

# **Biomass Support for the China Renewable Energy Law: Feasibility Report—Agricultural and Forestry Solid Wastes Power Generation Demonstration**

**December 2005**

*Center of Renewable Energy Development  
Beijing, China*

*Energy Research Institute  
Beijing, China*

*National Development and Reform Commission  
Beijing, China*

**Subcontract Report**  
**NREL/SR-710-40627**  
**October 2006**

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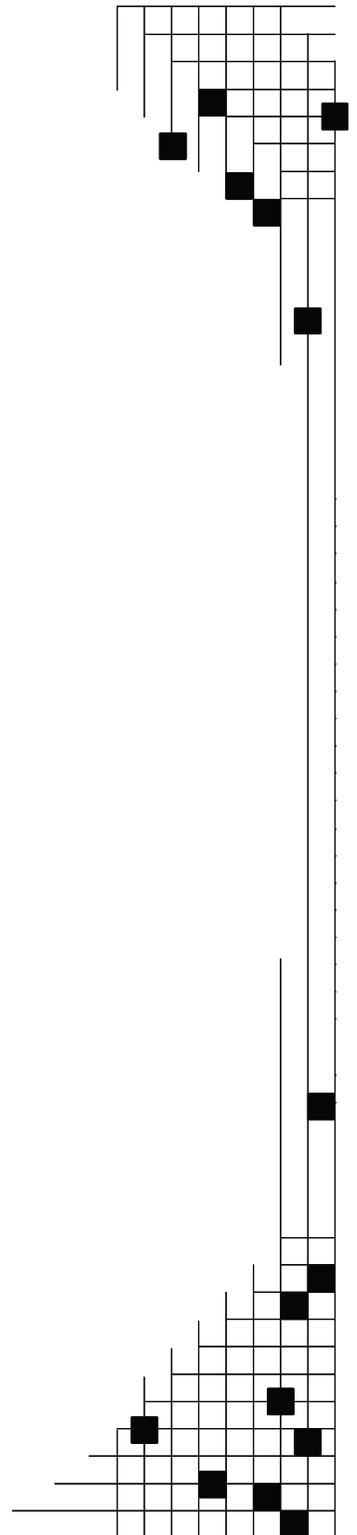
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# **Feasibility Research Report on the Agricultural and Forestry Solid Wastes Power Generation Demonstration Project**

## **1 Rudong Biomass Direct-fired Power Generation Project of Jiangsu**

### **1.1 Project background**

Rudong County of Jiangsu province locates in the Eastern China region along the eastern coastline, which is the downstream plain of Yangtze River. The total area of the county is 1873 km<sup>2</sup>, among which the arable land is around 1.58 million *Mu*. The annual agriculture yield is over 900,000 Ton, with stalk productions of 790,000 ton. This area basically depends on agriculture. Meanwhile, the industries grow very fast. Rudong enjoys plenty of stalk resources, and its utilization will positively contribute to the energy consumption in Jiangsu province, which is significant to improve the economic and social development.

Currently, the stalk is basically used for cooking (roughly 30%-40%), with direct combustion. The utilization efficiency is only 5-8%. On the hand, there are substantial stalks that are burned directly inside the plowing field, which may influence the transportation, and even airport regulation. It wastes the precious energy resources, as well as seriously pollutes the environment. Stalk generation could not only address the fuel and electricity supply deficiency issue, but also replace the fossil fuel, so as to deploy the energy resources in a more reasonable approach.

### **1.2 Project introduction**

Rudong stalk generation project is one of the important components of the new energy base construction in Rudong County. The total capacity is 24MW, with electricity generation of 156Gwh, 133Gwh of which is connected to the grid. In line with the National Renewable Energy utilization target, this project aims to import the oversea mature stalk generation technology and devices through international cooperation, so as to absorb and achieve the commercialization and scaling up of the stalk generation.

Rudong stalk generation project is located in the middle of Rudong project in Jiangsu province. It enjoys nice construction condition. This project could provide clean and reliable energy to the local economy development, and contribute to the local power grid. It could also replace the small steam coal-fired power plants whose development has been strictly controlled by the government, so as to reduce the coal consumption for power generation, which will be beneficial to the local environment and ecology protection. It is consistent with the government's sustainable energy strategy.

### **1.3 Straw resource and cost survey**

#### **1.3.1 Straw availability**

Through the spot survey of rural resident about 1000 household in Rudong, the output of straw for purchasing is about 7130 thousand tons (showns in Table1-3-1). Furthermore, the density of straw resource is high, and the production of straw is not effected on the climate. In 25km radius, the output of straw for purchasing is about 7600 thousand tons, which can fully supply the project.

**Table 1-3-1 Straw resource output in Rudong (in 25km radius)**

Type	Planting area (10000 Mu)	Total output (tons)	Tatio of grain to straw	Output (tons)	Availability rate (%)	Availability amount (tons)
Wheat	48.26	140999	1:1	140999	25	35250
Barley	35.19	91769	1:1	91769	27	24778
Bean	22.79	45483	1:1	45483	21	9551
Rape	23.96	37285	1:1.6	59656	23	13720
Rice	84.86	501952	1:0.623	312716	45	237664
Corn	15.63	63832	1:1.5	95748	68	65109
Tuber	1.70	5634	1:0.5	2917		
Peanut	3.77	7771	1:1.2	11657		
Cotton	11.12	9929	1:3	29787	24	7149
Sesame	0.18	431	1:2	862		
Husang	12			120000	100	120000
Bulrush	20			200000	100	200000
Total		905085		1111594		713221

**Table 1-3-2 Straw resources in the vicinity of Rudong (in 25km radius)**

Item	Qian country	Shizong country	Shigang country	Total
Planting area (Mu)	69841	73325	85415	
Crop output (tons)	39843	22909	53085	
Straw output (tons)	43827	25200	58394	127421
Straw availability (tons)	16873	9702	22482	49057

### 1.3.2 Straw characteristic

The four swatches, which are cotton, wheat, rice and rapeseed in six months, are delivered to test in Spain. Table1-3-3 lists the straw component and characteristic.

**Table 1-3-3 straw component and characteristic**

Straw properties	Unit	Average fuel	Min.	Max.
Moisture content	%	11.0	7.0	25.0
Ultimate analysis (dry)				
- Fixed carbon	%	18.7	16.5	21.5
-Volatiles	%	76.1	71.9	80.9
Ash content (815C)	%	5.2	2.6	11.5
Elementary analysis (dry)				
- Carbon	%	45.4	41.5	47.8
-Hydrogen	%	6.1	5.7	6.7
-Nitrogen	%	0.60	0.40	0.96
-Sulfur	%	0.08	0.05	0.17
-Oxygen	%	41.16	36.77	43.36
-Chlorine [n]	%	0.41	0.07	1.19
-Ash content (5.50C)	%	6.26	2.6	14.66
LHV, dry	MJ/kg	17.04	15.60	17.60
LHV, as received	MJ/kg	14.97		

### 1.3.3 Straw cost

The straw cost includes collecting, handling and transporting cost.

#### 1.3.3.1 Collecting cost

Through the survey, the purchase price is about 84-196Yuan/tons, which is shown in Table1-3-4.

**Table 1-3-4: straw purchase price**

Type	Availability (tons)	Share (%)	Purchase price (Yuan/t)
Wheat	60028	15.3	104
Rice	237664	60.4	96
Cotton	7149	1.8	196
Corn	65109	16.6	82
Bean	9551	2.4	150
Rapeseed	13720	3.5	84

Based on Table1-3-4, the average price is 97.5 Yuan/t. If the straw is collected in large scale, the price of straw will increase. Furthermore, because the purchase amount is large, the project need set up about 10 collecting site, which will increase the collecting cost. Therefore, the collecting cost in practice is about 200Yuan/tons (the cotent of water is below 11%).

#### 1.3.3.2 Handling cost

The straw for the project need be handled by machine. The denisity of each bale is 1t/m<sup>3</sup> and the weight is 340-380kg. Based survey and evaluation, the handling cost is about 30Yuan/ton.

#### 1.3.3.3 Transporting cost

In 15km, the transporting cost of straw is about 25Yuan/ton. Beyond 15km, the cost will reach 50Yuan/tons.

In conclusion, the total cost of straw is 280Yuan/ton

## 1.3 Construction condition

### 1.3.1 Resource

Rudong is within the JiangHai plain, and occupies abundant stalk resources. The arable land is 1.58 million Mu with 900,000 ton agricultural production. Taking into consideration of the mulberry and weed, the annual stalk production is accumulated to 1.11 million ton. Within 25km, the stalk production is 1.237 million ton, 0.76 million of which could be commercialized.

A sample survey within 1000 households in Rudong County indicated 713,000 ton of stalk could be commercialized given the price is within the scope of the farmers' anticipation. Since the stalk resource density is high, and seldom influenced by the climate, a commercial 760,000 ton can absolutely meet the requirements of this project when considering a 25km collection radius and a high commercial awareness from the farmers.

### 1.3.2 Transportation

The dense roads and rivers note the Rudong County. The possession proportion of agriculture vehicles is quite high. Villages are connected by road. Groups are reachable by any vehicles. This means a sound condition for stalk transportation. There are three candidates location for this project, which is all

within 1km distance from the national road line 317 and fourth level canal. All of them could be reached directly by waterage or road carriage. This convenience could absolutely meet the requirements in terms of the devices or feedstock transportation.

### 1.3.3 Power grid

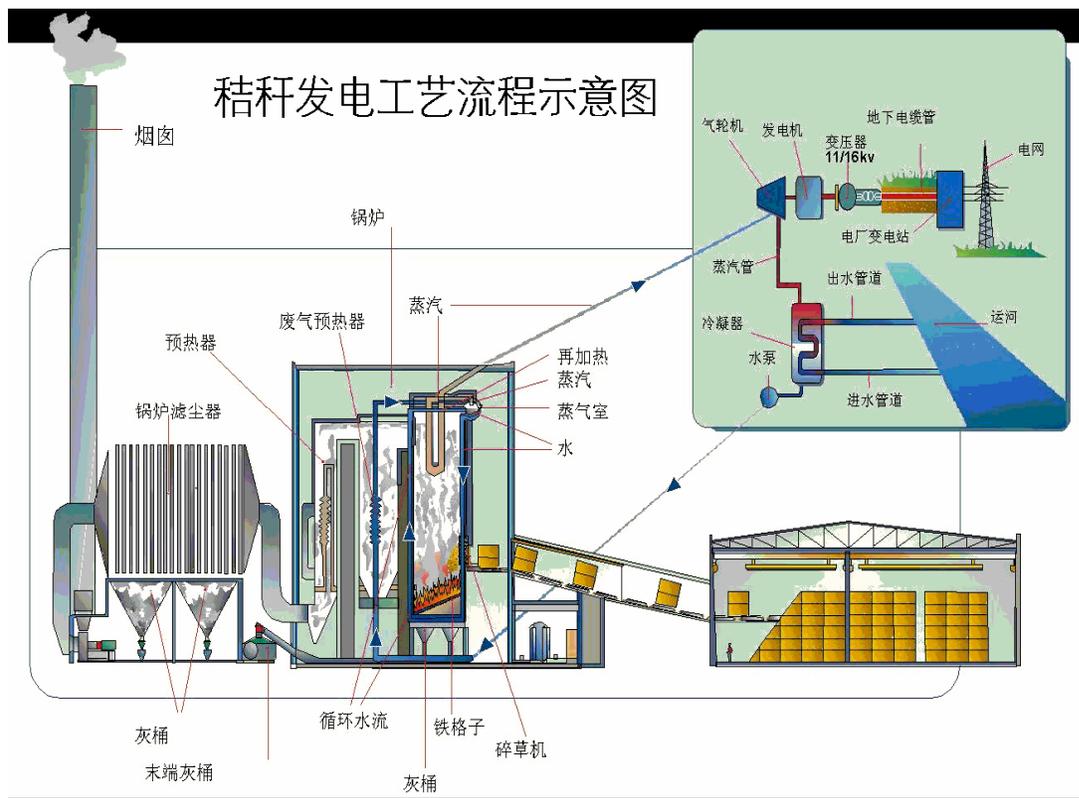
Rudong County power grid is the end of the JiangSu provincial power grid. The basic power plants are the nearby NanTong Power plant (1.4 GW), TianShengGang plant (550MW). There are 2\*220KV, 6\*110KV and 10\*35KV substations. The power supply grid is based on the MaTang Substation of 220KV, with the main 110KV substation and 110KV transmission lines, and supplemented by the 35KV substations and 35KV transmission lines. The three candidate sites are all close to the 220KV MaTang substation, and are quite easy to connect to the grid.

