quality of temporary measures,and the effect of slag and soil conservation by using temporary interception measures		once at least 3 months about the main construction progress, the factor of soil erosion, plant growth of soil and water conservation measures; In case of Unusual weather conditions, such as heavy rain, high winds, etc. Increase the monitoring frequency should be added timely; Complete the monitoring content within 1 week after the soil erosion hazard events occur. Survey or monitor once comprehensively at the pre-construction, mid-construction and after construction about the monitoring content.				
		Laid a ground monitoring points in the middle of the gas pipeline							

APPENDIX V

THE WORLD BANK
Working for a World Free of Poverty

Hebei Rural Renewable Energy Development Demonstration Project

Environment Management Framework

Project Management Office Of Hebei Rural Renewable Energy Development Demonstration Project

Hebei Jingmiao Environmental Consulting Co., Ltd

April 2014

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1 Project Introduction and Objective

1.1 Project Introduction

The environment management framework is an appendix of the operation manual of Hebei Rural Renewable Energy Development Demonstration Project. According to the planning, the Agriculture Department of Hebei Province, Development and Reform Commission of Hebei Province, and the Financial Department of Hebei Province proposed carrying out Hebei Rural Renewable Energy Development Demonstration Project (loaned by world bank) in Hebei province, this project intends to focus on the supporting of large-scale biogas production and centralized biogas supply project using straw and farming waste as raw material. This project has filed an application to the People's Government of Hebei Province ("Loan from World Bank" Foreign Investment office, Development and Reform Commission of Hebei Province [2013]473).

This project aims to demonstrate the production and utilization of sustainable and renewable energy, reduce environmental pollution and provide clean energy to rural areas.

1.2 Objective

The environment management framework complies with relevant policies and legal requirements of national and local government, as well as World Bank Environmental Assessment Policy (OP4.01) regulations. This framework is prepared to provide guidance to environmental management agencies and departments, standardize subproject siting, construction and management, ensure by all means to avoid and minimize the environmental impact; for those impacts that can't be avoided, necessary measures will be developed according to national law and World bank policies. The framework establish a mechanism for public participation and complaints, some technical guides and specifications relating to the environment management framework will be supplemented to provide guidelines for EIA as well as a set of screening tools for environmental experts involved in this project, including experts working for project implementation organizations and WB. These guidelines cover some critical materials needed by project capacity building, which will accept further modification and update in the implementation process of project so as to incorporate the newly acquired experience.

2 Policies, Laws and Regulations and Basis of Compilation

2.1 National laws

Since the 1980s, China has carried out environmental impact assessment in accordance with environmental protection act and relative laws and regulations; this has become applicable to all investments in China documented procedures. Closely associated with this project is the laws and regulations about environmental protection and pollution control:

(1) Environmental Protection Law of the People's Republic of China (December 26, 1989);

(2) Water Pollution Prevention and Control Law of the People's Republic of China (PRC) (June 1, 2008);

(3) Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution (September 1, 2000);

(4) Law of the People's Republic of China on the Prevention and Control of Environmental Noise (March 1, 1997);

(5) Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste (April 1, 2005);

(6) PRC Environmental Impact Assessment Law (September 1, 2003);

(7) Law of the People's Republic of China on Water and Soil Conservation (March 1, 2011);

(8) Water Law of the People's Republic of China (October 1, 2002);

(9) Cleaner Production Promotion Law of the People's Republic of China (Revised on February 29, 2012);

(10) Renewable Energy Law of the People's Republic of China (2009 Amendment);

(11) Circular Economy Promotion Law of the People's Republic of China(January, 2009);

(12) Land Administration Law of the People's Republic of China (August 28, 2004);

(13) Agriculture Law of the People's Republic of China(December, 2002);

(14) Law of the People's Republic of China on Protection of Cultural Relics (October 2002);

2.2 Laws and regulations

Regulations on the Protection of Basic Farmland (December, 1998)

Regulations on Administration of Environmental Protection in Construction Projects (State Council Decree No. 253, November 29, 1998);

Provision measures of public participation in environmental impact assessment (February 22, 2006);

Opinions on strengthening ecological protection work（Ministry of Environmental Protection [1997]785, November28,1997）;

Notice on strengthening management and prevention of environmental risk in environmental impact assessment (Ministry of Environmental Protection [2005]152);

State council decision on implement scientific concept of development and strengthen environmental protection (state council [2005]39, December 3,2005);

Notice on strengthening the management of construction project loans from international financial organizations in environmental impact assessment(Ministry of Environmental Protection, national development and reform commission, financial ministry, people's bank of china, June, 1993);

Requirements of construction project environmental protection design (Ministry of Environmental Protection [1987]002);

Hazardous waste pollution control technology policy(Ministry of Environmental Protection[2001]199);

Management implementation details of construction project environmental protection of Hebei province;

List of support, restricted and prohibited construction projects in environmentally sensitive areas of Hebei Province (2005Revision);

2.3 Normative documents

(1) Technical guidelines for Environmental Impact Assessment. General program (HJ2.1-2011)；

(2) Guidelines for Environmental Impact Assessment. Atmospheric Environment (HJ2.2-2008)；

(3) Technical guidelines for Environmental Impact Assessment. Surface water environment (HJ/T2.3-1993)；

(4) Technical Guidelines for Environmental Impact Assessment. Groundwater Environment(HJ610-2011)；

(5) Technical Guidelines for Environmental Impact Assessment. Noise Impact Assessment (HJ2.4-2009)；

(6) Technical Guidelines for Environmental Impact Assessment, ecological impact Assessment (HJ19-2011)；

(7) Outline of the national ecological environment protection (November 28, 2005);

(8) Emission standards of environment noise for boundary of construction site(GB12523-2011);

(9) Integrated wastewater discharge standard(GB8978-1996);

(10)Procedural regulations regarding the environment quality monitoring of water for agricultural use (NYT 396-2000) ;

(11) Technical specifications requirements for monitoring of surface water and waste water (HJ/T91-2002);

(12) Technical specifications for pollution treatment projects of livestock and poultry farms (HJ497-2009);

(13) Technical specifications for operation maintenance and safety of biogas in scale animal and poultry farms (NY/T1221-2006);

(14) Technical requirement for non-hazardous treatment of animal manure (NY/T 1168-2006);

(15) Pollution control technology policy of livestock and poultry breeding (Ministry of Environmental Protection [2010]151);

(16) Code for design and construction of filling station (GB50156-2002).

2.4 World Bank safety control policy

WB safety insurance policy is to give consideration to social and environmental impact brought by projects invested by WB, including analysis of possible impact and measures to slow down negative influences. It can not only avoid damage to environment or human, but also complete project design, improve work efficiency as well as protect reputation of WB and borrower.

Operational Manual - BP 4.01 - Environmental Assessment

Operational Manual - OP 4.11 - Physical Cultural Resources

Operational Manual - OP 4.12 - Involuntary Resettlement

Environmental, Health, and Safety Guidelines: Introduction

Environmental, Health, and Safety Guidelines: Air Emissions and Ambient Air Quality

Environmental, Health, And Safety Guidelines: Wastewater And Ambient Water Quality

Environmental, Health, And Safety Guidelines: Noise

Environmental, Health, And Safety Guidelines: Mammalian Livestock Production

Environmental, Health, And Safety Guidelines: Waste Management

3 Environmental management procedures

The environmental management procedures include 5 steps during project preparation and construction; and 5 steps during project operation. For each step, the requirements and responsibilities are as follows:

A. Project preparation and construction

(1) Project screening and classification

(2)Preparation of the EIA documents

(3)Public consultation (public opinion consultation and information disclosure)

(4)Complaints mechanism

(5)Review and approval

B. Project operation

(1) Supervision

(2) Report

3.1 Project screening and classification

Subprojects apply to join the Hebei Rural Renewable Energy Development Demonstration Project will be continuously identified and obtain loans during the project implementation. In order to ensure that the new subproject meets the requirements of world bank, the sub project need to be screened and classified by the environment management framework, so as to guide the preparation of environmental management plan, and keep consistent with the requirements of world bank and environment management plan in aspects of environmental impact screening, reduction and management measures.

Project screening

Steps :

Subproject screening, environmental impact reduction and management measures should comply with the following steps (see the flowchart in figure 1):

Step 1: Recognize subprojects according to selection standard and principles;

Step 2: The technical expert group of provincial PMO reviews and filters the list to determine subprojects;

Steps 3: The technical expert group offers proposals based on the site, scale and current conditions of the subproject;

Step 4: Place corresponding environmental requirements;

Step 5: Place management requirements;

Step 6: Report to the provincial PMO and file documents;

Step7: Go through internal review and approval by WB;

Step8: Put the agreed action, supervision, monitor and assessment into practice.

