Economic Benefit Analysis of Anaerobic Digestion System

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Abstract. This paper aims to clarify the conditions and specific details of data collection by establishing an economic benefit analysis model, and provide corresponding economic analysis and support for the construction of anaerobic digestion plants and PTG facilities.With the implementation of China's dual carbon policy, energy recovery and reuse and the development and use of clean energy have become hot issues. Through the corresponding literature reading, it was found that there is a new way to generate clean energy biogas abroad, and the biogas produced is used for power generation, that is, PTG facilities. At present, PTG facilities have not been studied in the literature. In order to consider the feasibility of establishing facilities, it is necessary to analyze the economic benefits, and the profits generated by the facilities can form a virtuous circle, so as to continue to invest in the construction, maintenance and construction of other supporting facilities.Based on the collected data, the calculation is carried out, considering the cost of labor, raw materials, and maintenance, and the final calculated profit is CNY4.33×10^9. Although it is necessary to increase the cost of maintenance and replacement of equipment inside the facility, the costs covered in this article account for only a small part of the total revenue, and the proportion of government subsidies in the income is much smaller than the proportion of power generation revenue, so the facility has great development prospects. **Keywords:** Economic analysis, PTG facilities, Clean energy.

1 Introduction

With the approaching of energy and resource crisis, China has paid more and more attention to the development and utilization of clean energy. Biogas is a very cheap and easy to obtain new energy, and the pollution of its combustion products is very small. In recent years, the country and the government have also attached great importance to the biogas power generation project. Every year, cities in China produce a large amount of household garbage, which is characterized by high water content, easy degradation and large production. Due to the special engineering treatment characteristics and physical and chemical characteristics, traditional treatment methods such as composting, incineration and burial will cause serious environmental pollution problems such as odor, high concentration leachate. As a crop, straw is rich in biomass energy. Anaerobic digestion provides an effective, safe and clean treatment method to replace incineration, which is a treatment method with great environmental pollution[1]. With the development of urbanization and the national emphasis on environmental protection, mixed raw material biogas power generation has become the latest technical means. Biogas power generation is realized through anaerobic fermentation

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of mixed raw materials, filtration treatment and other technologies, so as to achieve efficient utilization of urban household waste and crop resources and energy, and also an effective way to use renewable energy[2].

With more and more attention paid to the sectoral coupling of power and natural gas networks, more and more potential applications have been identified, among which the use of natural gas networks as a buffer zone for methane, biogas and hydrogen generated by biogas (PTG) technology has great value.With the development of gas power generation (PtG) technology from the development stage to commercial utilization, it is expected that more such facilities will be installed in the near future.

The topicality of PTG facilities has led some scholars to do some detailed review and research from different technical and economic aspects. Wulf et al.[3] outlined 220 power conversion research and demonstration projects and evaluated electrolysis application technologies and hybdrogen post-processing types. Gotz et al.[4] compared electrolysis and methanation technologies, taking into account capex and efficiency. Biogas produced by AD (anaerobic digestion ester) plants, due to its higher carbon dioxide content, can be used to produce SNG (synthetic natural gas) through PTG technology[5], which is a promising source of methanated natural gas. Collet et al.[6] discuss the technical-economic assessment process and life cycle assessment of methane production, including sensitivity analysis to biogas upgrades, electricity prices, and annual run time. Other studies have compared different technologies regarding the main equipment of biogas and PTG plants, namely hydroelectrolysis[7] and methanation[8].

Economic analysis refers to a research activity that is based on various economic theories and basic data, uses various indicators and models to analyze and study the economic dynamics and their effects in a certain period, finds out the rules and points out the development direction.Biogas treatment system and power generation system are important investment and construction contents of biogas power generation, with high economic input in the early stage, and economic benefit evaluation provides scientific reference for investment decision-making. At the initial stage of investment and construction of any project, it is necessary to comprehensively analyze social and economic benefits, and some also need to analyze environmental benefits, cultural benefits, etc. Economic analysis and evaluation occupy an important position, which is an important basis for ensuring the smooth progress of investment decisions and giving play to economic benefits. This paper focuses on the costs and benefits generated by the operation of the biogas treatment system and power generation system. Based on the knowledge of mathematical modeling and operational research, corresponding suggestions are put forward to provide reference for the location selection of the construction of the biogas treatment system and power generation system[9].