### 1.4 Technology introduction

The stalk resources come from the local farmers or the feedstock trader. In sequence with the collection, package, and transportation through rivers or vehicles to the factory storage, there comes to the following steps:

- Stalk transported from conveyor and shredder to the boiler
- Steam that produced from stalk combustion propels the steam turbines and generates electricity. The un-combusted stalk will stay at the bottom of the boiler. Meanwhile the ash enters the smoke filter chamber and emit through the chimney.
- The residues inside the boiler and the ash could be harvested as the agricultural fertilizer.

A detailed technique flow can be as following:



## 1.5 Economic assessments

This project is composed by the storage, boiler chamber, turbine etc. It occupies 101,000 m<sup>2</sup>. The gross investment is 333 million RMB. After two years construction period, the power capacity could reach 24MW, and annually consumes stalk 140,000 ton. The annual operation hours is 6500, and thus produces 156 GWh and sale 132.6 GWh to the grid. The annual sale value could reach 106 million RMB. Around 150 employments could be created.

The investment category is: 30% from capital cost, 67% from commercial bank loan, and another 20 million US\$ is needed to import the key devices.

- Total investment: 333.22 million RMB (inclusive of 20 million US\$)
- Unit investment (KW): 13885 RMB
- RMB currency exchange rate: 100 US\$=826 RMB

The bank loan period started from 21th Feb 2004 with the interest rate of 5.76%, and 15 years payback period. In addition to that, the flow capital during the first year was 15 million RMB, among which 5 million is self-capital, and 10 million comes from the flow capital bank loan.

- Power generation capacity: 24MW;
- Annual electricity output: 156 GWh;
- On-grid electricity: 132.6 GWh;
- Construction period: 2 years

**Table1-5-1 Fixed asset investment assessment (Unit: 10,000RMB)**

No.	Cost	Subtotal
1	Fixed asset investment	31992.80
1.1	Engineering cost	27580
1.1.1	Civil work and workshop construction (10108m <sup>2</sup> )	2525
1.1.2	Production sector	20582
1.1.2.1	Boiler (Denmark, FLS MIACJO)	14382
1.1.2.2	Other devices	6200
1.1.3	Supplementary production sectors	4214
1.1.4	Other expense	259
1.2	Contingency	4412.80
1.2.1	Basic contingency (8%)	2206.40
1.2.2	Contingency for price ascend (8%)	2206.40
2	Regulation tax on fixed asset investment direction (0%)	0.00
3	Interest during construction	1330.03
	Total investment: 1+2+3	33322.83

## 1.6 Finance assessments

Power generation capacity: 24MW; annual electricity output: 156 GWh; Ongrid electricity: 132.6 GWh; construction period: 2 years

The finance assessment work is as per the requirements of “Economy assessment approach and parameters for the construction project”, which is jointly issued by the National Development and Planning Commission, and Ministry of Construction, and carried out in line with the current finance and

tax policy as well as the current price systems. The calculation focused on cost and benefit, so as to explore its capability to make profit, payback ability etc finance condition, and further its finance feasibility.

The calculation period assumed 20 years, 2 construction years, and 18 operation years.

### **1.6.1 Cost estimation**

The generation cost includes: depreciation, O&M, salary and welfare, other cost and interest cost

The integrated depreciation rate: 6.67%; O&M rate: 1.0%; Staff number: 150; average salary: 20,000 RMB/a

The annual gross cost and operation cost is calculated to 78.86 million RMB (first year after operation) and 45.16 million RMB respectively.

### **1.6.2 Generation benefits**

#### **1.6.2.1 Grid connection price**

The IRR is generally accepted as 12-15% by the similar foreigner project developer. Combined with the domestic situation, the IRR is taken as 12% for this project. Taking into account of the favorable policies for the grid-connected power plants, the grid-connected electricity price during operation period with and without VAT is 0.731 RMB/kWh and 0.806 RMB/kWh respectively.

#### **1.6.2.2 Sale revenue, tax and profit**

- Sale revenue

The grid-connected electricity: 132.6 kWh; grid-connected electricity tariff: 0.806 RMB/kWh; sale revenue: 106.88 million RMB.

- Tax

The tax levied for the power projects include: VAT, sale surtax, income tax.

VAT: 17%, exclusive of the price;

Sale surtax: inclusive of urban construction tax and education tax, 7% and 3% respectively;

Income tax: 33%

- Profit

Generation profit= (Generation income)-(generation cost)-(sale surtax)

After-tax profit= (generation profit)-(income tax)

### **1.6.3 Profit making ability analysis**

- The total FIRR (hereafter means after tax): 6.75%
- Investment payback period: 10.26 years (ic=6%, excludes the construction).
- Average investment profit rate: 4.97%
- Average investment tax rate: 10.94%
- Capital cost IRR: 12%, which means it is financially feasible.

### **1.6.4 Conclusion**

The average grid-connected tariff during the operation period: Without VAT: 0.731 RMB/kWh; Include VAT: 0.806 RMB/kWh; Investment return period: 9.6 years; Capital cost IRR: 12%; overall project IRR 6.75%; higher than the coal-fired baseline IRR (6%). Accordingly, it is financially viable.

## **1.7 Conclusions and suggestion**

### **1.7.1 Conclusions**

#### **1.7.1.1 Necessity**

The RuDong 48MW stalk generation project is consistent with the 21<sup>st</sup> sustainable energy strategy plan, which is a positive contribution to JiangShu energy consumption. Meanwhile, this region has the advantageous generation and resource condition. The social and environmental benefits are also evident. Therefore, it is desirable to explore the local stalk resources.

#### **1.7.1.2 Technology availability**

The 24MW stalk power plant has been successfully operated for 2 years in foreign countries. The combination of direct combustion technology and gasification technology has been quite mature. An environmental friendly biomass power plant with the most advanced technology in western country could consume 160,000 tons of stalks annually, and produce 200GWh/a. Its overall investment is 51 million Euros. The commercial operation proves to be very successful and technically viable.

The overall capacity is 24MW, only 0.1% of the total capacity in JiangShu province. The electricity it produced could the power grid accept all.

There are no major disadvantageous geology problems that could bring negative influences to this project according to the geology materials.

The current road and transportation condition meet the requirements that the construction and feedstock transport need.

The local government is willing to offer positive support by providing the necessary land.

There are no negative factors that limit the project construction from the environment protection point of view. On the contrary, the project is beneficial for the environment.

#### **1.7.1.3 Evident social and environment benefits, desirable financial indicators**

Stalk is renewable resource. The RuDong power plant is positive contribution to JiangSu energy consumption as well as is environment friendly. It fills the blank in China in terms of the stalk utilization, which is significant for both the local economy development and improving the farmers' life quality. The project capacity during phase I is 24MW, with total investment 33.322million RMB. The unit investment is 13,885RMB, which is substantially lower in comparison with the foreign biomass power plant with the similar scale. The local manufactured devices, except the imported boiler, conveyor systems etc, contributed to the lower cost. The financial analysis shows that the financial payoff ability is quite strong. The on-grid tariff is acceptable and financial indicator is reasonable.

### **1.7.2 Suggestion**

With the high-speed development of the science and technology, the stalk power generation technology is becoming mature. Up to now, the foreign stalk generation is shifting from the pilot phase to the scale-up commercialization. As an emerging energy, government strong support is crucial to increase its competitiveness. In the worldwide, particularly in Germany, USA, Denmark, Spain etc, a series of favorable policies to promote the biomass resources utilization have been worked out, and has also achieved well effects.

JiangSu province is one of the developed provinces in China. There is a large energy demand. However, the primary energy resources are quite limited. It is necessary to make efforts to develop the

provincial stalk resources to make up the primary energy deficiency, so as to satisfy the national economy development and improve the provincial environment. There is a need to formulate some favorable policies in line with JiangSu's condition to promote the stalk resources utilization and promote its commercial and scale-up development.

- There should be favorable policies in terms of the tax, land utilization for the stalk generation as high- and new-technology.
- Since the biomass raw material is generally collected from the farmers without any offset. However the present VAT has no definite regulation on this issue. It is recommended to provide 10% offset for buying the stalk from the farmers that is equivalent with the other agricultural productions.
- All of the produced electricity should be bought strictly as per "Renewable Energy Law". The stalk power plant does not need to regulate the peak load. The power transmission work, starting from the substation outlet of the power plant, to the designated substation for transmission and distribution, should be built by the utility.
- It is recommended to offer bank loan plan, preferential loan interest, innovation fund and other policy support etc.

#### **1.8 Annex**

- Annex 1-1: Investment plan and financing
- Annex 1-2: Operation cost and income
- Annex 1-3: Total cost
- Annex 1-4: Repay capital with interest of loan
- Annex 1-5: Profit and loss statement
- Annex 1-6: Cash flow (capital fund)
- Annex 1-7: Cash flow (total capital)

## 2 Gaoyou Biomass Fixed-bed Gasification power generation

### 2.1 Introduction

Gaoyou city is located in an economic zone along the north of Yangtze River of Jiangsu province, and in the middle of Jiangsu province of Yangtze Delta and on the western fringe of Lixia River. Gaoyou city is neighbor with Xinghua city, connected with Jiangdu city, Hanjiang district and Yizheng city in the south, linked with Tianchang city (in Anhui province) and Jinhu county in the west, and bordered on Baoying county in the north. Total area of Gaoyou city is 1963 square kilometer, in which area of land covers 1175 square kilometer and water area 788 square kilometer. In 2004, there were 19 towns, 1 Hui nationality village (Xiang) and 1 provincial level economic development zone in Gaoyou city. The Basic information is shown in Table 2-1-1.