Detailed requirements of new subproject screening refer to attached list 1. The detailed requirements of selecting of new subproject site and biogas pipeline refer to chapter 4.4 in this environmental management framework.

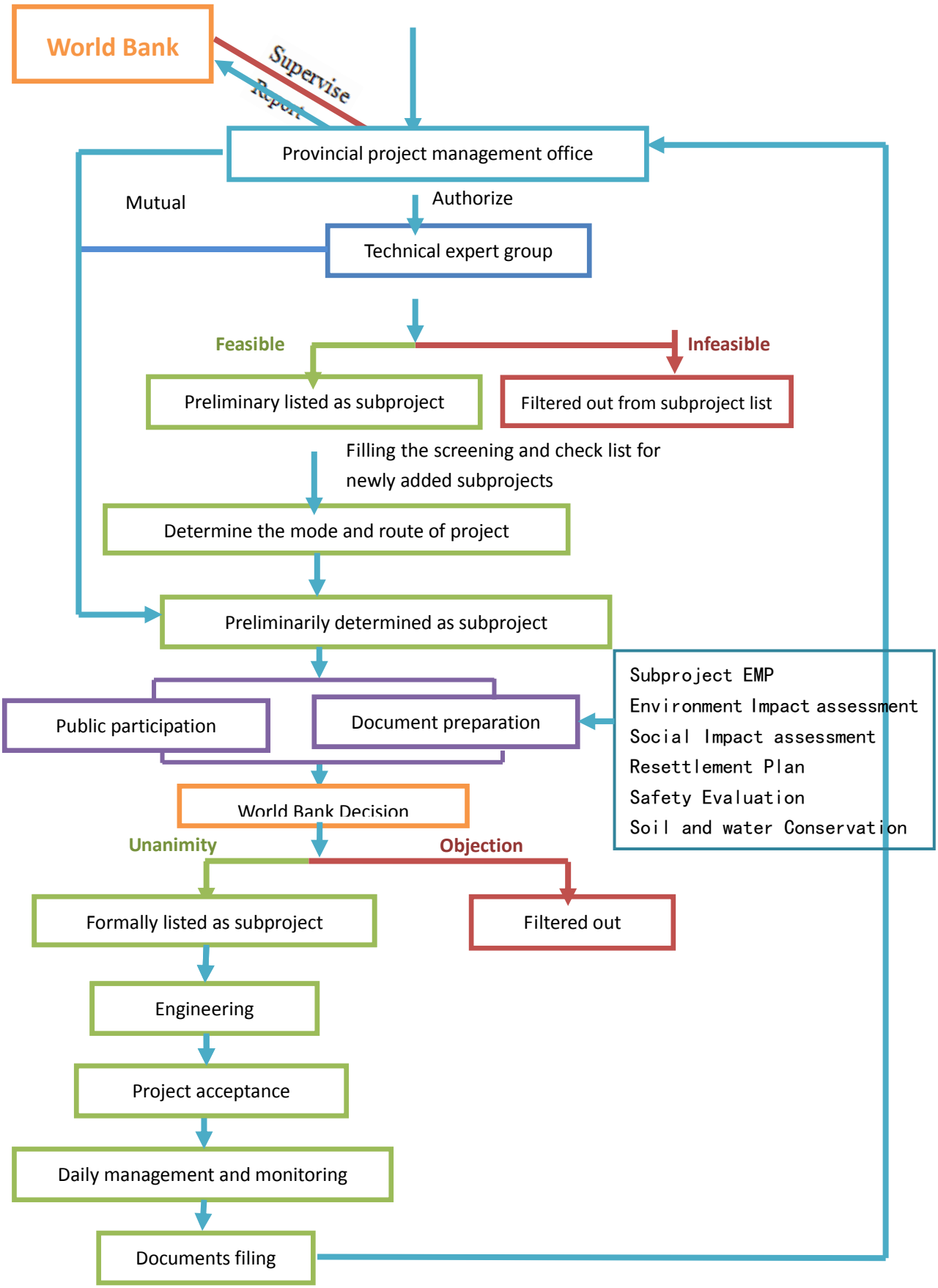

Figure 3-1 Flow chart for adding livestock farms in project

Engineering classification

This project intends to focus on the supporting of large-scale biogas production and centralized biogas supply project using straw and farming waste as raw material; According to project engineering characteristics and environmental impact features, new subprojects can be divided into the following categories:

Table 3-1 Engineering category

Project major category	Project subcategory
Biogas, bio-fertilizer, electricity generation project	Biogas production
	Bio-fertilizer production
	Electricity generation
Biogas pipeline, biogas filling station project	Biogas pipeline project
	Biogas filling station Gate stations
Demolition and resettlement	Demolition and resettlement

As the positions for all the gas filling stations and gate stations under the first batch works are not identified yet, the EA dor them has been included in the EMF.

3.2 Document preparation and requirements

Subproject borrowers have to provide documents listed in following table:

Table 3-2 Documents and requirements to be provided

No.	Documents	Attached monitoring	Approval department
1	Subproject environment management plan (EMP)		
2	Environment impact assessment (EIA)	Environment monitoring	Local environment protection departments
3	Social impact assessment		
4	Resettlement plan		
5	Safety evaluation		Safety production supervision departments

Subproject borrowers have to provide above documents.

Above documents should be prepared by agencies with relevant qualifications and experience, which have the approval of relevant local departments. Environmental management plan should be prepared in accordance with the requirements of the World Bank.

Subproject environmental management plan should include the main conclusion of EIA, Safety evaluation, Social impact assessment, Resettlement plan, it should also include all environmental protection measures during the design, construction and operation of the subproject. These measures should eliminate or compensate for the adverse effects of the project actives, or at least reduce the impact to acceptable levels.

Environment management plan (EMP) should have the following contents:

1 Qualitative analysis and evaluation of the current natural environment and social-economic conditions of the project area, determine the scope and extent of the environment impact assessment, review the design and implementation of the environment protection plan.;

2 Evaluation of the positive environmental impact; Identification, screening and predictive analysis of possible negative environmental impacts;

3 For inevitable negative environmental impacts, propose targeted and effective mitigation measures;

4 Develop requirements to ensure the timely and effectively implementation of these measures;

5 Assessment of the actual effect of these mitigation measures.

EMP outline should refer to following contents:

Outline of subproject EMP	
1Project profile 1.1 Project introduction 1.2 Purpose of EMP 1.3 Evaluation Scope 1.4 Environmental impact factor identification 1.5Evaluation level and methods 1.6Environmental protection objectives 2 Policies, laws and regulations 2.1 Basis of compilation 2.2Technical guidelines 2.3Compliance with relevant polices and planning 2.4 Evaluation criteria 3 Environmental conditions 3.1Environmental overview 3.2Present environmental quality 3.3Animal waste management situation 3.4Straw management situation 3.5Rural Household fuel situations 3.6Fertilizer using situation 3.7Respiratory disease situation 4 Project content 4.1 Construction content and scale 4.2 Construction plan 4.3 Technique description 4.4Component analysis 5 Environmental impact and mitigation plan (EIMP) 5.1 EIMP in construction period 5.2EIMP in operation period 5.3EIMP for environmental sensitive points 5.4Social impact analysis 5.5Environmental, Health, and Safety analysis	7.4 Environmental risk prevention and mitigation measures 7.5 Emergency plan 8 Alternatives analysis 8.1 Zero scheme analysis 8.2 Comparison and selection of project site 8.3 Comparison and selection of technique 9 Due diligence 9.1 Raw material guarantee 9.2Fertilizer market 10EMP 10.1Environmental management institution 10.2Environmental protection measures 10.3Capacity strengthening and training 10.4Environmental monitoring plan 10.5Information management and public complaints 10.6Environmental investment cost estimation 11Public consultation and information dissemination 11.1Purpose of the public consultation and information disclosure 11.2Methods of public consultation 11.3Mintutes of public consultation, comments and feedback 11.4 information dissemination 11.5Public consultation results of Social impact assessment Attachment: Attached list 1 Construction checklist Attached list 2 Environmental Rectification Notice Attached list3 Cultural relic emergency

6Land acquisition and relocation 7 Environmental risk analysis and mitigation measures 7.1Environmental risk identification 7.2Source term analysis 7.3 Environmental risk consequence analysis	preplan flow chart Attached list 4 environmental protection measures summary Attached list 5: Social management plan Rollup Attached list 6: Summary of environmental monitoring plan

3.3 Information publication and negotiation

Subproject borrowers are responsible for the organization of public consultation according national and world bank requirements, mainly including: a)EIA documents release；b)opinion consultation; c)record important discoveries, conclusions, recommendations and feedback. Subproject borrowers should release project announcements, full text EIA documents in public, collect the views of affected people. Public consultation methods include questionnaires, seminars, hearings, etc. Because there are uneducated crowd in rural area, seminars, hearings, etc should be taken as the main public consultation method. Public consultation procedures and methods should be developed according to nation and World Bank requirements. There should be as least two rounds of public consultation and information dissemination. The first round should be organized after the environmental impact screening and before the completion of EIA outline, release project information, environmental impact and mitigation measures, collect public opinions, and to provide feedback in affected areas. The second round should be organized after the completion of EIA draft, put out full text EIA on local website, mainstream media or village committee where the information is accessible for all affected public, collect public opinions, and to provide feedback.