The technical and economic analysis of the anaerobic digestion plant will greatly influence the decision maker's judgment. Whether an anaerobic digestion plant can be built in this area, technical and economic factors are one of the important factors that need to be measured by decision makers. For example, Zhao, SA et al[10]. conducted a study on whether anaerobic digestion improves the environmental and economic benefits of sludge incineration in China to explore the practical significance of anaerobic digestion for China. Similar studies were conducted by D'Adamo et al.[11] on the economic assessment and policy implications of biomethanes as an energy source for achieving sustainable production. Other studies are specific to raw materials or corresponding reaction devices, such as the technical and economic analysis of single stage and temperature phase anaerobic co-digestion of sewage sludge, distillers' grains and poultry manure by Sillero et al.[12], and the technical and economic analysis of micro-biogas device combined with microalgae culture to treat municipal organic waste by Barbera et al.[13].

The rest of this paper is organized as follows: in section 2, assumptions are proposed and models are established, and methods for understanding the models are proposed. Section 3 discusses the results of the empirical test. Section 4 introduces the conclusions and practical significance.

2 Modelling

This section presents a mathematical model based on the above problem statement. From the analysis above, there is a clear conflict between the anaerobic digestion plant and the biogas power plant(PTG facility), because the anaerobic digestion plant authorities want to be close to the source, while the cost of an anaerobic digester and the carbon emissions associated with transport are minimised, biogas power plants(PTG facility) aim to maximise the use of existing urban infrastructure and reduce construction costs.

2.1 Assumption

Normal anaerobic digestion has strict reactor requirements and internal environmental conditions. Therefore, the model for the location of biogas power generation is based on the following assumptions.

Assumption 1. The maintenance of roads, power grids, water pipes and equipment shall be carried out by workers, excluding the damage and replacement of equipment under unnatural conditions. It is assumed that the equipment can be used normally during its life cycle.

Assumption 2. Since the straw producing area is mainly located in the rural areas, and the corresponding transport conditions in the rural areas are relatively simple. For the sake of simple operation, it is assumed that Straw is transported by road.

Assumption 3. In the process of biogas power generation, it is assumed that the biogas produced by each ton of raw material mixture is a constant value.

Assumption 4. As hydropower is a relatively cheap resource, the demand needs to be dynamically adjusted according to the biogas supply, which is difficult to quantify, so the cost of hydropower is not considered here.

2.2 Notations

The following mathematical notations are used in this paper.

(1)Index:

i: Index of candidate site for anaerobic digestion plant,where $i = 1, 2, \cdots I$

j: Index of candidate site for the biogas power plant(PTG facility),where $j = 1, 2, \cdots J$

k: Index of site for straw producing area,where $k = 1, 2, \cdots K$

(2)Decision variables:

y_k: The distance from the straw raw material site to the anaerobic digestion plant.

$x_{i,j}$: The distance from the anaerobic digestion plant to the PTG facility

x_r: The sum of the distance from the anaerobic digestion plant to the road and from the PTG facility to the road

x_p: The sum of the distance from the anaerobic digestion plant to the nearest power grid and from the PTG facility to the nearest power grid

(3)Uncertain parameters:

p: The total cost of building an anaerobic digestion plant and the PTG facility

(4)Parameters:

$x_{i,k}$: straw quantities imported from area k to anaerobic digestion plant

c_0: collection cost per tonne of straw y_k: distance from area k to the anaerobic digestion plant

c_1: transportation cost per kilometer per tonne of straw

y_0: distance from the city to the anaerobic digestion plant

c_2: transportation cost per kilometer per tonne of waste

θ: mixed ratio of waste to straw

ω: Average gas yield in a mixed feed anaerobic digestion

α: The power generation efficiency of biogas

c_k: monthly salary of one straw transporter per area

n: number of personnel required for urban household waste transportation

c_n: monthly salary of urban household waste transporter

$x_{i,j}$: Length of biomass transportation pipeline required between anaerobic digestion plant and PTG facility