**Table 2-1-1 Basic Information of Gaoyou city (in 2004)**

Items	Amount	Ranking*
Population (10 <sup>4</sup> )	82.71	35
Local GDP (10 <sup>8</sup> RMB Yuan)	85.3	35
Value-added of the first industry (10 <sup>8</sup> RMB Yuan)	22	20
Value-added of the second industry (10 <sup>8</sup> RMB Yuan)	35	37
Value-added of industry (10 <sup>8</sup> RMB Yuan)	28	37
Value-added of the tertiary industry (10 <sup>8</sup> RMB Yuan)	28.3	32
Per capita local GDP (Yuan/person)	10291	31
Total investment in fixed assets of urban (10 <sup>8</sup> RMBYuan)	32.8	36
Total revenue (10 <sup>8</sup> RMB Yuan)	7.2	33
Per capital revenue (RMB Yuan)	873	29
Yield of grain (10 <sup>4</sup> tons)	58.5	14
Output of oil crops (10 <sup>4</sup> tons)	0.7	22
Output of meat (10 <sup>4</sup> tons)	5.3	49
Total pre-tax profits of industrial enterprises with above designated scale (10 <sup>8</sup> RMB Yuan)	4	35
Total retail sales of social consuming products (10 <sup>8</sup> RMB Yuan)	24.3	31
Total amount of export (10 <sup>4</sup> US\$)	9500	18
Actual direct investment from foreign merchant (10 <sup>4</sup> US\$)	4072	35
Average wages of works and staffs at post (Yuan/year)	11814	29
Per capita net income of rural residential (Yuan/year)	4420	28
Per capital deposits of residential (Yuan/person)	7296	24

\* It refers to Gaoyou city ranking within Jiangsu province.

Gaoyou city is located in the areas of Lixia River of Jiangsu province with a great quantity of straw resource. In 2004, yield of grain and oil crops was 585 thousand tons in Gaoyou city, and the amount of

straw was 900 thousand tons. Because it has already applied harvester to gather in crops, the stalk of crops is left relatively high. The amount of straw available was about 450 thousand tons. If it considers that some of them were consumed by farmers themselves and some of them were crushed and returned to the farmland, the real amount of straw that can be used for power generation was about 300 thousand tons, among them stalk of wheat was 100 thousand tons, stalk of rice 170 thousand tons and stalk of rape (Brassica napus) 30 thousand tons. In addition, there are 100 thousand mu reed growing at Gaoyou lakeside, so the stalk of reed can be also used for gasification power generation.

## **2.2 Introduction of owner**

The owner of this project is LinYuan Science & Technology Development Ltd. Company (LinYuan Company) of Gaoyou City.

### **2.2.1 Basic information and assets of LinYuan Company**

LinYuan Science & Technology Development Ltd. Company was established in 1991, and is an agricultural management entity integrated gain, forestry, fishery and seedling, and an agricultural comprehensive development and management ecological enterprise. LinYuan Company is located within Gaoyou city. It has 3000 mu wood of poplar, 1000 mu aquatic base, 500 mu seedling base and 1000 mu high quality and improved varieties of grain.

LinYuan Company is a shareholder enterprise with 25% shared by collective and 75% shared by private. Registered capital is 6 million RMB Yuan, and currently it has 46.5 million RMB Yuan of fixed assets (excluding the land). Total assets owned by LinYuan Company is 53 million RMB Yuan with zero liabilities. In 2004, it materialized over 3 million RMB Yuan of revenue.

### **2.2.2 The qualifications to undertake this project**

LinYuan Science & Technology Development Ltd. Company is always to dedicate itself to local agricultural comprehensive development, and to implement projects integrated agriculture, ecology and environment protection. In order to better use waste straw resources, LinYuan Company invested 1 million RMB Yuan in the test of straw briquetting and carbonization in 1995, and had a series of data available for purpose of development and mastered practical experience. However, due to technical and external reasons, it has a slow progress in this. China Renewable Energy Promotion Law has been issued in this year, and renewable energy technology has been developed greatly, all of which make LinYuan Company's envisagement about greatly utilization of straw become possible. Through a series of investigation and on-site survey, LinYuan Company decides to closely cooperate with enterprises that willingly do something in renewable energy industry and makes contributions to straw commercialization utilization in large scale.

## **2.3 Options of technical processes**

According to the current status of straw power generation at home and abroad and real situation of Gaoyou city, it plans to select the technology of fixed bed countercurrent gasification. The reasons for this selection are:

In Gaoyou city, it takes a household as a unit to make agricultural production. Each household may provide about 30 thousand tons straw every year. If it adopts a technology of direct combustion power generation, the installed capacity of power plant will be 25 MW, and it will consume about 200 thousand tons of straw every year. If calculation based on 30 thousand tons straw provided by a household each year, it needs collect and purchase straw from 67 thousand rural households. In Gaoyou, the harvest of agriculture is two seasons per year, so it will try to complete the purchasing trade of 130 thousand straws collecting every year. This is really a huge workload for them, and causing quite high cost for straw collecting. And thus, it is obviously the direct combustion is not suitable for real situation of Gaoyou.

At present, boiler using for straw direct combustion power generation is often to consume one kind of raw fuel, whereas, one kind of biomass material cannot satisfy the needs by 25 MW straw power plant.

Therefore, it chooses technical process of straw gasification power generation that can consume various biomass materials.

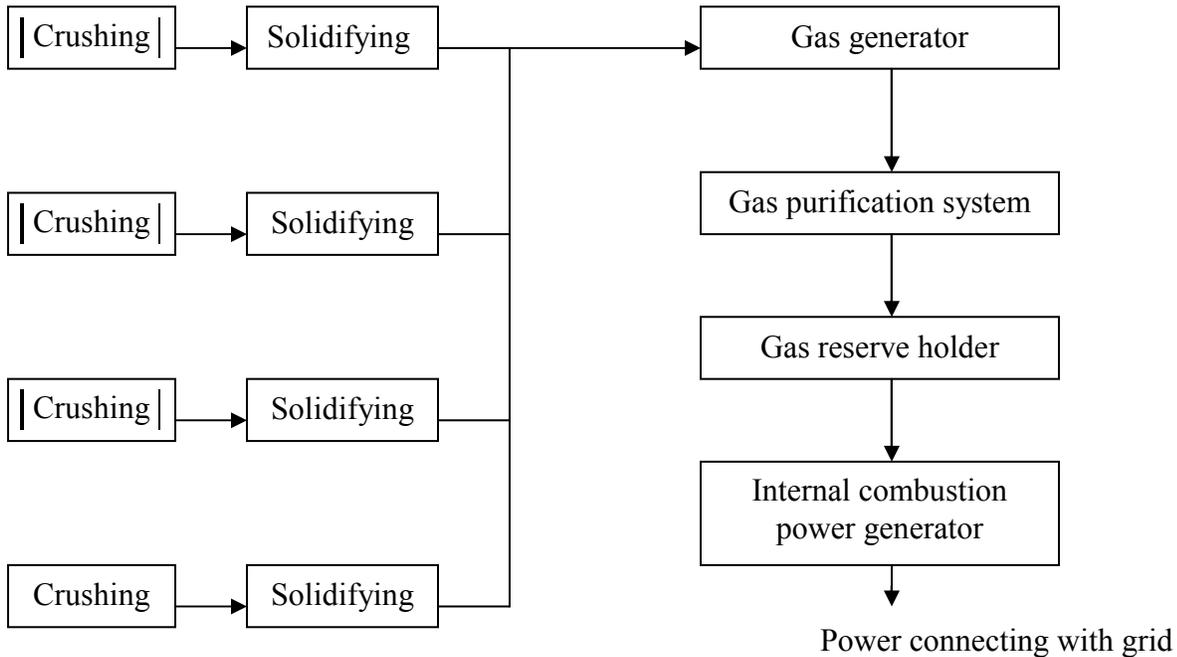
### 2.4 Targets of project construction

The overall targets of project construction are:

- Total installed capacity of 4000kW; annual power generation of 26 GWh; power connected with grid of 22.88 GWh annually.
- About 28-30 thousand tons of stalks of crops and forestry residue are consumed each year.
- The system of gas combustion purification and wastewater disposal facilities discharging satisfies the national standards.
- This project is run in a way of commercial business.
- The installed capacity of this project is 4000 kW, and the period of construction is one year.

### 2.5 Technical routes

Through the analysis on existing technology of straw power generation at home and abroad, it will adopt fixed bed straw gasification power generation as technical process route for this project. The technical flow chart is shown as following:



As shown in above-mentioned chart, the technical route used by this project is: after stalks of crops are crushed and briquetted, and then making it ready for raw materials that is needed for gasification. All of raw materials is collected and transported to straw gasification power generation plant. With gasification generator, the gas is generated. After gas is going through a series of such processes as cooling, de-tarring and de-sulfuring, and then put purified gas into gas reserve holder; the clean gas is sent to internal combustion power generator for power generation.

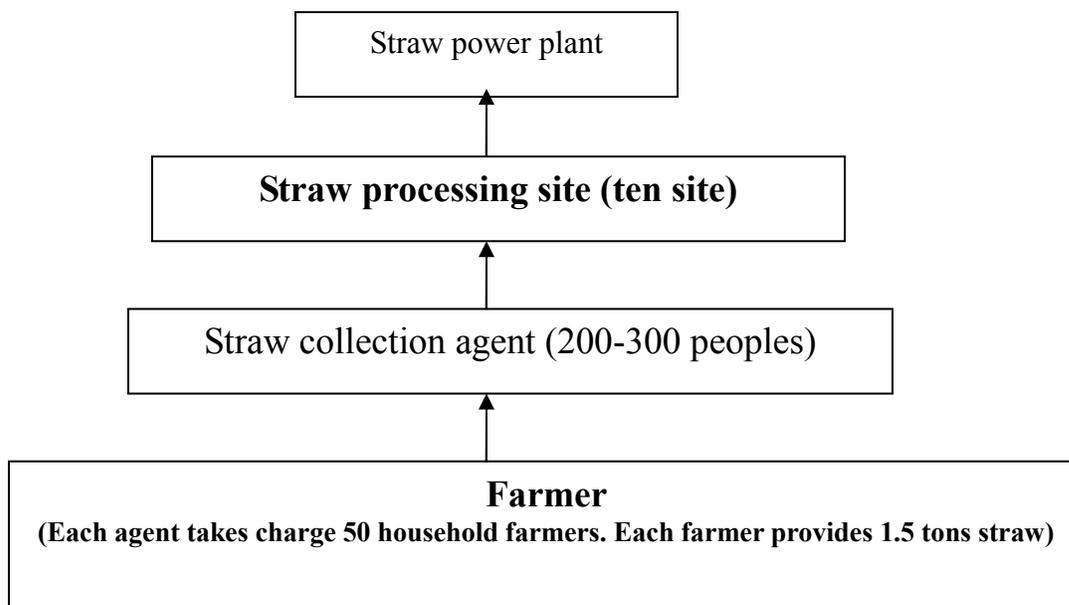
The construction of this project consists of two systems: straw preparation system, including straw collecting, reserve, crush, briquette and transport; the other one is straw gasification power generation system, including straw gasification, gas purification, power generation and power transmission and distribution.

## 2.6 Straw collection system

The operation of straw power plant depends on the supply straw to a great extent. Therefore, it is important to built straw collection system.