3.4 Complaint handling

If the affected individuals and organizes think that they are not treated properly in this project, it is necessary to establish a complaint handling mechanism to achieve a reasonable concern. Such mechanism should include: (1) Record and report system, including written and oral complaint; (2) being in charge of personnel designate by all levels of governments; (3) time limit for handling complaint. Besides, the mechanism will be specified in the safety control documents of the subproject. During implementation of the project, the PMO will carry out regular monitoring and assessment on execution of the complaint handling mechanism.

Complaint process should include: affected group or individuals can file a complaint in the form of oral or written message directly to the subproject borrower; subproject borrower should give reply

within time limit after receiving the complaint. If the complainant are not satisfied with the results, he can appeal to local environmental protection department. If the complainant are still not satisfied with the result, he can sue to local people's court.

3.5 Audit and Approval

National audit and approval: The project borrower is responsible for national audit and approval of EIA documents. Meanwhile, the project borrower should insure that EIA document was prepared based on the requirements from business policies, guidelines and procedures of Word Bank.

World Bank audit and approval: EIA document will be checked by World Bank to insure it simultaneously meet the national and World Bank requirements.

Project implementation stage: The project borrower is responsible for comprehensive and effective implementation of EIA and EMF of whole Word Bank loan project. It also should employ outside environmental monitoring institution to conduct environmental monitoring according to requirements of EMF, and submit progress report.

3.6 Supervision

During the project implementation period, the project implementation condition will be supervised by Word Bank jointly with the local competent department of environmental protection administration and project borrower to insure it meet the requirements of EMF.

3.7 Report

During the period of project implementation, the project borrower and implementation agency should regular report implementation condition of EMF. The implementation agency should carefully record monitoring results according to the monitoring scheme in EMF, and insure necessary rectify or protective measures must be adopted during the monitoring period. The progress report submitted by the implementation agency should include implementation condition of EMF (such as mitigation measure and supervisions), if exist major environmental problems and relevant solutions. The semi-annual EMF implementation report should be submitted to Word Bank by the project borrower, which includes the implementation of EMF, the occurred environmental problems and relevant solutions and results.

4 Environmental Impact Identification

4.1 Content of Environmental Impact Identification

The categories of engineering project in this EMF: 1) the engineering on bio-gas, bio-fertilizer and power generation, 2) the engineering on bio-gas supply pipeline and station.

Based on environmental impact characters from the project, regional environmental characters, control index listed in standards and stipulations on environmental protection at national and local level,

and Word Bank requirements, the environmental impact factors are identified. The environmental impact factors at different phase see Table 4-1.

Table 4-1 The environmental impact factors at different phase

Impact factors \ Engineering Characters		Construction period					Operation period							
		Construction	Site clearing	Material transportation and stack	Crossing engineering	construction encampment	Waste gas	Waste water	Solid waste	Noise	Fire and explosion risk	Bio-gas supply	Power generation	Bio-fertilizer
Natural environment	Environmental air													
	Surface water													
	Underground water													
	Sound environment													
	Electromagnetic environment													
	High temperature environment													
	Greenhouse gas reduction													
Ecological environment	Crop													
	Soil													
	Surface vegetation													
	Land utilization													

Social environment	Economic development													
	Expanding employment													
	Occupational health													
	Life quality													
	Environmental landscape													
	Respiratory system disease													

Note: + positive effect, - negative effect; ★ large impace,☆ general impact, ○ slight effect。

4.2Main Environmental Problem Identification

(1) Sensitive area identification

According to the field investigation, nature reserve, national forest park, national key public welfare forest land, scenic area are not involved in the project sites and covering area along the line decided by this EMF.

(2) Sensitive protection target

After project contents and route were confirmed, the detailed field investigation will be conducted. Once the sensitive protection targets were found, EIA grade should be determined according to related national stipulations, and the specific abatement measures also should be developed.

(3) Environmtal impact factor identification

Based on environmental impact factors from subproject, regional environmental characters, control index listed in standards and stipulations on environmental protection at national and local level, and Word Bank requirements, the environmental impact factors are identified. The identification of environmental impact factor see Table 4-2.

Table 4-2 Identification of environmental impact factor

Activities may affect environmental resources and values	Natural or social Damages or benefits	Impact analysis basis	Typical mitigation measures	Engineering classes and possible impact factor identification	
				Biogas, bio-fertilizer, power generation project	Pipeline, biogas plants project
1 Possible environmental problems during construction					
Crossing sensitive points such as roads, villages, surface water, irrigation facilities, etc.	Traffic blocking, environmental impacts of waste water, gas, etc.	Pipeline layout, sensitive point position, construction methods, social impact, environmental impact	During the design and selection of pipeline layout and site selection, the avoidance of sensitive points should be fully considered		
	Schools, hospitals and nursing homes, etc.	Construction noise and students safety	Construction should stop during noon(12:00-14:00), evening(20:00-6:00), college entrance exam, high school entrance exam		
Temporary land occupation during pipeline construction	Pipeline excavation impact on arable land, crops, traffic and pedestrian safety	land occupation area, social impact, economic value	When the construction need to interrupt with municipal services (including water, electricity, telephone and bus routes,		

			etc.), at least five days of announcements should be made to affected public, with the beginning and ending of interrupt service time. Construction site vegetation should be restored to an extent, at least to the state before construction. Contractor is responsible for the execution of the pipeline ECOP		
Temporary land occupation of the construction material stacks	land use and production, pedestrian safety	land occupation area, social impact, economic value	Supervision on the construction activity		
Vegetation clearing	Ecological damage	Damaged land Type/ area(arable land), economic value, damaged ecological landscape	Clearing method		
Waste generated during earthwork	Soil erosion and fertilizer losing	Position of temporary earthwork stacks, natural drainage patterns	Contractor's responsibility (drainage and sediment tanks), supervision		
	Land occupation and irrigation facilities damage	Position, scope, land occupation purpose	Contractor is responsible for "temporary land occupation and irrigation facility		

			management”		
	Dust emission	Position, distance and wind direction of the residential	Project construction schedule Contractor duty(watering) Supervision of the earthwork project		
Transportation of the construction material and equipment	Dust and noise	Material volume, traffic transportation	Prohibit open-top carriage, breakdown cars on the road		
Employment of construction workers	The hiring of local labor can bring direct benefits to local residents	Expected number of employment Estimated number and proportion of local employment	Contractor duty (small civil works ECOP)		
	Pollution of domestic sewage to nearby surface water	Surface water quality, environmental quality standards, emission standards	Contractor duty (small civil works ECOP)		
Solid waste	Soil pollution	Category and quality of solid waste: domestic garbage, construction waste, unneeded soil	Contractor duty (small civil works ECOP)		
Construction	Un-restored construction site	Temporary land occupation	Contractor duty (small civil works		

completion		and position Equipment that may be used, wastes generated	ECOP)		
Biogas power generation	noise	Noise standard Distance to nearest residential Occupational health	Purchase low-noise equipment, daily maintenance and supervision		
	Waste water	Treatment and discharge of waste water from soft water preparation	Used for dust suppression after neutralization		
	Solid waste	Content and category	Solid waste treatment		
	Air emission	Ambient Air quality at plant site	Environmental quality standards, emission standards Flue gas pollutant monitoring Low NOx combustion technology Desulfurization, denitrification technology		
	Electromagnetic, thermal influence	Occupational monitoring	Safety assessment, occupational health assessment		
	Fire, explosion	Environmental risk	Risk prevention measures and emergency plans		
Biogas production, bio-fertilizer production	Air emission	Ambient Air quality at plant site	Environmental quality standards, emission standards Measures to reduce the odor		

	Waste water	Treatment and discharge of waste water (silage tank, biogas liquid, domestic sewage)			
	noise	Noise standard Distance to nearest residential	Purchase low-noise equipment, daily maintenance and supervision		
	Solid waste	Waste Desulfurizer, biogas residues, domestic garbage	Waste Desulfurizer is send to supply manufactures for recycling; domestic garbage is collected by the local sanitation departments		
	soil	Soil pollution near the fermenter, biogas residue and liquid tanks; heavy metal and organic pollution caused by organic fertilizer use; soil quality improvement caused by using of organic fertilizer instead of inorganic fertilizer or manure	Content of manure and bio-fertilizer		
	Environmental risk (Fire, explosion)	Ambient Air quality Environmental risk of Fermenter, compression and purification plant, biogas	Environmental quality standards, emission standards Measures to reduce the odor Risk prevention measures and		

		cabinet	emergency plans		
	Social impact	Living standard, the ability and willingness to pay	Heating, electricity supply can promote economic development and improve living standards Reasonable pricing, implementation of subsidy policy		
Biogas pipeline	Gas in substitution of coal	Reduction of air pollutants			

4.3 EMT Selection

Based on the type and characteristics of subproject included by the EMF, different environmental management tool (EMT) should be selected for them. Main EIA tools: EMP, EIA.