$c_{i,j}$: monthly price of biomass pipeline transportation

c_r: Cost per kilometer of road maintenance

$x_{i,p}$: The distance of the anaerobic digestion plant from the nearest power grid

$x_{j,p}$: The distance of the PTG facility from the nearest power grid

c_p: Cost per kilometer of power grid maintenance

$x_{i,r}$: The distance of the anaerobic digestion plant from the nearest road

$x_{j,r}$: The distance of the PTG facility from the nearest road

c_r: Cost per kilometer of road maintenance

c_b: Cost per kilometer of biogas pipeline transportation maintenance

p_t: The total cost to be considered for the construction of anaerobic digestion plant and PTG facilities

X_{i0}: daily production of urban household waste

X_1: demand quantity of straw

c_i: Average monthly wage of workers in operation of anaerobic digestion plant

c_j: Average monthly wage of workers in operation of PTG facility

N_i: Number of workers required for infrastructure construction of anaerobic digestion plant

N_j: Number of workers required for infrastructure construction of PTG facility

r_1: Revenue per ton of waste disposal

r_2: Revenue of one kilowatt hour electricity

2.3 Project Objectives

1.Cost

The biogas power plant has an organizational structure to generate income. The main objective of the project is to use municipal solid waste and biogas in crop straw to generate cogeneration, so as to save energy, reduce emissions, and generate income and profits. In this process, we do not need to consider the costs generated during the construction period, but only the costs and profits generated during the operation period to judge whether it is profit or loss. In order to describe these objectives more intuitively, we have established corresponding mathematical expressions in the study in the following ways.

In general, profit is calculated by subtracting costs from revenues. In this study, the raw materials were treated by anaerobic digestion plant and then supplied to PTG facilities. The natural gas of PTG facilities will be provided to the power plant free of charge, and the generated electricity will be supplied to the power plant or surrounding areas at a price lower than the grid electricity. The project cost is divided into raw material procurement cost, transportation cost, maintenance cost and personnel cost.

(1)Raw material procurement cost

The cost of purchasing raw materials is mainly the cost of purchasing crop straw privately owned by villagers. Anaerobic digestion treatment of urban household waste is conducive to rational utilization of resources and lightening the burden of government waste treatment.As a clean waste disposal method, it can be regarded as income. The treatment of municipal solid waste here does not involve a specific reaction cycle of anaerobic digestion device, but only involves a production cycle of one year. Since we only consider the total amount of raw materials here, that is, the annual crop straw output in this region, the raw material procurement cost C_1 can be expressed as Eq. (1):

$$C_1 = \sum_k x_{i,k} c_0. \tag{1}$$

(2)Transportation cost

The transportation cost designed in this study consists of the transportation cost of raw materials (urban household waste and straw), the transportation cost of biogas and the cost of employing transportation personnel. In order to facilitate the study, the employment time of transportation personnel is consistent with the operation cycle of the study, which is one year.Therefore, the transportation cost C_2 can be expressed as the following formula Eq. (2):

$$C_2 = (\sum_k x_{i,k} y_k c_1 + 12k c_k) + (\sum_k x_{i,k} \theta y_0 c_2 + 12n c_n) + x_{i,j} c_{i,j} \cdot \sum_k x_{i,k} \cdot \omega. \tag{2}$$