### 2.6.1 Collection system frame

The straw for generation power comes from 10 straw processing sites. (The economic analysis of these sites is shown in the tenth part of this report). Each site has 30-40 agents for straw collection, and then each agent purchase the straw form 100 household rural residents (shown as Figure)



### 2.6.2 Collection process

#### 2.6.2.1 Straw processing site

The straw power plant will establish 10 straw processing sites in certain radius. The distance between these sites from the power plant is about 5-10 kilometer. Furthermore, the distance between two sties is about 5 kilometer. The main assignment of these sites includes:

- Collect and storage straw
- Smash and solidify straw
- Transport straw according to the arrangement of the biomass power plant

The production of each straw processing site is 4000 tons every year. Each site has tow straw solidifying machines, and the matching equipment, such as smash, drying and transportation.

Each straw process site manages 30-40 agent of straw collection. These agents will collect straw from the farmer to directly deliver to the straw process sites and contracts with each farmer to confirm the number, quantity and price of straw.

#### 2.6.2.2 Agent of straw collection

The agent of straw collection is the key of relation between farmers and straw process site, therefore, which is main the peasant in the local area of the site. In the light of the scale of village, each village will select 3-4 agents and each agent will be charged with 50 household farmers.

### 2.6.2.3 Farmer

In the collection system of this project, the main task of farmer is only agreeing with the straw bargain according to the acceptable price. The farmers need not consider the transportation and drying of straw.

### 2.6.3 Straw price

For correctly confirming the straw price, the investor test for the straw purchase in the summer in 2005. The result is shown in Table2-6-1

**Table 2-6-1 Straw collection cost**

Item	Cost (Yuan/tons)	Note
Purchase cost	50	Exclude collection, drying and delivering
Collection worker salary	50	The worker is charged with collecting the straw in the cultivated field
Worker salary for raw straw transportation	20	The transportation distance is between the cultivated field and the straw drying site
Keeper salary	30	The keeper is charged with incepting, drying, stacking and keeping straw in the straw drying site
Dry straw transportation cost	10	The transportation distance is between the straw drying site and the straw processing site
Total	160	

The table shows the total cost form the cultivated filed to the processing site is about 160Yuna/tons. If the site purchases the straw in the light of 190Yuan/tons price, the profit of agent will be 30 Yuan/tons.

### 2.6.4 Prevention of price risk

With straw power plant operating, the straw consumption will increase, which can induce the straw price increasing to some degree.

For preventing the risk of straw price increasing, the two measures will be adopted.

- Enlarge straw collection radius. In the range covered by the straw collection system, the straw supply should exceed the straw demand.
- Increase straw purchase price of processing site. Because the worker salary is decided by the manpower resource in the local, the salary will not increase with straw power plant operating. Therefore, the uncertain factor of straw price increasing is the purchase price for raw straw, which can be confirmed 70-80 Yuan/tons to remain the room for price increasing.

## 2.7 Main technical and economic indicators of system

### 2.7.1 Technical indicators

- Straw use 28535 t/year
- Capacity of maximum gas generated 10000 m<sup>3</sup>/h
- Heat value of gas 1350 kcal/m<sup>3</sup>
- Capacity of generator 4000 kW
- Annul power generation 26 MWh
- Annual power grid connection 22.88 MWh
- Area covering (gasification power station)10000m<sup>2</sup>
- Rate of gas generated by straw 1.86 m<sup>3</sup>/kg
- Straw use by unit power generation 1.098 kg/kwh
- Gas tar content <10 mg/m<sup>3</sup>

- Gas sulfur content <math><20 \text{ mg/m}^3</math>
- Life-span >15 years

## 7.2 Economic indicators

- Total investment 33.826 Million Yuan
  - In which: interest during construction 682 Thousand Yuan
- Investment in fixed assets 33.14 Million Yuan
  - In which: Straw power plant 28.48 Million Yuan
    - Site for straw processing 4.66 Million Yuan
    - Research & experiment 1.87 Million Yuan
- Amount of sites for straw processing 10
- Annual net revenue from each straw processing site 28.6 Thousand Yuan
- Annual net revenue of straw power plant (before tax) 5.36 Million Yuan
- Annual net revenue of straw power plant (after tax) 3.577 Million Yuan
- IRR (before tax) 10.85 %
- IRR (after tax) 7.59 %
- Investment payback period (before tax) 7.59 Year
- Investment payback period (after tax) 9.04 year
- Self-owned capital IRR (after tax) 12.02 %
- Self-owned capital NPV (after tax) 6.469 Million Yuan
- Self-owned capital investment payback period (after tax) 10.11 year

## 2.8 Economic analyses

We adopt the method described in “Economic Analysis of Feasible Study for Construction Project” issued by the National Development and Reform Commission to make our economic analysis

### 2.8.1 Basic data

- Scale of project (Installed capacity) 4000 kW
- Amount of site for straw processing 10
- Construction period 12 months
- Share of self-owned capital 30%
- Annual interest rate 5.76%

### 2.8.2 Equipment and construction

Main equipment of straw power generation plant includes systems of gasification, gas purification, power generation, power transforming & transmission and auxiliary. The detail information is shown in Table 2-8-1.

**Table2-8-1 Main equipment of straw gasification station**

No.	Equipment	Amount	Unit price	Total price
1	Machines for straw crushing and briquette	20	23.3	466
2	Gasification system	1	400.5	400.5
3	Gas purification system	1	195	195
4	Power generation system	1	1041.5	1041.5
5	Power transforming & transmission	1	120	120
6	Auxiliary system	1	40	40
7	Total	1	2263	2263

Construction of power plant mainly consists of gasification workshop, power generation work and raw materials storehouse. Total area covers 1870 m<sup>2</sup> with building cost of 1014 Yuan/m<sup>2</sup>. Main buildings are listed in Table2- 8-2.

**Table2-8-2 List of buildings**

<b>Buildings</b>	<b>Area (M<sup>2</sup>)</b>	<b>Unit cost (Yuan/M<sup>2</sup>)</b>	<b>Total cost (10<sup>4</sup> Yuan)</b>
Gasification workshop	800	1200	96
Power generation workshop	150	1200	18
Pump-house	20	800	1.6
Recycled water pool	100	600	6
Waste water disposal pool	50	600	3
Main controlling room	50	1000	5
Raw material storehouse	400	600	24
Offices (Lab)	300	1200	36
<b>Total</b>	<b>1870</b>	<b>1013.9</b>	<b>189.6</b>

### 2.8.3 Investment for Straw process sites and operations

It plans to set up 10 sites for straw processing. The power plant will provide 2 straw briquette machines and 2 crushing machines for each site, with annual production of 3000 tons briquette straw. For straw processing sites, it mainly has crushing machine, briquette machine and tractor. Among them, the crushing machine and briquette machine will be provided by straw power plant, so it only needs the processing site to prepare transporting vehicles by themselves. The investment for this is about 25 thousand Yuan.

The operation cost of straw processing site mainly refers to the costs of salary, electricity, raw materials and product transport. The power plant will purchase processed briquette products at a price of 300Yuan per ton with net profits of 28600 Yuan. The detailed analysis please sees Table2-8-3.

**Table 2-8-3 Investment and operation cost of processing site**

<b>No.</b>	<b>Items</b>	<b>Unit</b>	<b>Annual use</b>	<b>Unit price</b>	<b>Investment</b>
<b>1</b>	<b>Input</b>				<b>541400</b>
1.1	Maintenance	Yuan/yr.			10000
1.2	Salary	Person.month/yr.	48	800	38400
1.3	Electricity fee	Yuan/kWh	120000	0.75	90000
1.4	Total cost of raw materials				384000
1.4.1	Cost of raw material purchasing	Yuan/ton	2000	190	380000
1.4.2	Rent for site		2000	2	4000
1.5	Cost of product transport	Yuan/ton	1900	10	19000
<b>2</b>	<b>Output</b>				<b>570000</b>
2.1	Sales of briquette straw	Yuan/ton	1900	300	570000
<b>3</b>	<b>Tax</b>				<b>0</b>
3.1	Business tax			0%	0
3.2	Construction fund			7%	0
3.3	Education surcharge			3%	0
<b>4</b>	<b>Net profits</b>				<b>28600</b>

#### 2.8.4 Investment in fixed assets

Total investment of this project is 33.83 million Yuan, among them investment of fixed assets is 33.14 million Yuan, and interest during the construction is 682 thousand Yuan, research & experiment is 1.87 million Yuan. The crushing machine and briquette machine are provided by power plan with total investment of 4.66 million Yuan. The transport vehicles will provide by raw materials processing site itself. Investment of fixed assets is detailed in Attached Table 1.

#### 2.8.5 Scheme of investment

Total investment of this project is 33.83 million Yuan, in which self-owned capital accounts for 30% with 10.15 million Yuan, and loan from commercial bank accounted for 70% with 23.68 million Yuan. The rate of bank interest is based on 5.67% annually. The detailed scheme of investment is shown in Table2-8-4.

**Table 2-8-4 Scheme of investment**

No.	Item	Construction period	Total
		1	
1	Total investment	3382.61	3382.61
1.1	Investment of fixed assets	3314.41	3314.41
1.2	Regulating tax of fixed assets investment		0.00
1.3	Interest during construction	68.19	68.19
1.4	Operating fund		0.00
2	Capital channeling itself	3382.61	3382.61
2.1	Itself-owned capital	1014.78	1014.78
	In which: used for operating fund		0.00
2.2	Loan	2367.83	2367.83
2.2.1	Long-term loan	2367.83	2367.83
2.2.2	Loan for operating fund		0.00
2.2.3	Other short-term loan		
2.3	Others		

#### 2.8.6 Operation cost and profits

##### 2.8.6.1 Operation cost

Annual operation cost is 10.68 million Yuan. The operation cost and total cost is detailed in Attached Table 2 and Attached Table 3.

##### 2.8.6.2 Profits

For this project, 22.88 MWh will be put on power grid. If the price of electricity sold to power grid is 0.727 Yuan/kWh, an annual net profit is 5.36 million Yuan (before tax) and 3.58 million Yuan (after tax).

#### 2.8.7 Tax

This project mainly consists of value-added tax, sale tax surcharge and income tax. The sale tax

surcharge includes city construction fund and education surcharge with rate of 5% and 3% of value-added tax. Rate of income tax is 33%. In this report, it does not consider any preferential for taxation.

### **2.8.8 Analysis on cash flow**

Based on above-mentioned data, if the project is 15 years life-span (excluding construction period), the resulted current flow is as following:

- IRR: 10.85% (before tax), 7.59% (after tax)
- NPV (basic profit rate of 6%): 11.66 million Yuan (before tax), 3.58 million Yuan (after tax)
- Investment payback period: 7.59 years (before tax), 9.04 years (after tax)
- Self-owned capital IRR: 12.02% (after tax)
- Self-owned capital NPV: 6.47 million Yuan
- Self-owned capital investment payback period: 10.11years

The detailed cash flow analysis is shown in Attached Table 4-5.

### **2.8.9 Sensitive analysis**

It carries out the sensitive analysis on main influent factors of straw gasification power generation project. The basic method is to increase and decrease 10% of each influent factor, and then it calculates IRR before income tax of this project. It takes the following influent factors to analyze project sensitive:

- Investment
- Price of electricity that put on power grid
- Price of raw material purchasing
- Rate of interest of loan

Data in Table 9-5 shows that price of electricity is a major factor to influence the profits of project with degree of sensitive of 5.12. For this regard, the rational electricity price is a key element to let this project obtain profits. Under the guarantee of renewable energy law, the generated power will be totally purchased, which can be brought about relatively good economic benefits. At time of this project is established, “China Renewable Energy Law” would have been put into effects. So it can get beneficial from “China Renewable Energy Promotion Law”, in which it stipulates that it should purchase total renewable generation with fixed electricity price. Therefore, it can great improve its capacity to combat the risk of project.