EIA should be simultaneously met national and World Bank requirements.

EMP should include all environmental protective measures for project design, construction and implement three steps. All those environmental protective measures should eliminate or compensate harmful environmental and social impact from subproject activities, or at least reduce harmful impact to acceptable level.

The main conclusions from EIA, social impact assessment, safety assessment, water and soil conservation (if needed), implement requirements, risk management measures should be included in EMF.

EMT for the subproject included by EMF should be selected according to requirements in Table 4-3.

Table 4-3 EMT selection

Broad category	Subcategory	Nature	EMT	Note
Engineering on bio-gas, bio-fertilizer and power generation	Bio-gas production engineering	New	EIA, EMF	Approved by Department of Environmental Protection
	Organic fertilizer engineering	New	EIA, EMF	Approved by Department of Environmental Protection
	Power generation engineering	New	EIA, EMF	Approved by Department of Environmental Protection
Engineering on bio-gas supply pipeline and station	Bio-gas supply engineering	New	EIA, EMF	Approved by Department of Environmental Protection
	Bio-gas station engineering	New	EIA, EMF	Approved by Department of Environmental Protection
Demolition and relocation	Demolition and relocation engineering	-	Demolition and relocation plan	-

4.4 Requirements for Site and Rout Selection

(1) Requirements for site selection of Bio-gas production engineering

①The construction of bio-gas station is prohibited in the forbidden areas. The forbidden areas include life drinking water source reserves, scenic areas, the core and buffer of nature reserves; City and town residential areas include cultural, education and scientific research areas, medical areas, commercial areas, industrial areas, excursion areas and other densely inhabited areas; The forbidden areas demarcated by the people's government at county level according to law; Other areas needed special protection according to national or local laws and regulations;

②Bio-gas stations nearby the forbidden areas should located in downwind direction or side of perennial dominant wind direction; new, reconstruction and extension of biomass project's

environmental protection distance isn't less than 300m.

③Engineering geological condition of gas station is preferable;

④Waste water from the bio-gas station isn't flowed into sensitive waster areas and other waster areas owned special functions.

⑤The land utilization of the bio-gas station meets overall plan for land utilization of township (town). And the land contract (subcontract) or relevant procedure has been transacted.

⑥Before the bio-gas construction, its EIA document

⑦The transportation, water and electricity supply of bio-gas station should be convenient;

⑧The extra land for the extension of bio-gas station should be prepared;

⑨Self-finance capacity should be had for the bio-gas station, and a commitment for this was made.

⑩ Most reasonable and economic feasibility site of bio-gas station should be choose through the comparison of different scheme.

(2) Pipeline engineering route selection requirements

①At route design phase, in-depth and detailed study on route selection schemes should be conducted through advanced methods. On the basis of schemes approachment and comparison, the optimal scheme is selected considering society, environment, technology, cost and other factors.

②Under the premise of traffic safety, comfortable and fast, the route design should guarantee to minimum engineering quantity, low cost and operating expenses, good benefits, and conducive to construction and maintenance. If the increase of engineering quantity is small, high technology indicators should try to be adopted. Low indicators isn't easily choose, also high indicators isn't sought at one-side.

③Route selection should be achieved that less farmland occupied, and high yield field, economic crops field or economic gardens (such as tea garden, orchard) aren't occupied as far as possible.

④It should avoid route to occupy nature reserves, scenic spots or historic sites, etc., keep in harmony with the surrounding environment, landscape, and pay attention to protect important historical relics sites.

⑤It should develop a thorough survey of engineering geology and hydrogeology for route selection to find out the influence degree to highway engineering.

⑥Reduce original terrain destruction to achieve the purpose of environmental protection; Take full advantage of the characteristics of mountainous terrain slope big, fill ditch digest waste side, so as to achieve the goal of the dumping waste.

(3) gas-station location selection requirements

Site selection should be based on the requirements of *Design and Construction Specification for Gas Station (GB50156-2002)* (see Table 4-4).

Gas-station location selection should be consistent with urban planning, environmental protection and fire safety requirements;

Fireproofing distance between inside facilities (such as ventilation tube mouth)

and outside buildings must be conformed to requirements of *Design and Construction Specification for Gas Station (GB50156-2002)*, and specifically confirmed by different grade of bio-gas station.

First grade gas station shouldn't be built in urban build-up area. The second and third grade gas station can be built in urban build-up area at following conditions: Fireproofing distance between inside facilities (such as ventilation tube mouth) and outside buildings conformed to requirements of *Design and Construction Specification for Gas Station (GB50156-2002)*; the location selection meet the requirements of urban planning and environmental protection and has convenient traffic conditions, and others.

Gas and oil station built in urban build-up area should be close to the urban road, whose location is unfavorably chosen nearby the intersection of urban primary road.

The distance of gas storage well group, filling machine, compressor respectively with outside railway and urban road isn't less than 22m and 6m.

The distance of gas storage well group, filling machine, compressor respectively with second and third class civil building isn't less than 14m and 12m.

The distance of gas storage tank group respectively with minor road, bypass isn't less than 10m, and with high tension line isn't less than 1.5 times pole height.

The distance of filling machine, compressor respectively with minor road, bypass isn't less than 5m. The high tension line shouldn't span gas-station.

Table 4-4 Fireproofing distance between technology facilities of CNG station and buildings outside CNG station

Fireproofing distance (m)			Name		
			Group gas storage cylinder, desulfurization and dehydration equipment	Ventilation tube mouth	Gas storage well group, air-entrapping well group, compressor
Term	Important public building		100	100	100
	Sites produced open fire or spark		30	25	20
	Protection category of civil building	First class			
		Second class	20	20	14
		Third class	18	15	12
	Production workshop, storeroom for a and b class items, warehouse, and storage tanks for liquid a and b		25	25	18
	Production workshop, storeroom for other class items, storage tanks for liquid c and underground storage tanks(volume is not more than $50m^3$) for liquid a and b		18	18	13
	Outdoor sub-station		25	25	18
	Rail		30	30	22
	Urban road	Express way, primary road	12	10	6
		Minor road, bypass	10	8	5
	Overhead communication line	National level 1 and 2	1.5 times pole height	1.5 times pole height	Shouldn’t span station
		Common	1 time pole height	1 time pole height	
	Overhead power line	Voltage >380V	1.5 times pole height	1.5 times pole height	Shouldn’t span station
		Voltage≤380V	1.5 times pole height	1 time pole height	

Note: 1. Fireproofing distance between device equipment and buildings outside the station should be determined by fireproofing distance of corresponding

equipment in this table.2. Fireproofing distance between device equipment and rural road should be determined according with the urban road: highway, class I and class II road according with the urban express way and primary road; Class III and IV road according with minor road and bypass. 3. Fireproofing distance between fixed parking space for storage tank trailer and outside buildings should be determined by the fireproofing distance of storage tank in this table.4. Overhead communication line and power line shouldn’t span station.

5 Environmental Management Process and Institution

5.1 Environmental Management Process

Environmental management process of project see Figure 5-1.

5.2 Environmental Management Institution and Its Duty

Environmental management institution and its duty of project see Table 5-1 and Table 5-2.