(3)Maintenance cost

Other costs in the maintenance process include the maintenance cost of the biomass energy transport pipeline, the maintenance cost of the power grid and the maintenance cost of the road network. In addition, PTG facilities should also consider the maintenance cost of the water network. Therefore, the following calculation formula Eq. (3), Eq. (4), Eq. (5) is obtained:

$$x_r = x_{i,r} + x_{j,r}. \tag{3}$$

$$x_p = x_{i,p} + x_{j,p}. \tag{4}$$

$$C_3 = x_r \cdot c_r + x_p \cdot c_p + x_{i,j} c_b. \tag{5}$$

(4)personnel cost

Among the personnel costs, the transportation personnel costs are attributed to the costs required for transportation. The personnel costs here mainly refer to the costs incurred by the anaerobic digestion plant and PTG to ensure the normal operation of the facilities and equipment maintenance. The research period is one year, so it is necessary to calculate the annual personnel costs. The formula Eq. (6) is as follows:

$$C_4 = 12(c_i N_i + c_j N_j) \tag{6}$$

The total cost to be considered for the operation of anaerobic digestion plant and PTG facilities is shown in the following formula Eq. (7):

$$\begin{aligned} P_t &= C_1 + C_2 + C_3 + C_4 \\ &= \sum_k x_{i,k}c_0 + (\sum_k x_{i,k}y_k c_1 + 12kc_k) + (\sum_k x_{i,k}\theta y_0 c_2 X_u + 12nc_n) + x_{i,j}c_{i,j} \cdot \sum_k x_{i,k} \cdot \omega \\ &\quad + x_r \cdot c_r + x_p \cdot c_p + x_{i,j}c_b + 12(c_i N_i + c_j N_j). \end{aligned} \tag{7}$$

2.Income

The income of this paper is mainly from two aspects, one is the subsidy given by the government for waste disposal, and the other is the income from biogas power generation.

(1)Income from waste disposal

$$R_1 = \sum_k x_{i,k} \cdot \theta r_1. \tag{8}$$

(2)Income from biogas power generation

$$R_2 = \sum_k x_{i,k} \cdot \omega\alpha r_2. \tag{9}$$

3.Profit

$$\begin{aligned} P_r &= R_1 + R_2 - (C_1 + C_2 + C_3 + C_4) \\ &= \sum_k x_{i,k} \cdot \theta r_1 + \sum_k x_{i,k} \cdot \omega\alpha r_2 - (\sum_k x_{i,k}c_0 + (\sum_k x_{i,k}y_k c_1 + 12\sum_k c_k) + (\sum_k x_{i,k}\theta y_0 c_2 \\ &\quad + 12nc_n) + x_{i,j}c_{i,j} \cdot \sum_k x_{i,k} \cdot \omega + x_r \cdot c_r + x_p \cdot c_p + x_{i,j}c_b + 12(c_i N_i + c_j N_j)). \end{aligned} \tag{10}$$

2.4 Solution to the Model and Project Constraints

Economic benefit analysis refers to the assessment and evaluation of the size or level of economic benefits, and the analysis and research of the reasons for their formation. The purpose is to sum up experience and expose contradictions in order to seek the correct way to further improve economic efficiency.

The assessment of economic benefits is generally carried out through the comparison of relevant economic indicators. For example, through labor productivity, wage profit margin and other indicators, evaluate the economic benefits of live labor consumption; Through raw material consumption rate, fuel power consumption rate and other indicators, evaluate the economic benefits of physical and chemical labor consumption, and evaluate the economic benefits of live labor and physical labor consumption through cost profit margin, commodity circulation rate and other indicators; Evaluate the economic benefits of labor occupation through indicators such as capital turnover rate and capital interest tax rate,etc.

However, since the distances involved in this paper include multiple distances from the straw raw material site to the anaerobic digestion plant and from the road to the anaerobic digestion plant, and the price is a range value, the size of the range can be determined through market research. Therefore, taking all distance related indicators as decision variables, the following constraints are obtained:

$$\sum_k x_{i,k}y_k c_1 > 0, x_{i,j}c_{i,j} \cdot \sum_k x_{i,k} \cdot \omega > 0, x_r \cdot c_r + x_p \cdot c_p + x_{i,j}c_b > 0 \tag{11}$$