**Table 2-8-5 Sensitive analysis of straw gasification power generation**

<b>Influent factor</b>	<b>Value</b>	<b>Rate of changing</b>	<b>IRR (%)</b>	<b>Rate of IRR changing</b>	<b>Co-efficiency of sensitive</b>
Production load (6500 hours/yr.)	7150.0	10%	15.64	30.12%	2.48
	5850.0	-10%	9.69	-19.38%	
Fixed assets (33.144 M Yuan)	3645.9	10%	9.83	-18.22%	2.65
	2983.0	-10%	16.2	34.78%	
Electricity price (0.727Yuan/kWh)	0.800	10%	18.73	55.82%	5.12
	0.654	-10%	6.42	-46.59%	
Rate of loan interest 0.576%	0.634%	10%	12.02	0.00%	0.17
	0.518%	-10%	12.43	3.41%	

**2.9 Annex**

- Annex 2-1: Investment
- Annex 2-2: Operation coat and income
- Annex 2-3: Total cost
- Annex 2-4: Cash Flow (Total capital)
- Annex2-5: Cash Flow (Capital Fund)

## **3 Xinhua biomass fluidized bed gasification generation power**

### **3.1 Project description**

#### **3.1.1 Project introduction**

To construct a 4000 kW biomass power plant using the rice hull from rice milling plant in Daiyao Town, Xinghua City, Jiangsu Province. The power plant will be equipped with a 2500 kW internal combustion generator unit and a 1500 kW steam turbine generator unit.

#### **3.1.2 Project owner**

The project owner is the Xinghua Suyuan Biomass Power Generation Co. Ltd jointly set up by Zhenjiang Zhongke Huadian New Energy Co. Ltd and Daiyao Town of Xinhua City, Zhejiang Province.

#### **3.1.3 General description of project location**

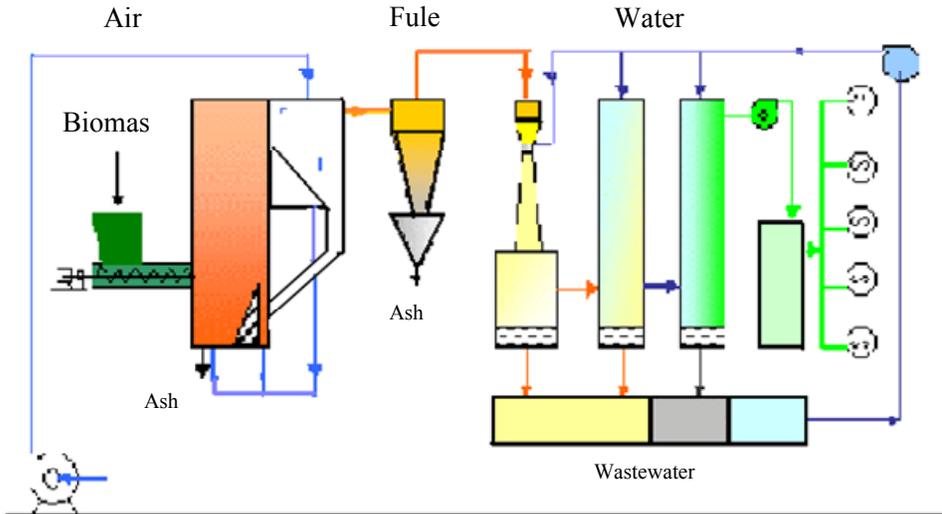
Xinghua city is located at the economic belt of Yangtze River Delta, and in the influx center of Taizhou, Yangzhou, Tandong, Yancheng economic zone, Jiangsu Province. It has advantages in natural resources with abundant water. There are nearly 1 million Mu water areas with the water quality reaching Standard III of national land water. The air quality is higher than Standard II of national level. The total soil is 3.59 million Mu and the soil is fertile. In 2003, the commissariat production reached 925,200 tons, the cotton, 13,700 tons, and the oil plants 37,100 tons. The annual production of agricultural straws is 1.04 million tons, with the obtainable 600,000 tons. 300,000 tons of it can be used as energy (power generation).

The project site, Daiyao Town, is located in the east of Xinghua City, which is the influxing area of three cities Xinghua, Dafeng and Dongtai. The area is 96.9 square meters with a population of 72,000. The east of Daiyao Town is 204 national road, and in the west, Ningyan first class road, Ningjingyan highway, in the south, provincial, and in the north first class road. Also, Xinchang railway, national inner-river route is along the border. Therefore, the transportation is quite convenient.

The project is built in the industrial district of Daiyao Town. Within 30 kilometers, there are 300,000 mu, producing 300,000 tons crops annually. The production of straws is approximately 330,000-350,000 tons. The project only utilizes 10% of the total production. In addition, Daiyao Town has great numbers of milling plants with annual production of rice hulls 10,000 tons. The rice hulls could be used directly as the raw materials for fluidized bed gasification.

### 3.2. Technical Process

#### 3.2.1 Technical flow



#### 3.2.2 Gasification power system

The biomass circulating fluidized bed gasification combined power generation device consist of materials feeding device, steam generating devices, waste heat boiler, tar deep cracking device, gas cleaning device, air pre-heating device, gas generator, steam generator unit, circulating cooling water device, water treatment device, electric control system, waste water and residues treatment system.

#### 3.2.3 Device equipping Plan

The proposed 4000 kW biomass gasification power plant will adopt the scheme of biomass gasification combined circulate power generation. The specific devices are:

- One circulating fluidized bed gasification boiler
- Six 500 kw gas internal combustion generator (one is for spare wheel)
- One waste heat boiler
- One 1500 kw steam turbine generator unit

**Table 3-2-1 Energy consumption index of 4000 Biomass power plants**

No	Project	Parameter
1	Capacity of gas internal combustion generator unit (kw)	5X500
2	Capacity of steam turbine generator unit (kw)	1500
3	Power generation of the power plant per hour (kwh/h)	4000
4	Power generation of the power plant per year (10 <sup>4</sup> kwh/y)	2600(6500 hour/year)
5	Electricity consuming ratio of the power plant (%)	15
6	Feed-in electricity annually (10 <sup>4</sup> kwh/y)	2210
7	Biomass consumption for power generation (kg/kwh)	1.1
8	Annual consumption of biomass (t/y)	27000
9	Gross heat efficiency of the power plant (%)	28
10	Annual replacement amount of standard coal (t/y)	8000
11	Consumption of circulating water per hour (Yangtze river m <sup>3</sup> /h)	585
12	Consumption of other water resources per hour (tap water m <sup>3</sup> /h)	26

### **3.3 Feedstock collection system**

The feedstock includes two types, the one is rice husk, and the other is straw. The rice husk need not be process to gasify in the gasification boiler, and the straw nee be smashed to use. Furthermore, because the origin of rice husk and straw is different, the collection method and collection cost are different.

#### **3.3.1 Rice husk**

There are many small grinding rice mills near the power plant and surrounding area, which produce 100 tons rice husk every year. The small parts of the rice husk are sold for the feed process factory, and the other is use as the waste.

Through survey and negotiate, the purchase price of rice husk will be about 200 Yuan/tons. The price may increase to some extent. But the range of fluctuation will not be large because the object of purchaser is enterprise and the rice husk is the waste. Considering 10% increasing, the price will be 220 Yuan/tons.

The transportation cost of rice husk is 20 Yuan/tons, which includes the distance between grinding rice mill and collection site, and the collection site and power plant. The rice husk need be transferred by the collection site because the power plant cannot store all rice husk.

The maintenance cost of rice husk is about 30 Yuan/tons, which including the field, storehouse, keeper, management worker, anti-fire and profit of site.

In the range with 5-kilometer radius, the total amount of rice husk is about 8000-10000 tons. From grinding rice mill to power plant, the collection cost is 250-207 Yuan/tons.

#### **3.3.2 Straw**

Xinhua is an agricultural country, which has abundant straw resource. The total amount of straw for generation power is about 300 thousand tons, which can meet with the demand of the power plant. The straw collection will adopts the tower structure, namely, agent will collect the straw from farmer, and then collection site purchase the straw form the agent.

The tem collection site will be established to charge with the purchase of straw and rice husk. The distance of the site is about 2-3 kilometer. Furthermore, the distance between the site and power plant is 5 kilometer.

Each site will manage 30-40 agents for collecting straw. The agent will be from the local farmer and charge with collecting the straw form the cultivated field. The straw will be delivered to the filed with the agent and dried to reach the demand for straw moisture.

Each agent will charge with 50 household farmers around the collection filed. The work of agent will include delivering the straw to the field owned by agents, and drying, stacking, and transportation to the collection site.

Based on the survey, the detailed collection cost is as follows:

- Purchase cost for raw straw: 50 Yuan/tons
- Agent cost: 70 Yuan/tons
- Collection site cost: 30Yuan/tons
- Profit of site: 15-20 Yuan/tons
- Transportation cost from site to power plant: 10 Yuan/tons

According to the above, the total cost of collection from cultivated field to power plant is 180 Yuan/tons. The price increasing will be from directly collecting the straw from the farmer. The increasing rate is about 60%, so the total cost is 201 Yuan/tons, which can be accepted by the power plant.

### **3.4 Project construction**

#### **3.4.1 Site selection**

The initial decision of the plant site is in the industrial zone in the west of Daiyao Town, Xinghua City. The reasons are as follows:

- There are abundant raw materials
- The water resources are rich. The Chelu River can not only provide the water for production, but also providing water route for raw materials transportation
- Parts of public utilities could be utilized to reduce the initial investment.

#### **3.4.2 Transportation**

The project site, Daiyao Town, is located in the east of Xinghua City, which is the influx area of three cities Xinghua, Dafeng and Dongtai. The area is 96.9 square meters with a population of 72,000. The east of Daiyao Town is 204 national road, and in the west, Ningyan first class road, Ningjingyan highway, in the south, provincial, and in the north first class road. Also, Xinchang railway, national inner-river route is along the border. Therefore, the transportation is quite convenient.

Both water route and highway can be used for transporting materials and equipments during the construction period of the power plant, as well as raw materials when in operation.

### **3.5 Environmental impact analysis**

From the aspect of environment, utilizing biomass for power generation could obtain zero emission of CO<sub>2</sub> and thus contribute to solve problem of the green house effect caused by over using fossil energy.

As the density of biomass materials is low, it will consume more energy during the transportation comparing with the conventional energy. This consumption cost considerably, and must not be neglected. Taking into consideration the energy used during transportation, smashing and drying process, it is estimated that the CO<sub>2</sub> generated will be 90% less that of fossil energy. In addition, it could also reduce the emission of CO, SO<sub>2</sub>, NO<sub>x</sub> and other pollutants. Therefore, it could contribute to improve the environment.