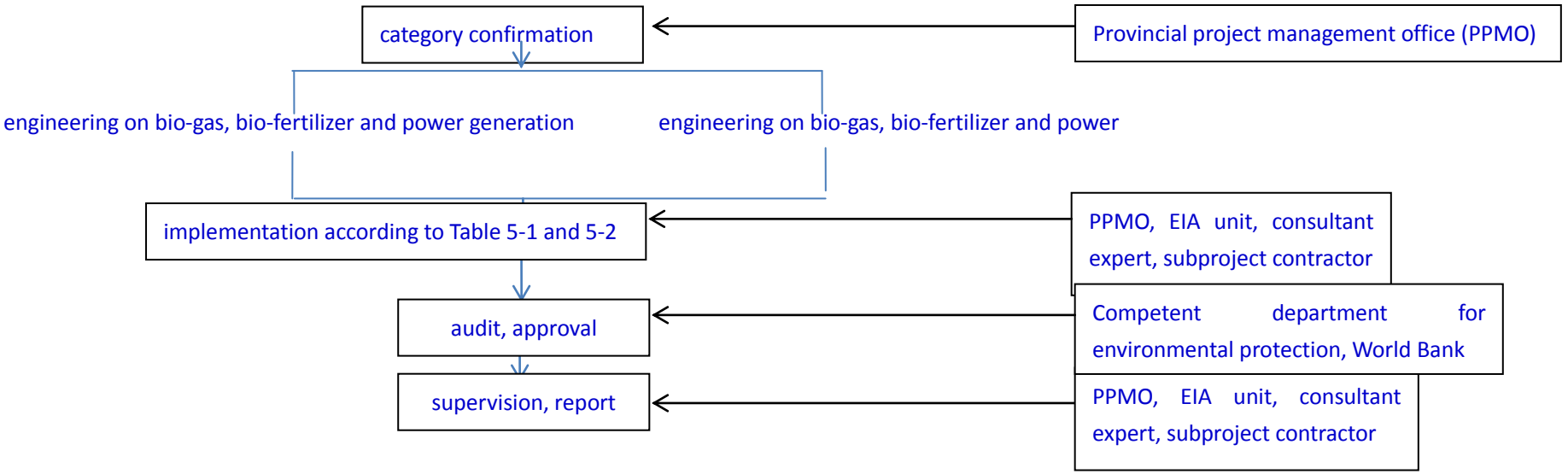

Figure 5-1 Environment management flow

Table 5-1 Constitution of environment management system

Nature	Name	Mission
Management institution	Provincial leading group office	Environment management institution of project
Supervisory institution	World Bank	The supervision, inspection of EMP, supervision and inspection for EMP implementation will be conducted by World Bank at least once a year
	Town/Country environmental protection bureau	The administrative department of supervision and administration
Contractor	Qualified construction unit	The implementation of environmental protection measures at construction period
Coordinating institution	PPMO	In charge of communication between office and subproject contractor; Regular data and information collection from subproject contractor, development and submission of the report
Consultancy and service institution	Experts	The implementation of environmental audit, consulting, technical support under the authorization from environment management institution
	Environmental monitoring institution	To undertake professional environmental monitoring tasks under the authorization from project implementation institution

Table 5-2 Environmental management institution and its duty

Institution name	Supervisory bodies	**Institution responsibility**
①environmental protection departments at all levels	Supervisory agency	**Whole process environmental supervision and management, including: approval of the EIA (including subproject EIA works), environmental supervision and management during construction and operation.**
② provincial project leading group and PMO	Implementing agency	Preparation and monitoring of the implementation of EMP; Supervise and coordinate the implementation of the national and World Bank management requirements; Submit the reports to th World bank every half year; Check the PMO environmental management at all ;evels; Coordinate with other departments to solve major environmental problems; Entrust environmental expert group to check the group;
③ provincial project leading group and PMO	Implementing agency	Preparation and monitoring of the implementation of subproject environmental management regulations; Organize the preparation and approval of domestic EIA documents; Promote the project designed to meet the requirements of the EIA; Environmental protection measures in the EMP should be taken into the construction contract; Organize environmental management training plan; Organize thematic studies or relevant investigation; Make a record of the public complaint during the construction and operation, give answers to the public, address public complaints; Review of the environmental consulting report; Submit a report to the PMO every three months; Sign the construction site check list, check environmental sensitive issues and archive; Accept environmental working inspection 9including the World Bank project check)
④World bank	Supervisor	World bank send inspection team every year responsible for the specific inspection of the implementation of the project

	ry agency	Check the implementation of the project loan agreement and EMP;
⑤ EIA agency with B qualification	EIA agency	Site visit to each project, environmental impact assessment; EMP preparation;
⑥environmental expert group hired by PMO	Consulting service agency	Check the construction site, assist the PMO check the subproject's environmental protection work; Guide the EIA and construction company with the project design and construction, report to PMO, give environmental protection recommendations and comments
⑦Environmental monitoring agency	Consulting service agency	During the construction and operation, conduct environmental monitoring in accordance with the "environmental monitoring plan", report to PMO and archive; Check the wastewater treatment, soil and water conservation treatment, gas emission and noise control measures, solid waste treatment, sanitation and epidemic prevention; Regularly fill in the EMP checklist in the attachment (attached list1 and 2); Raise rectification plan and follow the implementation for the environmental issues during the construction, including: rectification notice (attached list3)check the file archiving; Preparation and submit the implementation of the environmental protection measures report weekly to PMO
⑧construstion agency	construstion agency	Implementation of the environmental protection measures; Accept supervision and inspection from project engineering supervisor, world bank and environmental protection departments; Establish a feedback mechanism, complete the rectification in three days after receiving a rectification notice (10 working days if need coordination from management agencies) Fill in the check list 1 and 2 together with the engineering supervisor before the construction, report to PMO; Report the implementation of the environmental protection measures weekly to the engineering supervisor.

5.3 Training and Cost Requirement of Environmental Management Institution

5.3.1 Content of environmental training

The training from environmental management institution should be included:

The mastery and apply of World Bank environmental policies and national laws and regulations, standards on environmental protection;

Environmental management mode of World Bank loan project and environmental terms in loan agreement;

EMF and EIA of this project;

Environmental management provision of this project;

Technology management framework of bio-gas engineering;

Safe operation manual for bio-gas pool;

Contingency program of bio-gas project;

Maintenance management and safe operation of bio-gas transmission pipeline and station;

Safe awareness enhancement and education program for public from sensitive point;

The duty and interrelation among environmental manager, engineering project supervisor, environmental monitoring staff and contractor of subproject.

Environmental management report, environmental supervision report and environmental monitoring report.

Table 5-4 Training content

Topic	Target	Detailed content
Regulation and policies on environmental protection	Subproject contractor, construction unit	Ⅰ Laws and regulations on environmental protection
		Ⅱ EMF
		Ⅲ Word Bank environmental management
Implementation of EMF	Subproject contractor, construction unit, supervision unit	Ⅰ Environmental protection duty at project construction period
		Ⅱ Main tasks of environmental protection at project construction period
		Ⅲ Main contents of environmental protection at project construction period
		Ⅳ EMF(including environmental management procedure)
		Ⅴ Improve or amendment of EMF
		Ⅵ Inside monitoring method, data collection and handling, etc.
		Ⅶ Construction safety
Crisis management	Subproject contractor, construction unit	Bio-gas operational safety; Maintenance management and safe operation of gas transmission pipeline, transport vehicle, gas

Topic	Target	Detailed content
		station
Public safe awareness and education program	Subproject contractor, community/village cadres, resident	Lectures on gas utilization, distribution of gas safety using manual and promotional material, regular check and promote gas safety knowledge
Environmental monitoring inspection, report	Subproject contractor, environmental monitoring staff	The check of the environmental protection facilities, environmental quality monitoring, preparation of the report
Environmental protection facility, environmental protection measures	Subproject contractor,	Ⅰ Environmental safety regulations and procedures
		Ⅱ Contingency program for bio-gas operation

5.3.2 Environmental training program

The environmental training will be intensively conducted at the beginning of project. It aims to insure all the participants fully know their duties at the environmental activity implementation, and better know environmental management monitor plan's implementation reasons and functions on long-term economy and human health.