$$y_k > 0, x_{i,j} > 0, x_r > 0, x_p > 0 \tag{12}$$

2.5 Global Model

The building process of this model can be summarized as follows. First of all, biogas power generation projects need to consider the local market price and the requirements of economic development. In order to consider in detail the various costs involved as far as possible during the modeling process, the costs are divided into four categories, which involve the cost of running most biogas power generation systems. In order to simplify the modeling operation, the weight was determined according to the cost, and the corresponding parameters were combined. Finally, it was summarized and simplified into three decision variables. Then, the corresponding formula obtained is solved by the linear programming of operations research, and the boundary value of profit and loss can be calculated. Finally, some suggestions are proposed according to the sub-boundary values. According to the above, the global model can be expressed as Eq. (13):

$$
\begin{aligned}
&maxP_r = R_1 + R_2 - (C_1 + C_2 + C_3 + C_4) \\
&= \sum_k x_{i,k} \cdot \theta r_1 + \sum_k x_{i,k} \cdot \omega\alpha r_2 - (\sum_k x_{i,k} c_0 + (\sum_k x_{i,k} y_k c_1 + 12kc_k) + (\sum_k x_{i,k} \theta y_0 c_2 \\
&+ 12nc_n) + x_{i,j} c_{i,j} \cdot \sum_k x_{i,k} \cdot \omega + x_r \cdot c_r + x_p \cdot c_p + 12(c_i N_i + c_j N_j)).
\end{aligned}
$$

$$
s.t. \begin{cases}
\sum_k x_{i,k} y_k c_1 > 0. \\
x_{i,j} c_{i,j} \cdot \sum_k x_{i,k} \cdot \omega > 0. \\
x_r \cdot c_r + x_p \cdot c_p + x_{i,j} c_b > 0. \\
y_k > 0. \\
x_{i,j} > 0. \\
x_r > 0. \\
x_p > 0.
\end{cases} \tag{13}
$$

3 Model Solving

This chapter will expand the solution based on the above modeling and methods. It is divided into three parts. The first part is data acquisition region, the second part is date collection,the last part is model solving and result analysis.

3.1 Data Acquisition Region

In 2000, China implemented the "Great Western Development Strategy" to support the social and economic development of provinces in the western region. However, Sichuan is one of the most populous provinces in southwest China. The atmospheric environment assessment found that the air quality of Sichuan is lower than the national average, and its total carbon emissions exceed 13 million tons, ranking eighth[14, 15]. Therefore, the national authorities decided to focus on energy conservation and emission reduction in their future development plans[16].

Chengdu, the capital of Sichuan Province, is one of the newly constructed first tier cities in China, with more than 16 million permanent residents. This considerable population produces a large amount of household garbage. In 2011, it was about 2218800 tons, of which 500000 tons (22.53%) were burned and 1718800 tons (77.44%) were sanitary landfilled[17]. With the increasing pressure of six landfill sites in Chengdu, the treatment of household waste has become a problem.There is quite a wide range of cultivated land in Chengdu. The main crops are rice, wheat and corn [18]. Each production time is different, that is, wheat is in April and May, corn is in June and July, and rice is in August and September [19].