### 3.6 Investment estimation and financing resources

#### 3.6.1 Investment estimation

Table3-6-1 Investment estimation of 4000kw biomass power plant

No	Item	Subtotal
1	Investment in fixed assets	3675.6
1.1	Project cost	3063.0
1.1.1	land and plant construction	298.5
1.1.2	Thermal power system	1057.0
1.1.3	Fuel supply system	100.0
	Straw collection and smashing system	100.0
1.1.4	Dust removal system	28.5
1.1.5	Chemical water treatment system	100.0
1.1.6	Water supply system	23.0
1.1.7	Electric power system	399.0
1.1.8	Hat engineering controlled system	100.0
1.1.9	Fuel gas cleaning system	200.0
1.1.10	Cabinet	120.0
1.1.11	Others	537.0
1.2	Provisional finance	612.6
1.2.1	Basic provisional finance (12%)	367.6
1.2.2	Appreciation provisional finance (8%)	245.0
3	Interest during construction	75.6
	<b>Total investment: 1+2+3</b>	<b>3751.2</b>

Total investment of the project is 37.512 million Yuan, among which 36.756 million Yuan are invested in fixed assets; the interest during construction period is 756,000 Yuan.

#### 3.6.2 Financing

The finance of this project is proposed to have 30% free finance (capital investment), which is 11.254 Yuan, 70% from the bank loan, which is 26.258 with the annual interest rate 5.76%.

### 3.7 Fiscal analysis

#### 3.7.1 Basic data

##### 3.7.1.1 Project lifetime

The calculation period of this project is 15 years (exclusive of construction period), and the construction time frame is 12 months.

##### 3.7.1.2 Component of construction investment

- Fixed assets investment: According to the calculation, it is around 36.756 Yuan
- The construction interest is the loan interest for the fixed assets investment. The interest during this period will be taken into account of total investment in fixed assets investment. It is calculated to be 756,000 Yuan.
- Total investment: It is 37.512 Yuan.

### 3.7.2 Operation cost

Please refer to the table below for the operation cost of the project and the overall cost are included in the appendices.

**Table 3-7-1 Operational cost of the 4000kw straw power plant** Unit: 10, 000 yuan

No	Item	Unit	Annual cost	Unit price	Sub-total
<b>1</b>	<b>Input</b>				<b>971.8</b>
1.1	Maintenance				70.0
1.2	Salary				100.0
1.2.1	Administrative staff	10 <sup>4</sup> yuan/man year	8	2	16.0
1.2.2	Operational staff	10 <sup>4</sup> yuan/man year	38	2	76.0
1.2.4	Maintenance	10 <sup>4</sup> yuan/man year	4	2	8.0
1.2.3	Assisting staff	10 <sup>4</sup> yuan/man year	10	2	20.0
1.3	Fuel & power				801.8
1.3.2	Water cost	Yuan/ton	5687.5	1.2	0.7
1.3.3	Pollutants treatment	Yuan/ton	5687.5	0.6	0.3
1.3.4	Raw material	Yuan/ton	28600.0	280	800.8
1.4	Depreciation				232.8
<b>2</b>	<b>Output</b>				<b>1646.5</b>
2.1	Electricity sale	yuan/kwh	2210.0	0.714	1646.5
<b>3</b>	<b>Tax</b>				<b>135.0</b>
3.1	Value added tax				122.7
3.1.1	Output tax (17%)				239.2
3.1.2	Input tax (17%)				116.5
3.2	City maintenance & construction (7%)				8.6
3.3	Education add-ons (3%)				3.7

### 3.7.3 Fiscal assessment

The feed-in tariff of this project is 0.745 Yuan/kwh. The internal rate of return (IRR) of the total finance is 6.06% (after tax), and 8.74% (before tax). The investment payback period is 11 years (after tax) and 9.63 years (before tax). Please refer to the appendices for cash flow.

The capital investment IRR of this project is 12.04% (after tax). The Fiscal net present value is 1.702 million Yuan. The payback period is 11.14 years. Please see the appendices for the project cash flow.

### 3.7.4 Sensitivity analysis

After analysis of four uncertain factors, i.e. production load, construction investment, feed in tariff, and interest rate of loan, it shows that the biggest factor is the feed in tariff to impact the economic benefits. As the renewable energy law has been in effect, and the project belongs to the renewable energy power generation, the access to the grid and the tariff could be guaranteed by the law. Therefore, the risk could be avoided.

**Table3-7-2 Sensitivity analysis of the 4000kw biomass power plant**

Uncertain factors	Changing ratio	Value	IRR	Changing ratio	Sensitivity coefficient
Production load (6500 hour/year)	10%	7150.0	14.68	21.93%	2.38
	-10%	5850.0	8.96	-25.58%	
Construction investment (36.756million yuan)	10%	4043.2	9.57	-20.51%	2.12
	-10%	3308.0	14.67	21.84%	
Feed in tariff (0.745 yuan/kilo hour)	10%	0.820	16.96	40.86%	5.13
	-10%	0.671	4.61	-61.71%	
Interest rate of loan 0.576%	10%	0.634%	11.96	-0.66%	0.08
	-10%	0.518%	12.15	0.91%	

### 3.7.5 Analysis of investment benefits

Please see the table below for the analysis of the project investment benefits

**Table 3-7-3 Investment benefits index of the 4000kw straw power plant**

Index	Value (%)
Annual average return	164.2
Investment return rate	4.4
Annual average profit tax	380.1
Investment profit rate	10.1
Capital investment return rate	14.6
Capital investment profit tax rate	33.8

### 3.8 Annex

- Annex 3-1: Total cost
- Annex 3-2: Repay capital with interest of loan
- Annex 3-3: Profit and loss statement
- Annex 3-4: Cash flow (total capital)
- Annex 3-5: Cash flow (capital fund)

**Annex 1-1:Investment plan and financing****Unit: 10,000RMB**

No.	Item	Construction period		Operation period	Total
		1	2	3	
1	Total investment	16325.52	16997.31		33322.83
1.1	Fixed asset investment	15996.40	15996.40		31992.80
1.2	Regulation tax on fix asset investment direction				
1.3	Interest during construction period	329.12	1000.91		1330.03
1.4	Flow capital				0.00
2	Financing	16325.52	16997.31		33322.83
2.1	Self capital	4897.66	5099.19		9996.85
2.2	Bank loan	11427.87	11898.12		23325.98
2.2.1	Long-term bank loan	11427.87	11898.12		23325.98
2.2.2	Flow cash loan				0.00
2.2.3	Other short-term loan				
2.3	Other				

**Annex1- 2:Operation cost and income****Unit: 10,000RMB**

No.	Item	Unit	Quantity	Unit price	Total
<b>1</b>	<b>Input</b>				<b>6442.56</b>
1.1	O&M				202.62
1.2	Salary	10,000/a/per capita	150	2	300.00
1.3	Material	RMB/ton	14	280	3913.73
1.3.1	Collection	RMB/ton	14	200	2795.52
1.3.2	Package	RMB/ton	14	30	419.33
1.3.3	Transportation	RMB/ton	14	50	698.88
1.4	Depreciation				2026.21
<b>2</b>	<b>Output</b>				<b>10687.56</b>
2.2	Electricity sale	RMB/kWh	13260	0.806	10687.56
<b>3</b>	<b>Tax</b>				<b>1082.66</b>
3.1	VAT				984.23
3.1.1	Sale VAT rate (13%)				1552.89
3.1.2	Buy VAT rate (17%)				568.66
3.2	Urban construction tax (7%)				68.90
3.3	Education surtax (3%)				29.53

**Annex 1-3:Total cost**

**Unit: 10,000RMB**

No.	Item	Construction period		Operation period (full capacity)																		
		1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	Fuel & power			3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7
2	Salary and welfare			300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
4	O&M			202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6	202.6
5	Depreciation			2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2
6	Amortize cost			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Finance cost	329.1	1000.9	1343.6	1241.1	1129.1	1006.8	873.3	727.3	568.0	393.8	203.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.1	Long-term loan interest	329.1	1000.9	1343.6	1241.1	1129.1	1006.8	873.3	727.3	568.0	393.8	203.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.2	Flow capital loan interest					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	Subtotal (1+2+...+9)	329.1	1000.9	7786.1	7683.6	7571.7	7449.4	7315.8	7169.9	7010.5	6836.4	6646.2	6442.6	6442.6	6442.6	6442.6	6442.6	6442.6	6442.6	6442.6	6442.6	6442.6
	Hereinto: Fixed cost	0.0	0.0	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8	2528.8
	Variable cost (1+2+7)	329.1	1000.9	5257.3	5154.8	5042.9	4920.6	4787.0	4641.1	4481.7	4307.6	4117.4	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7	3913.7
10	Operation cost (9-5-6-7)	0.0	0.0	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3

**Annex 1-4:Repay capital with interest of loan**

**Unit: 10,000RMB**

Item	Construction period		Operation period (full capacity)																		
	1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Repaying loan and interest																					
Accumulative loan and interest in beginning year	0.0	11427.9	23326.0	21546.6	19603.0	17479.9	15160.7	12627.5	9860.3	6837.6	3535.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan	0.0	11427.9	23326.0	21546.6	19603.0	17479.9	15160.7	12627.5	9860.3	6837.6	3535.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest of construction period		329.1	1000.9																		
Annual loan	11427.9	11898.1	0.0																		
Interest	329.1	1000.9	1343.6	1241.1	1129.1	1006.8	873.3	727.3	568.0	393.8	203.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Return loan	0.0	0.0	1779.4	1943.6	2123.1	2319.1	2533.3	2767.2	3022.7	3301.8	3535.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Return interest	329.1	1000.9	1343.6	1241.1	1129.1	1006.8	873.3	727.3	568.0	393.8	203.7	0.0	0.0	0.0	0.0	0.0	0.0				
Capital source for repay loan			3122.9	3184.7	3252.2	3326.0	3406.5	3494.5	3590.6	3695.6	3810.3	3933.1	3933.1	3933.1	3933.1	3933.1	3933.1	3933.1	3933.1	3933.1	3933.1
Profit			1096.7	1158.5	1226.0	1299.8	1380.3	1468.3	1564.4	1669.4	1784.1	1906.9	1906.9	1906.9	1906.9	1906.9	1906.9	1906.9	1906.9	1906.9	1906.9
Amortize			2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2	2026.2
Depreciation			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

**Annex 1-5: Profit and loss statement**

**Unit: 10,000RMB**

Item	Construction period		Operation period (full capacity)																			
	1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	合计	
Selling income			10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	10688	1828289
Total cost	329	1001	7786	7684	7572	7449	7316	7170	7011	6836	6646	6443	6443	6443	6443	6443	6443	6443	6443	6443	6443	1256574
VAT			1819	1921	2033	2156	2289	2435	2594	2768	2959	3162	3162	3162	3162	3162	3162	3162	3162	3162	3162	456181
Profit			600	634	671	711	755	804	856	914	976	1044	1044	1044	1044	1044	1044	1044	1044	1044	1044	150540
Income tax			1219	1287	1362	1444	1534	1631	1738	1855	1982	2119	2119	2119	2119	2119	2119	2119	2119	2119	2119	305641
Profit after income tax			1219	1287	1362	1444	1534	1631	1738	1855	1982	2119	2119	2119	2119	2119	2119	2119	2119	2119	2119	305641
Distributed profit			122	129	136	144	153	163	174	185	198	212	212	212	212	212	212	212	212	212	212	30564
Surplus accumulation fund																						00
No distributed profit			1097	1159	1226	1300	1380	1468	1564	1669	1784	1907	1907	1907	1907	1907	1907	1907	1907	1907	1907	275077
Accumulated non-distributed profit			1097	2255	3481	4781	6161	7630	9194	10863	12648	14554	16461	18368	20275	22182	24089	25996	27903	29810		2354290