Table 5-5 Capacity building and training schedule

Topic	Targets	Content	Times	Days/ time	Number/ Time	Budget (Ten thousand yuan)
construction period						
Regulation and policies on environmental protection	Subproject contractor, construction unit	Ⅰ Laws and regulations on environmental protection				
		Ⅱ EMP				
		ⅢWord Bank environmental management				
Implementation of EMF	Subproject contractor, construction unit, supervision unit	Ⅰ Environmental protection duty at project construction period				
		Ⅱ Main tasks of environmental protection at project construction period				
		Ⅲ Main contents of environmental protection at project construction period				
		Ⅳ EMF(including environmental management procedure)				
		Ⅴ Improve or amendment of EMF				
		ⅥInside monitoring method, data collection and handling, etc.				
		ⅦConstruction safety				
Crisis management	Subproject contractor, construction unit	Bio-gas operational safety; Maintenance management and safe operation of gas transmission pipeline, transport vehicle, gas station				
Subtotal of construction						

Topic	Targets	Content	Times	Days/ time	Number/ Time	Budget (Ten thousand yuan)
period						
Operation period						
Environmental monitoring inspection, report	Subproject contractor, environmental monitoring unit	The check of the environmental protection facilities, environmental quality monitoring, preparation of the report				
Environmental protection facility, environmental protection measures	Subproject contractor, operator, pipeline, serviceman for bio-gas station	Ⅰ Environmental safety regulations and procedures				
		Ⅱ Contingency program for bio-gas operation				
Safe awareness, safe facility	Subproject contractor, community/village cadres, resident	The use and safety knowledge training for new energy				
Subtotal of operation period						
Subtotal						

6 Environmental Codes of Practice

For the projects taken into EMF, Environmental Codes of Practice is formulated to guide the environmental management activities during the design, construction and operation of the project. It mainly include environmental management measures, institutional procedures and requirements. For environmental sensitive points, detailed impact analysis and pretection measures will be taken. Refer to table 6 for details.

Table 6 Environmental Codes of Practice during construction and operation

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
Design				
Implementation of environmental measures in the construction design and tender preparation process	(1)In the process of construction， contractor have to communicate with public around the construction area, establish bulletin boards at the entrance to each construction site, inform the public of detailed construction activities and construction time, while providing contacts and their telephone number, to facilitate public complaints and suggestions. (2) The construction contractor shall actively cooperate with project owner to complete the environmental supervision works. (3) Before the start of the construction, the construction program must include “environment management plan of the construction site” (4) The contractor must comply with local regulations on the safely and orderly construction. (5)Before the construction, Construction company must receive training on environmental protection and environmental management. (6)For serious environmental impacts caused by non-compliance with environmental protection measures, construction must take timely remedial measures and notify PMO within 24 hours. PMO should supervise and assist construction contractor with remedial measures. The contractor must record the implementation of the measures, and report to higher units. (7) Contractor have to set aside environmental management deposit from annual budget, the proportation of the amount accounted for about 3% of the budget should be funded.	PMO	PMO, Project owner, local EPA and transportation departments	
Construction				
Construction site	(1) Determine the scope of permanent and temporary occupy area; handle with relevant formalities of project land.	Constructi	PMO, Project	Project

item			Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
preparation ECOP			(2) Investigate existing pipelines to avoid damage to existing pipeline	on company	owner, local EPA and transportation departments	owner entrust a qualified institution by contract basis
			(3)Construction production site, borrow pits and slag fields should keep distance with surface water bodies.			
			(4)Construction company should consult with local relevant departments to determine suitable public water source, municipal water should be used as drinking water source, prohibit new wells drilling.			
Construction site management	Environmentalimpact control of the main construction area	Surface cleaning	(1)Water sprinkler should be used for dust suppression of the construction site.			
			(2)Construction waste should be removed timely; closed vehicles should be used for the transportation.			
		Roadbed construction	(1)Take strictly control on the excavation of roadbed and pipeline, to avoid damage on the surrounding vegetation,			
			(2)Construction waste should be removed timely; closed vehicles should be used for the transportation.			
			(3) Water sprinkler should be used for dust suppression of the construction site.			
		Vegetation recovery	(1)Construction site vegetation should be restored to an extent, at least to the state before construction.			
			(2)The arable topsoil stripped in the process of construction should be stacked in a relatively flat area，with bagged soil around as landing，and dust-proof network cover; There should be temporary gutters and grit chamber. The arable topsoil should be used for ecological restoration in the end of the construction.			
		Construction	（1）The construction time should be strictly controlled. For construction sites within the scope of 150 meters from the residential areas, machines of large noise were prohibited working during			

item			Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
		noise	22:00~06:00.			
			(2)Removable cultural relics should be surrendered to local administrative department of cultural relics proactively.			
			(3)Construction should keep as far as possible from school, hospital etc. construction work time of big noise machine should consult with school nearby. No construction during exam.			
		others	(1)Burning of all types of waste should be prohibited in construction site.			
	Construction production site environment control	Surface cleaning	(1)Water sprinkler should be used for dust suppression of the construction site.			
			(2)Construction waste should be removed timely; closed vehicles should be used for the transportation.			
		Asphalt mixing	(1) Municipal asphalt mixing plant is preferred for the purchase.			
			(2)Semi-enclosed boil asphalt operations should be prohibited.			
		asphalt mixing	(1)Commercial mixed concrete is preferred.			
			(2) Wet mixing concrete should be used, mixing processes should be sealed.			
		Material handling and storage	(1) In the process of powder transportation, handling and storage, dust shelter and dust suppression measures should be taken.			
			(2) Material storage site should be flat and solid.			
			(3) There should be hoarding measures around the powder material stacks, and Gabonese cloth cover to reduce erosion caused by storm.			
		vehicles	(1)Vehicles carrying powder should be covered and cleaned before leaving the construction site.			
			(2)Construction waste should be removed timely; closed vehicles should be used for the			

item			Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
			transportation.			
		Precast yard	(1) Concrete mixing wastewater should be collected in the sedimentation tank, and can be reused for dust suppression. After the construction, the sedimentation tank should be buried, and ecologically restored.			
		Construction noise	(1)Damping base should be installed for fixed machines with large vibration;			
			(2) The construction time should be strictly controlled. For construction sites within the scope of 150 meters from the residential areas, machines of large noise should be prohibited working during 22:00~06:00.			
		others	(1) Construction site vegetation should be restored to an extent, at least to the state before construction.			
			(2) The arable topsoil stripped in the process of construction should be stacked in a relatively flat area，with bagged soil around as landing，and dust-proof network cover; There should be temporary gutters and grit chamber. The arable topsoil should be used for ecological restoration in the end of the construction.			
			(3) Burning of all types of waste should be prohibited in construction site.			
Equipment	Drip oil pollution control		(1) Advanced equipment should be used in order to effectively reduce the oil drops and leaking, as well as the maintenance time.			
			(2) In the inevitable oil drop and leaking, solid-state absorbing material (such as cotton, sawdust, oil-absorbing paper) should be used, in order to avoid excessive wastewater.			
			(3) The maintenance of construction equipment should be concentrated at repair point of individual road section to facilitate the collection of oily water.			

item		Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
management		(4) There should be advection sedimentation tank at mechanical maintenance sites. Oily water should be treated with acid-base balance, precipitation, grease traps, slag removal, etc. before discharge. After the construction, the sedimentation tank should be buried and greened.			
		(4) The ground of the repair point should be hardened, and seepage treated, to avoid soil pollution.			
		(5)Keep regular repair and maintenance of the equipment			
	Equipment noise control	(1) All equipment should comply with the relevant national standards, low noise machines should be used in construction.			
		(2) Damping base should be installed for fixed machines with large vibration;			
		(3) Kept good maintenance and repair of all kind of equipment, in order to maintain their good running (to reduce noise and vibration)			
	Equipment exhaust gas control	(1)All equipment should comply with national health protection standards for construction equipment and transport vehicles, to ensure that gas emissions comply with the relevant national standards.			
	Solid waste control	(1) Qualified departments should be entrusted for the processing of sporadic hazardous waste (oil gloves, gauze top, etc.).			
		(2) The oil leaked into the soil should be collected using scraping device, sequestrated and transported to qualified departments for centralized treatment.			
		(3)when the maintenance of construction equipment can't be concentrated at repair point of individual road sections, solid-state absorbing material (such as cotton, sawdust, oil-absorbing paper) should be used, and transported to qualified departments for centralized treatment.			

item			Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
Construction material field Environmental protec	Borrow pits control	General requirements	(1)Earthwork balance should be kept; if borrowing earth was needed, urban construction waste soil is preferred, single borrow pits should be avoided.			
			(2) Borrow pits should be centralized.			
		Dust control	(1) Sprinkler should be used to reduce dust pollution.			
		Ecological impact control	(1) The arable topsoil stripped in the process of construction should be stacked in a relatively flat area，with bagged soil around as landing，and dust-proof network cover; There should be temporary gutters and grit chamber. The arable topsoil should be used for ecological restoration in the end of the construction.			
			(2)Construction site vegetation should be restored after the construction.			
		Landscape control	(1) Appropriate measures in accordance with the project EIA report should be taken.			
	Slag field environment control	General requirements	(1)Excess earthwork should be firstly considered for recycling use in situ or transported to other construction sites, or borrows pits' restoration, to avoid single waste earthwork field.			
			(2) The slag should be transported to specified disposal site.			
		Dust control	(1)Waste slag fields should be layer-compacted, to avoid dust pollution.			
			(2)Dust suppression sprinkles should be used to avoid dust pollution.			
		Ecological impact control	(1)Surface soil stripped during construction was stacked in a relatively flat area, with bagged soil around as landing，and dust-proof network cover; was used for land reclamation.			
			(3) The vegetation should be restored after the earth borrowing.			