Figure 1. Study area

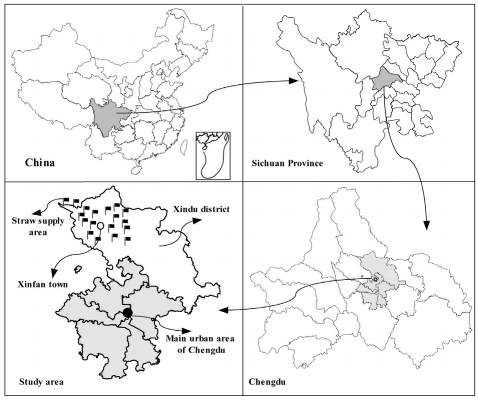

Table 1. Various price parameters

Parameters Meaning	Unit	Numerical
Transportation costs of urban household waste: c_2	(CNY/tonne*km)	0.5
Straw transportation cost: c_1	(CNY/tonne*km)	0.35
collection cost per tonne of straw: c_0	(CNY/tonne)	380
monthly cost of one straw transporter per area: c_k	(CNY/month)	4500
Monthly salary of urban household waste transporter: c_n	(CNY/month)	6000
monthly price of biomass pipeline transportation: $c_{i,j}$	(CNY/m^3)	0.15
Cost per kilometer of road maintenance: c_r	(CNY/km*year)	150000
Cost per kilometer of power grid maintenance: c_p	(CNY/km*year)	150000
Cost per kilometer of biogas pipeline transportation maintenance: c_b	(CNY/km*year)	60000
Average monthly wage of workers in operation of anaerobic digestion plant: c_i	(CNY/mouth)	5000
Average monthly wage of workers in operation of PTG facility: c_j	(CNY/mouth)	7500
Revenue per ton of waste disposal: r_1	(CNY/tonne)	400
Revenue of one kilowatt hour electricity: r_2	(CNY/KWh)	0.57

The Chengdu Statistical Yearbook (2021) reported that the annual output of these three main crops exceeded 2 million tons, indicating that the straw output was millions of tons. Since straw burning is not encouraged and the natural degradation rate is relatively slow, Chengdu authorities are looking for new ways to use these wastes.

Therefore, we selected the main urban areas of Chengdu and its surrounding Xindu District as the study area to prove the effectiveness of the proposed biogas power generation project in reducing carbon emissions and generating income. In order to reduce the calculation workload, Xindu District only selects 18 crop producing areas as the straw supply area for verification, and chooses nearby Xinfeng as the power supply object. The location of the study area is shown in figure 1.

3.2 Collection of Data

Through the analysis of the formulas listed, the data to be collected this time mainly include the total amount of straw raw materials and the mixing ratio of raw materials, transportation costs, personnel costs and the maintenance costs of corresponding facilities.When it comes to price data, take an average based on market research.

The numerical information for the price parameters shown in the table 1 comes from the current prices of labor, transportation, and electricity in China.

Table 2. Other certain parameters used in the proposed model

Parameters meaning	Unit	Numerical
mixed ratio of waste to straw: θ		13.5
average gas yield in a mixed feed anaerobic digestion: ω	(m^3/tonne)	580
The power generation efficiency of biogas: α	(KWh/m^3)	1.8
number of personnel required for urban household waste transportation: n		6
quantity of straw	(tonne/year)	68031.70
quantity of waste	(tonne/day)	15000
Distance from the city to the anaerobic digestion plant:y_0	(km)	33.1
Number of workers required for infrastructure construction of anaerobic digestion plant:N_i		50
Number of workers required for infrastructure construction of PTG facility:N_j		80

Project parameters describe the basic build-up information for the project, including data on some parameters, such as anaerobic digestion gas production efficiency [20, 21]. Other parameters were from the Ministry of Agriculture Biogas Research Institute (BIOMA) , Chengdu Statistical Yearbook (2021) , historical data and other channels. See the table 2 below for details.

The formula after substituting the data is as follows:

$$maxP_r = R_1 + R_2 - (C_1 + C_2 + C_3 + C_4) = \sum_{k=18} x_{i,k} \cdot 13.5 \cdot 400 + \sum_{k=18} x_{i,k} \cdot 580 \cdot 180 \cdot 0.57 - (\sum_{k=18} 380x_{i,k} + (\sum_{k=18} 0.35x_{i,k}y_k + 12 \cdot 18 \cdot 4500) + (\sum_{k=18} x_{i,k} \cdot 13.5 \cdot 0.35 \cdot 33.1 \cdot 0.5 + 12 \cdot 6 \cdot 6000) + 0.15x_{i,j} \cdot \sum_{k} x_{i,k} \cdot 580 + 150000x_r + 60000x_{i,j} + 150000x_p + 12(5000 \cdot 50 + 7500 \cdot 80))$$

$$\begin{cases} \sum_{k=18} x_{i,k}y_k \cdot 0.35 > 0 \\ 12x_{i,j} \cdot 0.15 > 0 \\ \sum_{k=18} x_{i,k} = 68031.70 \\ 28200x_r + 1200x_{i,j} + 5000x_p > 0 \\ y_k > 0, x_{i,j} > 0, x_r > 0, x_p > 0 \end{cases}$$

3.3 Model Solving

Based on data such as the 2021 Chengdu Statistical Yearbook, the distance from the local anaerobic digestion bureau and the raw material production of each region for 18 regions as shown in the table 3 below are included in the above formula to draw the conclusions of the next section.