Calculation indicators	Investment profit rate (%)	4.97
	Investment tax rate (%)	10.94

**Annex1-6: Cash flow (capital fund)**

**Unit: 10,000RMB**

No.	Item	Construction period		Operation period																	
		1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Cash inflow			10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6
1.1	Selling income			10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6
2	Cash outflow																				
2.1	Self capital																				
2.2	Principal payback	5226.8	6100.1	9222.1	9317.7	9422.2	9536.3	9660.9	9797.1	9945.8	10108.2	10214.9	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6
2.3	Loan interest	4897.7	5099.2	0.0																	
2.4	Operation cost	0.0	0.0	1779.4	1943.6	2123.1	2319.1	2533.3	2767.2	3022.7	3301.8	3535.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.5	Sale income tax and surtax	329.1	1000.9	1343.6	1241.1	1129.1	1006.8	873.3	727.3	568.0	393.8	203.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.6	Income tax	0.0	0.0	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3
3	Net cash flow	0.0	0.0	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7
4	Accumulated net cash flow	0.0	0.0	600.2	634.0	671.0	711.3	755.4	803.6	856.1	913.6	976.4	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6
		-5226.8	-6100.1	1465.4	1369.8	1265.4	1151.3	1026.6	890.5	741.8	579.3	472.7	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0
		-5226.8	-11326.9	-9861.4	-8491.6	-7226.3	-6075.0	-5048.4	-4157.9	-3416.1	-2836.8	-2364.1	1780.9	5925.8	10070.8	14215.8	18360.8	22505.8	26650.8	30795.7	34940.7

Calculation indicators	<b>FIRR</b>	<b>12.00%</b>
	<b>Financial net value (ic=10%)</b>	<b>6702.69</b>
	<b>Pt(year)</b>	<b>9.6</b>

**Annex 1-7: Cash flow (total capital)**

**Unit: 10,000RMB**

No.	Item	Construction period		Operation period (full capacity)																		
		1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	Cash inflow	0.0	0.0	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6
1.1	Sale income			10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6	10687.6
2	Cash outflow	16325.5	16997.3	7442.8	7374.1	7299.1	7217.2	7127.7	7029.9	6923.1	6806.5	6679.0	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6	6542.6
2.1	Fixed asset investment	16325.5	16997.3	1343.6	1241.1	1129.1	1006.8	873.3	727.3	568.0	393.8	203.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.2	Flow capital			0.0																		
2.3	Sale tax			1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7	1082.7
2.4	Operation cost			4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3	4416.3
2.5	Income tax	0.0	0.0	600.2	634.0	671.0	711.3	755.4	803.6	856.1	913.6	976.4	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6	1043.6
	Net cash flow value	-16325.5	-16997.3	3244.8	3313.5	3388.5	3470.4	3559.9	3657.7	3764.5	3881.1	4008.5	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0	4145.0
	Accumulated net cash flow value	-16325.5	-33322.8	-30078.0	-26764.6	-23376.1	-19905.7	-16345.8	-12688.2	-8923.7	-5042.6	-1034.1	3110.9	7255.9	11400.9	15545.8	19690.8	23835.8	27980.8	32125.8	36270.7	
	Net cash flow value before taxation	-16325.5	-16997.3	3845.0	3947.5	4059.4	4181.7	4315.3	4461.2	4620.6	4794.7	4984.9	5188.6	5188.6	5188.6	5188.6	5188.6	5188.6	5188.6	5188.6	5188.6	5188.6
	Accumulated net cash flow value before taxation	-16325.5	-33322.8	-29477.9	-25530.4	-21471.0	-17289.2	-12973.9	-8512.7	-3892.1	902.6	5887.5	11076.0	16264.6	21453.1	26641.7	31830.2	37018.8	42207.4	47395.9	52584.5	

Calculation indicators	After taxation	Before taxation
<b>FIRR (%)</b>	<b>6.75%</b>	<b>9.66%</b>
<b>Financial net value(Ic=10%) (10,000RMB)</b>	<b>1705</b>	<b>8955</b>
<b>Pt(year)</b>	<b>9.25</b>	<b>8.81</b>

**Annex 2-1: Investment**

**Unit: 10<sup>4</sup> Yuan**

No.	Engineering or cost	Estimated value					Area of construction (M <sup>2</sup> )	Unit cost	Remarks
		Construction	Equipment purchasing	Installation	Others	Total			
<b>1</b>	<b>Investment of fixed assets</b>	<b>169.20</b>	<b>2061.50</b>	<b>229.80</b>	<b>853.91</b>	<b>3314.41</b>	<b>1870.00</b>		
<b>1.1</b>	<b>Cost of engineering</b>	<b>169.20</b>	<b>2061.50</b>	<b>229.80</b>		<b>2460.50</b>			
<b>1.1.1</b>	<b>Production</b>	<b>127.00</b>	<b>1944.50</b>	<b>213.50</b>		<b>2285.00</b>			
1.1.1.1	Gasification	80.00	320.40	80.10		<b>480.50</b>	800.00	1000.00	
1.1.1.2	Power generation	15.00	937.35	104.15		<b>1056.50</b>	150.00	1000.00	
1.1.1.3	Gas purification	4.00	165.75	29.25		<b>199.00</b>	100.00	400.00	
1.1.1.4	Raw material preparation	24.00	5.00	0.00		<b>29.00</b>	400.00	600.00	
1.1.1.5	Crushing and briquette machines		466.00			<b>466.00</b>			
1.1.1.6	Power transforming and transmission	4.00	50.00	0.00		<b>54.00</b>	50.00	800.00	
<b>1.1.2</b>	<b>Civil engineering</b>	<b>15.20</b>	<b>53.00</b>	<b>16.30</b>		<b>84.50</b>			
1.1.2.1	Water supply and discharging	3.20	41.00	11.10		55.30			
1.1.2.1.1	Water discharging network in plant		1.20	5.00	2.50		8.70	20.00	600.00
1.1.2.1.2	Waste water disposal system	2.00	28.00	7.00		37.00	50.00	400.00	
1.1.2.1.3	Water for fire-fighting and safety system		8.00	1.60		9.60			
1.1.2.2	Power line and lighting in plant		8.00	3.20		11.20			
1.1.2.3	General plan	12.00				12.00			
1.1.2.3.1	Wall and gate	2.00				2.00			
1.1.2.3.2	Road inside plant	10.00				10.00			
1.1.2.4	Power use system in plant		4.00	2.00		6.00			
<b>1.1.3</b>	<b>Service engineering</b>	<b>27.00</b>	<b>64.00</b>	<b>0.00</b>		<b>91.00</b>			
1.1.3.1	Office	18.00				18.00	300.00	600.00	
1.1.3.2	Engineering outside plant	9.00				9.00			
1.1.3.2.1	Road outside plant	2.00				2.00			

1.1.3.2.2	Pipeline	2.00				2.00			
1.1.3.2.3	Vegetation	5.00				5.00			
1.1.3.3	Office equipment		10.00			10.00			
1.1.3.4	Purchasing cost of tool and furniture		14.00			14.00			
1.1.2.5	Cost of spare parts		40.00			40.00			
<b>1.2</b>	<b>Others</b>					<b>479.24</b>	<b>479.24</b>		
1.2.1	Cost of production preparation					40.00	40.00		
1.2.2	Cost of engineering design					123.03	123.03		0.05
1.2.3	Cost of earliest stage works					20.00	20.00		
1.2.5	Cost of land					60.00	60.00	15.00	畝
1.2.6	Cost of construction management					24.61	24.61		0.01
1.2.7	Cost of construction monitoring					24.61	24.61		0.01
1.2.8	Cost of research & experiment					187.00	187.00		
<b>1.3</b>	<b>Cost of preparation</b>					<b>374.68</b>	<b>374.68</b>		
1.3.1	Cost of basic preparation					235.18	235.18		0.08
1.3.2	Prepared cost for price raise					139.50	139.50		0.06
<b>2</b>	<b>Regulating tax of investment for fixed assets</b>					<b>0.00</b>			0.01
	<b>Total</b>	<b>169.20</b>	<b>2061.50</b>	<b>229.80</b>		<b>853.91</b>	<b>3314.41</b>		

**Annex 2-2: Operation coat and income**

No.	Items	Unit	Annual use	Unit price	Sum
<b>1</b>	<b>Input</b>				<b>1068.08</b>
1.1	Cost of maintenance				20.99
1.2	Salary				74.40
1.2.1	Managing staffs	10 <sup>4</sup> Yuan/person.yr.	4	2.4	9.60
1.2.2	Leader of group	10 <sup>4</sup> Yuan/person.yr.	16	1.8	28.80
1.2.4	Operation workers	10 <sup>4</sup> Yuan/person.yr.	30	1.2	36.00
1.2.3	Auxiliary workers	10 <sup>4</sup> Yuan/person.yr.	40	0.96	38.40
1.3	Fuel & power				972.69
1.3.1	Electricity	10 <sup>4</sup> kwh	104	0.73	75.92
1.3.2	Water fee	Yuan/t	8760	1.2	1.05
1.3.3	Pollution discharging fee	Yuan/t	8760	0.6	0.53
1.3.4	Cost of engine oil	Yuan/Kg	43200	9	38.88
1.3.5	Cost of raw material	Yuan/t	28543.7	300	856.31
1.4	Cost of depreciation				209.91
<b>2</b>	<b>Output</b>				<b>1724.49</b>
2.1	Power sales	Yuan/kWh	2288.0	0.727	1663.38
2.2	Tar oil	Yuan/t	611.1	1000	61.11
<b>3</b>	<b>Tax</b>				<b>120.16</b>
3.1	Value-added tax				109.24
3.2	City construction tax (7%)				7.65
3.3	Education surcharge (3%)				3.28
3.3	Education surcharge			3%	2.82
<b>4</b>	<b>Income tax</b>			<b>30%</b>	<b>143.37</b>

**Annex2-3: Total cost**

**Unit: 10,000RMB**

No.	Items	Operation period																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Fuel & power	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7
2	Salary & welfare	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4
3	Expenditure of maintenance	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
4	Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Depreciation	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9	209.9
6	Allocation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Financial cost	136.4	124.8	112.1	98.2	83.0	66.3	48.0	27.9	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.1	Interest of long-term loan	136.4	124.8	112.1	98.2	83.0	66.3	48.0	27.9	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	Expenditure of total cost	1414.4	1402.8	1390.1	1376.2	1361.0	1344.3	1326.0	1305.9	1283.9	1278.0	1278.0	1278.0	1278.0	1278.0	1278.0	1278.0	1278.0	1278.0	1278.0	1278.0
	# Fixed cost	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3	305.3
	Variable cost	1109.1	1097.5	1084.8	1070.9	1055.7	1039.0	1020.7	1000.6	978.6	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7	972.7
9	Cost of management	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1	1068.1