item			Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
tion						
Soil and water conservation control	Construction site control		(4) There should be temporary water-block ditches outside the low-lying land in rainy season.			
			(2) There should be dust network coverage on the stacks of surface soil and materials, to avoid rain erosion and pollution of surrounding environment.			
			(3) Construction duration should bereasonably arranged, in order to shorten temporary land use time; timely vegetation or restoration was done.			
	Sidewalk control		(6) For new construction sidewalk, engineer protection and drainage works should be made.			
			(7) Construction duration should be reasonably arranged, in order to shorten temporary land use time;			
	Borrow earthwork field control		(1) Necessary drainage measures should be made before borrow earthworks; there should be settling basin at the exports of drainage; on the side of borrow earthwork outer slope platform and upslope, there should be intercepting ditches that connected with drainage ditches,			
			(2) Timely vegetation or restoration should be made to avoid soil erosion; surface soil should be used for restoration, land consolidation measures should be taken..			
			(8) There should be temporary coverage on the newly vegetated slope , to prevent slope erosion.			
			(9) Timely vegetation or restoration should be made on the borrow earthwork field.			
	Slag field control		(1) Low- lying land should be selected as slag field.			
			(2) According to the topographical features, a retaining wall should be set under the slag field, the setting of the retaining wall should be safe, economical and reasonable.			
			(3) There should be drainage ditches above the slag field. On both ends of the ditches, settling tanks should be set.			
			(4) Slag should be timely roller compacted, and set gutters.			
			(5) Slag field should be restored after the construction.			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
Ecology restoration	(1) Stripped surface soil should be used for the restoration of ecology.			
	(2)A combination of grass, bushes and trees should be used during greening; no empty land should be leaved, in order to prevent the invasion of alien species.			
	(3)No alien species be used.			
Cultural relics protection	(1) If cultural relics are discovered during the construction period, the construction work shall be stopped immediately, while at the same time immediately reporting to local administrative department of cultural relics.			
	2) The construction unit shall formulate special construction scheme for the section containing cultural relics according to the opinions issued by the administrative department of cultural relics, and may start construction only after obtaining the consent from relevant department,			
	(3)Removable cultural relics should be surrendered to local administrative department of cultural relics proactively.			
Construction traffic control	(1)Construction duration should be reasonably arranged, in order to shorten temporary land use time;			
	(5) Closed transport vehicles should be used for the transportation of earthworks, slag and construction garbage.			
	(3)If there is residential in 50 meters of the construction sidewalk, the transportation of construction materials in the night was prohibited.			
	(4) Rush hour should be avoided, to prevent traffic congestion and accidents.			
	(5)There should be specified routs for construction vehicles, private driving route should be prohibited, in order to prevent damaging the farmland and woodland.			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
traffic safety Hazardous Materials	（1）The driver must be safe driving, cannot change the planned route.			
	（2）The driver must have driving license.			
	（3）To draw up reasonable vehicle use plan, obeying the traffic rules.			
	（4）Set speed control system on the truck to supervise driver.			
	（5）Inspecting vehicles at regular intervals to prevent accidents.			
	（6）To improve visibility of road signs, strengthening the traffic safety.			
	（7）To hold safe education of traffic at school and community.			
	（8）Using local vehicles, and shortening transport distance. Using regular bus to transport workers.			
	（9）Prohibit the overloaded vehicles. Covering the materials in transport vehicle and cleaning up the scattered materials along the transportation route to reduce the generation of dust.			
	（10）To set reminders and lights near dug road.			
	（1）Gasoline and diesel packaging should be check before access site, the leakage should be rejected and returned.			
	（2）Oil and chemical solvents should be provided with special storehouses with warning signs, anti-seepage treatment and materials for accident handling, such as adsorption of the packet, sand and sawdust.			
Communicate with the public	（3）Preparing emergency plans and training workers.	Enterprise	PMO& ETA	
	（1）Set notice-board consist of name of the project, main construction content, construction time, notice of complaint and contact information.			
	（2）To arrange technical staff for answering questions about environmental protection.			
me t pac im ial	（3）In the case of requirement of continuous construction during the night, it shall be reported to the			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
	environment protection department for approval and notice the surrounding residents. The notice should include starting and stopping time and the night construction permit.			
	（4）If works need to cut off city services(such as water, electricity, telephone, bus running lines, etc.) Enterprise should issue announcement to public, which include starting and stopping time.			
	（5）The question from public and the reply from enterprise must keep in the archives and be accepted the supervision and inspections of the administrative institution.			
	（1）When enterprise and the compensation make the subsidy agreement, enterprise should be in strict accordance national and regional subsidy standards, according to local conditions, to make sure the compensatory payment be assigned to village group and individual.			
	（2）Engineering vehicle should avoid the rush hour to prevent accidents.			
Landscape impact measures	（3）Occupied or destroyed road in the process of project construction should be repaired and afforested , and enterprise should pay compensation for land occupying.			
	（1）In order to strengthen coherence and coordination between project and surrounding landscape, slope of filling and excavation cubage should be circular pattern. Slope surface should keep crude for easy afforesting.			
	（2）To improve the management and construction personnel's awareness of environmental protection, prohibit casual waste disposal.			
Construction safety	（3）Delimiting residue field and material area, materials are prohibited piling in other regions.			
	（4）After the project is completed, should clean the construction site timely, smooth ground, and restore the original landform.			
	（1）Set up warning marks or warning instructions in the job positions, equipment, and place where is			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
	probable bring occupational-disease-inductive.			
	（2）Offering Occupation health training and physical examination to workers who works in the toxic and hazardous operations frequently.			
Healthcare	（3）Provide protection facility for construction personnel as required, such as safety helmets, safety belts, safety shoes and work cloths.			
	（4）The construction site should use low noise equipment, promoting to using automation and closure construction process, for reducing mechanical noise. Constructors should wear hearing protection.			
	（5）The poor ventilation area in construction plant(such as anti-corrosion and waterproof in basement), should equipment ventilation facilities. Operator should wear gas masks or respirators in the workplace with hazardous gas.			
	（6）On the dust producing region, should spraying water to reduce the dust concentration, constructor should wear dust masks. The welding operator needs to wear personal protective equipment protective masks, goggles.			
	（7）On hot days, construction site should offer heatstroke prevention, and setting the reasonable working hours.			
	（1）Meal, drinking water and rest places should conform to the hygiene standards.			
	（2）Dormitory, dining room, bathroom and toilet should have ventilation, lighting facilities, and maintenance staff.			
Operation stage Water contam	（3）Dorm should set open windows, with the bed less than 2 layers. Prohibits to use a wide bed for large numbers of people			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
	（4）Canteen should have hygiene license, clean cooking utensils, and chef with health certificate.			
	（5）Canteen should build in a place which far from toilets, garbage and hazardous.			
	（6）Canteen should build separate cooking room and separate storage room, and set a rat baffle whose height is larger than 0.2m in the door.			
	（7）Toilet, sanitation, drainage and dark-humid zone should be disinfected regularly.			
	（8）Living area should set up a closed container, transported and t killing flies regularly			
	（9）The construction site shall be set up clinic with medicine chest, drugs, bandages, tourniquet, neck support, stretchers and other emergency equipment.			
	（10）If there is an accident such as constructor infectious diseases, food poisoning or acute occupation poisoning with construction workers, the enterprise should inform the health and quarantine departments and department in charge of construction, and handling with the relevant provisions of the health and epidemic prevention departments.			
	(1)Wastewater collection system must be according to the standardized standard construction. As an important data, the penetrating coefficient of soil should be gauging from the various levels of soil permeation rate.			
	(2)The fermentation pond is not allowed to discharge waste into the environment, only if the pond had been damage to serious disasters, in this case, the wastewater must be diluted to use large quantities of water. During the period of the pond repairing, waste liquid should be stored in biogas digester temporarily, till repairs completed, biogas fluid discharge into the fermentation pond to continue to use.			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
Air pollution	(3)Fending groin of fermentation pond must be according to the standardized standard construction, to ensure fending groin will not collapse even.in the worst possible circumstances.	Enterprise	PMO& ETA	
	(4)Enterprise must comply with design specs, operation norm, and management standard			
	(5) In the organic fertilizer use area , launching environmental and health education such as the harm of biogas slurry drains into water			
	(1)Faeces management measures must contain measure of reducing the odor gas, such as reasonable feces collection frequency and covering the fermentation pond.			
	(2) Executing a strict operation process to reduce emissions of toxic gas. According to the requirements of *Integrated emission standard of air pollutants* , NO_x execute maximum acceptable concentration: NO_x ≤240mg/m³.Other pollutants meet the *Hygienic standards for the design of industrial enterprises requirements*,CO_2: 0.04mg/m³; H_2S: 0.01mg/m³; NH_3: 0.2mg/m³.			
Noise pollution	(3) stock yards needed to provide suitable wastewater systems	Enterprise	PMO& ETA	
	(4) Executing a strict management of the waste collection and transportation process to prevent pollutants leakage			
	(5) Growing trees in critical area and the perimeter of project to reduce volatile gases, toxic gases, dust and odor			
	(6) Enterprise must comply with design specs, operation norm, and management standard			

item	Environmental impact mitigation measures	Implementing agency	Supervision agency	Monitoring agency
	(7)Make personnel training about environmental risk			
	(8)Draw up air quality monitoring plan in project's region, especially the area around the digester. exhaust emission must meet the *Ambient air quality standards* and *Hygienic standards for the design of industrial enterprises* requirements			
	(1)Place high noise equipment in sealing room			
	(2To install vibration control unit and damping materials in high noise equipment			
solid waste Environment risk control	(3)Keep a regular maintenance equipment to reduce the noise	Enterprise	PMO & ETA	
	(4) To close idle equipment or change into vibration control state			
	(5) Noise intensity must meet the standards(*Emisson standard for industrial enterprises noise at boundary)* requirements			
	Carriers of livestock and poultry waste must be treat with measures of sealing and anti-seep.	Enterprise	PMO& ETA	
	（1）To draw up *measures for accident of Hazardous Materials Transportation*			
traffic safety	（1）The driver must be safe driving, cannot change the planned route.			
	（2）The driver must have driving license.			
	（2）Setting speed limit signs and No honking signs in the transit to reduce traffic noise			
	（3）Increasing signal lights at environmentally-sensitive areas, to set up zebra crossings in the road cross schools, hospitals, residential area, to protect the surrounding residents.			

Attached List 1 Screening and Check List for Hebei Rural Renewable Energy Development Demonstration Project

Date: No.:

Project owner: Contact information:

Project name: Address:

Content	Questions	Answer		
		Yes	No	Other
I. Project site selection analysis	**Basic Site selection requirements**			
	Does the scope of the project involves the cultural relics, immigrants, or Indigenous people?			
	Does the scope of the project involves drinking water source protection area			
	Does the scope of the project involves natural resources protection area			
	Does the scope of the project involves physical cultural resources protection area			
	Biogas production site			
	Does the project satisfy the requirements of not building within prohibited areas? (prohibited areas include: drinking water source protection area, scenic spot, core and buffer area of natural reserve; residential area in city and town-cultural education and scientific research district, medical treatment district, commercial district, industrial park, scenic spot and other densely inhabited areas; prohibited area defined by local people's governments at the county level according to law; other districts under special protection according to state or local laws and regulations.			
	Does the project waste water satisfy the requirements of not draining into sensitive water areas and water areas with special functions?			
	Does the project satisfy the requirements of convenient transportation, water supply and power supply conditions?			
	Gas Filling Station site			
	Does the gas filling station site compliance with urban development planning, environmental protection and fire safety requirements			
	Does the fireproof distance between the station facilities and the construction outside the station satisfy the requirements of "code for design and construction of automobile gasoline and gas filling station(GB50156-2002)"			
II. Certificate and qualification	Does the project compliance with the overall planning of urban and rural, and has the file of opinions issued by local authorities			
	Does the project compliance with the land use planning, and has the file of opinions issued by local authorities			
	Does the project have the approved project proposal issuex by the Development and Reform Bureau of Hebei Province			
III. Public participation	Has the project carried out public participation work, such as publicity, visiting and issuing public participation survey?			
	Does the surrounding public support this project?			
	Has the provincial PMO invited environmental experts to inspect the project site and make full understanding on its current situation (including the pollution control facilities and			

	digestion area?			
Overall evaluation				
Signature	Signature of head of expert group:_____ Date: _____ Signature of principal of provincial PMO_____ Date: _____			

Note: The “answer” section should be filled by the project owner; once “No” is filled in this section, the project will lose its qualification to WB project.

Attached List 2 Check List for Construction

No. Contract No. and name:

Project name: Copy:

Current construction stage: Reviewed by: Date:

Check item	Implemented or not			Remarks/recommended actions
	Yes	No	N/A	
1. Check before commencement				
1.1 Have you employed construction team?				
1.2 Has construction site been arranged and whether the construction mechanism is in normal condition?				
1.3 Do the constructors have Temporary Pass and wear them when going in and out?				
1.4 Is there project publicity tables posted at and surrounding the construction site?				
1.5 Have the construction protective equipments been prepared such as respirator, earplug, arcing protection glasses?				
1.6 Are the materials being used environment-friendly and nontoxic?				
1.7 Others (please specify)				
2. Air pollution control				
2.1 Is the construction site watered to reduce dust in dry condition?				
2.2 Have the vehicles transporting powder materials been covered and cleared before leaving the construction site?				
2.3 Have the dusty roads been water to reduce dust?				
2.4 Has it confirmed that the water used to reduce dust will not affect surface flow or the local community?				
2.5 Are the yards stacking powder materials being covered or watered to reduce dust; and are if the bags of cements are unpacked in a sheltered area?				
2.6 Have the transported goods are covered properly and lashed securely during transportation?				
2.7 Has the effect wind direction been considered when selecting places to pile materials?				

Check item	Implemented or not			Remarks/recommended actions
	Yes	No	N/A	
2.8 Is there any anti-wind and dust-controlling measures taken when piling the construction materials?				
2.9 If the construction vehicles runs within speed limits?				
2.10 Are the residual powder materials cleared from the road when the piled materials are removed?				
2.11 Others (please specify)				
3. Water pollution control				
3.1 Is the drain tank being cleared regularly?				
3.2 Is the domestic wastewater and equipment cleaning waste water being discharged into municipal pipe?				
3.3 Is the waste water treatment system (such as sedimentation tank) at construction site working and maintained normally?				
3.4 Do the constructors clean equipments before constructors leaving the construction site?				
3.5 Others (please specify)				
4. Noise pollution control				
4.1 Do the constructors comply with the laws and regulations relating to noise during construction?				
4.2 Is there a valid CNP provided during noise prohibited or limited period?				
4.3 Are the noise-making equipments placed in a closed room in running time?				
4.4 Are there low-noise equipments to be applied in construction period?				
4.5 Is the construction conducted in specified working hours so as to reduce noise pollution?				
4.6 Does the contractor maintain the construction				

Check item	Implemented or not			Remarks/recommended actions
	Yes	No	N/A	
equipments and try their best to keep it at best working condition and lowest noise level?				
4.7 Are the unused facilities at the construction site in off or energy-saving and vibration-controlling state?				
4.8 Have you got approval of relevant departments and conducted construction in specified period when in need of night construction?				
4.9 Others (please specify)				
5. Solid waste management				
5.1 Has a unit possessing environmental service qualification certificate been selected for solid waste treatment?				
5.2 Is the construction site in clean and tidy condition?				
5.3 Do you clear and classify the construction waste, reclaimable waste, general trash etc at the stacking yard periodically?				
5.4 Is there any greasy dirt spilling out during construction and if the polluted soil is cleaned timely?				
5.5 Are the residual wastes at the construction site removed timely and disposed properly after completion of the project?				
5.6 Is the domestic garbage transported by covered containers or tracks to designated garbage disposal places?				
5.7 Is there adequate area at the construction site for temporary storage of solid wastes?				
5.8 Others (please specify)				
6. Staff health and safety management				
6.1 Are there fire equipment equipped at camp, on-site facility and construction area?				

Check item	Implemented or not			Remarks/recommended actions
	Yes	No	N/A	
6.2 Are the machine operators and vehicle managers provided with operation certificate?				
6.3 Is the construction camp equipped with sufficient fire fighting equipments, fire hoses and hydrants for fire protection purpose?				
6.4 Do the constructors wear respirator, earplug, arcing protection glasses when necessary?				
6.5 Others (please specify)				

Attached List 3 Notice on Environmental Rectification

No.: Contract No. and name:

Project name: Copy:

Current construction stage: Date:

Problems discovered in on-site inspection:
Analyzed cause and improvement measure:
Rectification comments proposed by environmental authorities (when necessary):
Environment checker: Date: Time limit for rectification: complete within days Accepter: Date:
Conclusion of recheck: Rechecked by: Date:

Attached List 4 Chance find flow chart