Note: Cost of total cost=(1+2+...+8); Variable cost=(1+2+7); Cost of management = (8-5-6-7)

**Annex 2-4:Cash Flow (Total capital)**

**Unit.: 10<sup>4</sup> Yuan**

No.	Year	Construction	Production reaching design capacity																				
			1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Cash inflow	0	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724
1.1	Income		1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724
2	Cash outflow	3383	1387	1380	1371	1362	1352	1340	1328	1315	1322	1302	1296	1296	1296	1296	1296	1296	1296	1296	1296	1296	1296
2.1	Fixed asset	3383																					
2.3	VAT and addtion		120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
	Interest		136	125	112	98	83	66	48	28	28	6											
2.4	Running cost		1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068
2.5	Income tax		63	67	71	75	80	86	92	98	106	108	108	108	108	108	108	108	108	108	108	108	108
3	Net cash flow	-3383	337	345	353	363	373	384	396	410	403	423	429	429	429	429	429	429	429	429	429	429	429
4	Accumulated net cash flow	-3383	-3045	-2700	-2347	-1984	-1611	-1227	-831	-421	-18	404	833	1261	1690	2118	2547	2976	3404	3833	4261	4690	
	Net cash flow before income tax	-3383	400	411	424	438	453	470	488	508	508	530	536	536	536	536	536	536	536	536	536	536	536
	Accumulated net cash flow before income tax	-3383	-2983	-2571	-2147	-1709	-1256	-786	-298	211	719	1249	1785	2322	2858	3394	3930	4467	5003	5539	6075	6612	
	Index		After income tax										Before income tax										
	IRR		7.59%										10.85%										
	NPV Ic=6% (10 <sup>4</sup> Yuan)		3.58 Million Yuan										11.66 Million Yuan										
	Payback period (year)		9.04 years										7.59 years										

**Annex2-5: Cash Flow (Capital Fund)**

**Unit: 10<sup>4</sup> Yuan**

No.	Items	Construction	Operation period																			
		1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Cash inflow	0	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724
1.1	Income	0	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724	1724
2	Cash outflow	1083	1588	1600	1612	1626	1641	1658	1676	1697	1704	1405	1296	1296	1296	1296	1296	1296	1296	1296	1296	1296
2.1	Self-owned capital	1015																				
2.2	Repayment of capital	0	201	220	241	264	290	318	348	382	382	103	0	0	0	0	0	0	0	0	0	0
2.3	Payment of loan interest	68	136	125	112	98	83	66	48	28	28	6	0	0	0	0	0	0	0	0	0	0
2.4	Running cost	0	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068
2.5	VAT and addtion	0	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
2.6	Income tax	0	63	67	71	75	80	86	92	98	106	108	108	108	108	108	108	108	108	108	108	108
3	Net cash flow: 1-2	-1083	136	125	112	98	83	66	48	28	21	320	429	429	429	429	429	429	429	429	429	429
4	Accumulated net cash flow: 1-2	-1083	-947	-822	-710	-611	-528	-462	-414	-386	-365	-46	383	811	1240	1668	2097	2525	2954	3383	3811	4240
	IRR (%)	12.02																				
	NPV (ic=10%, 10 <sup>4</sup> Yuan)	646.9																				
	Investment payback period (yr.)	10.11																				

**Annex3-1: Total cost**

**Unit: 10<sup>4</sup> yuan**

No	Item	Construction period	Production period of reaching the designed capacity														
		1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Fuel & power		801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8	801.8
2	Salary & welfare		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4	Reparation cost		70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
5	Depreciation cost		232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8
6	Amortizing cost		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Fiscal cost	75.6	151.2	141.1	130.1	118.1	104.9	90.5	74.8	57.7	38.9	18.4	0.0	0.0	0.0	0.0	0.0
7.1	Long-term interest rate of loan	75.6	151.2	141.1	130.1	118.1	104.9	90.5	74.8	57.7	38.9	18.4	0.0	0.0	0.0	0.0	0.0
7.2	Interest of loan of flow finance																
8	Total cost (1+2+...+8)	75.6	1355.9	1345.8	1334.7	1322.7	1309.5	1295.1	1279.4	1262.3	1243.5	1223.0	1204.6	1204.6	1204.6	1204.6	1204.6
	Fixed cost	0.0	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8	402.8
	Variable cost (1+2+7)	75.6	953.1	943.0	931.9	919.9	906.7	892.3	876.6	859.5	840.7	820.3	801.8	801.8	801.8	801.8	801.8
9	Operation cost (8-5-6-7)	0.0	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8

**Annex 3-2: Repay capital with interest of loan**

**Unit: 10<sup>4</sup> Yuan**

No	Item	Construction period	Operating period															
		1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Repaying loan and interest																	
1.1	Accumulative loan and interest in beginning year	0.0	2625.9	2450.5	2258.9	2049.7	1821.1	1571.5	1298.8	1000.9	675.5	320.0	0.0	0.0	0.0	0.0	0.0	
1.1.1	Loan	0.0	2625.9	2450.5	2258.9	2049.7	1821.1	1571.5	1298.8	1000.9	675.5	320.0	0.0	0.0	0.0	0.0	0.0	
1.1.2	Interest of construction period	75.6																
1.2	Annual loan	2625.9																
1.3	Interest	75.6	151.2	141.1	130.1	118.1	104.9	90.5	74.8	57.7	38.9	18.4	0.0	0.0	0.0	0.0	0.0	
1.4	Return loan	0.0	175.4	191.6	209.2	228.6	249.7	272.7	297.9	325.4	355.4	320.0	0.0	0.0	0.0	0.0	0.0	
1.5	Return interest	75.6	151.2	141.1	130.1	118.1	104.9	90.5	74.8	57.7	38.9	18.4	0.0	0.0	0.0	0.0	0.0	
2	Capital source for repay loan		326.6	332.7	339.4	346.6	354.6	363.2	372.7	383.1	394.4	406.7	417.8	417.8	417.8	417.8	417.8	
2.1	Profit		93.8	99.9	106.6	113.8	121.8	130.4	139.9	150.3	161.6	173.9	185.0	185.0	185.0	185.0	185.0	
2.2	Depreciation		232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	232.8	

**Annex3- 3: Profit and loss statement**

**Unit: 10<sup>4</sup> yuan**

No	Item	Construction period	Operation period														
		1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Product turnover		1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5
2	Turnover tax and add-ons		135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0
3	Total cost	75.62	1355.9	1345.8	1334.7	1322.7	1309.5	1295.1	1279.4	1262.3	1243.5	1223.0	1204.6	1204.6	1204.6	1204.6	1204.6
4	Total profit: 1-2-3		155.6	165.7	176.7	188.8	201.9	216.3	232.0	249.2	267.9	288.4	306.8	306.8	306.8	306.8	306.8
5	Income tax (33%)		51.3	54.7	58.3	62.3	66.6	71.4	76.6	82.2	88.4	95.2	101.3	101.3	101.3	101.3	101.3
6	Profit after tax: 4-5		104.2	111.0	118.4	126.5	135.3	144.9	155.5	167.0	179.5	193.2	205.6	205.6	205.6	205.6	205.6
8	Profit can be allocated: 6-7		104.2	111.0	118.4	126.5	135.3	144.9	155.5	167.0	179.5	193.2	205.6	205.6	205.6	205.6	205.6
9	Surplus accumulating fund (10%)		10.4	11.1	11.8	12.6	13.5	14.5	15.5	16.7	18.0	19.3	20.6	20.6	20.6	20.6	20.6
10	Profit to be paid																
11	Profit not being distributed		93.8	99.9	106.6	113.8	121.8	130.4	139.9	150.3	161.6	173.9	185.0	185.0	185.0	185.0	185.0
	Accumulated profit not being distributed		93.8	193.7	300.3	414.1	535.9	666.4	806.3	956.5	1118.1	1292.0	1477.0	1662.1	1847.1	2032.1	2217.1

**Annex 3-4: Cash flow (total capital)**

**Unit: 10<sup>4</sup> Yuan**

No	Item	Constructio n period	Operation period														
		1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1	Cash flow-in	0	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	
1.1	Product turnover		1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	1646	
2	Cash flow -out	3751	1309	1303	1295	1287	1278	1269	1258	1247	1234	1220	1208	1208	1208	1208	
2.1	Fixed assets investment	3751	151	141	130	118	105	91	75	58	39	18	0	0	0	0	
2.2	Flow finance																
2.3	Turnover tax		135	135	135	135	135	135	135	135	135	135	135	135	135	135	
2.4	Operational cost		972	972	972	972	972	972	972	972	972	972	972	972	972	972	
2.5	Income tax	0	51	55	58	62	67	71	77	82	88	95	101	101	101	101	
3	Net cash flow	-3751	337	344	351	359	368	378	388	400	412	426	438	438	438	438	
4	Accumulated net cash flow	-3751	-3414	-3070	-2719	-2360	-1992	-1614	-1226	-826	-414	12	451	889	1327	1766	
	Net cash flow before tax	-3751	388	398	410	422	435	449	465	482	501	521	540	540	540	540	
	Accumulated net cash flow before tax	-3751	-3363	-2964	-2555	-2133	-1699	-1249	-785	-303	198	719	1259	1799	2338	2878	
	Index	After tax								Before tax							
	FIRR	6.06%								8.74%							
	FNPV Ic=10%( Unit: 10 <sup>4</sup> yuan)	15								714							
	Investment return period (year)	11.00								9.63							

**Annex 3-5: Cash flow (capital fund)**

**Unit: 10<sup>4</sup> yuan**

No	Item	Construction period	Operation period														
		1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Cash flow-in		1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5
1.1	Turnover		1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5	1646.5
1.2	Remain value of fixed assets callback																
1.3	Flow finance callback																
2	Cash flow-out	1201.0	1484.8	1494.2	1504.5	1515.7	1528.0	1541.4	1556.1	1572.1	1589.6	1540.5	1208.1	1208.1	1208.1	1208.1	1208.1
2.1	Self-raising finance	1125.4	0.0														
2.2	Payback loan principal & interest	0.0	175.4	191.6	209.2	228.6	249.7	272.7	297.9	325.4	355.4	320.0	0.0	0.0	0.0	0.0	0.0
2.3	Pay interest of loan	75.6	151.2	141.1	130.1	118.1	104.9	90.5	74.8	57.7	38.9	18.4	0.0	0.0	0.0	0.0	0.0
2.4	Operational cost	0.0	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8	971.8
2.5	Vendition tax & add-ons	0.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0
2.6	Income tax	0.0	51.3	54.7	58.3	62.3	66.6	71.4	76.6	82.2	88.4	95.2	101.3	101.3	101.3	101.3	101.3
3	Net cash flow: 1-2	-1201.0	161.7	152.3	142.0	130.7	118.4	105.0	90.4	74.3	56.9	106.0	438.4	438.4	438.4	438.4	438.4
4	Accumulated net cash flow	-1201.0	-1039.3	-887.1	-745.1	-614.4	-496.0	-391.0	-300.6	-226.3	-169.4	-63.4	375.0	813.3	1251.7	1690.1	2128.5
	Index																
	FIRR	12.04%															
	FNPV Ic=10%( Unit: 10 <sup>4</sup> yuan)	170.24															
	Investment return period (year)	11.14															

# REPORT DOCUMENTATION PAGE

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