Since Chengdu does not currently have PTG facilities, the power plant closest to the existing anaerobic digestion plant and has the potential to be retrofitted was selected to calculate the corresponding economic benefits.Therefore, bring $x_{i,j} = 6.2$,$x_r = o.5$,$x_p = 0.5$into the formula for operation. Finally, we roughly calculated that the economic benefit of the anaerobic digestion power generation is income CNY4.33×10^9.

In order to display the results and proportions more intuitively, here I choose to use a pie chart to display. As shown in the following figure 2.

From the cost ratio in figure 2, we can see that the cost of transportation is higher, accounting for 53.48% of the total cost; followed by the cost of raw materials, accounting for about one-third; and the cost of maintenance is the least, only 0.66%.In the calculation process, it was found that the transportation cost of natural gas accounted for relatively high, reaching about 49% of the transportation cost. Therefore, during construction, if the two facilities are not adjacent to each other, it is necessary to consider the distance between the anaerobic digestion device and the PTG facility.

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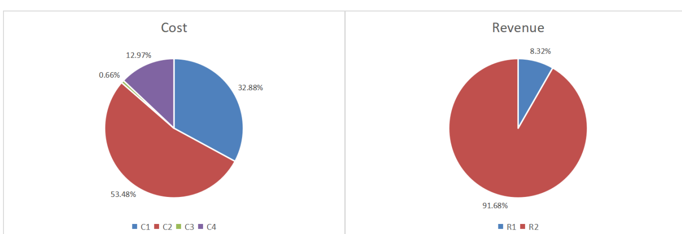
Table 3. Crop yield and distance from anaerobic digestion plants in the corresponding region

i	Region	Distance from area i to biogas plant	Straw(t)
1	Long Yi village	7.1km	3495.830
2	Li Yuan village	3.0km	4183.441
3	Da Mu Shan village	2.9km	2999.440
4	Liang Jia village	4.9km	4315.735
5	Xing Yan village	6.2km	2191.228
6	Bai Bi village	4.6km	3443.555
7	Huang Ni village	4.0km	3165.667
8	Ji Jia village	2.4km	3474.049
9	Gao Yuan village	3.3km	4247.181
10	Wang Jia village	5.8km	3187.908
11	Tian Jun village	4.9km	4284.783
12	Min Yin village	5.5km	2495.482
13	Tong Xin village	4.5km	4497.325
14	Qing Zhen village	7.7km	5484.604
15	Gong Yi village	10.4km	3770.049
16	Qu Shui village	8.1km	4711.702
17	Shi Yun village	6.0km	3552.921
18	Xin Pang village	5.9km	4530.800

Figure 2. Conclusion pie chart



From the profit ratio in figure 2, we can see that the benefits generated by power generation are far greater than the benefits of government subsidies for the treatment of domestic waste, so the impact of government subsidies on the total efficiency of the facility is low.

4 Conclusion

With the continuous development of technology, the country pays more and more attention to the protection of the environment, and the concept of sustainable development runs through all aspects of technological development. Therefore, the development and use of clean energy is on the agenda.At the same time, economic development must also be carried out with technological development, thus forming a virtuous circle.We took into account a considerable amount of costs in operations as much as possible, but the cost ratio to revenue was only 1.78%. So we can reasonably conclude from the economic point of view that the development scenario of this facility is bright.

In summary, this paper takes into account the related raw material costs, personnel costs, maintenance costs and other expenses involved in the operation process of anaerobic digestion plants and PTG facilities every year, combined with the relevant policies and measures today, lists the corresponding formulas for profit calculation and calculates the final profit. The formula can be added and deleted in combination with today's specific policies, with a high degree of freedom. At the same time, there are currently no corresponding PTG facilities built in China, so the calculation here provides economic support for the establishment of PTG facilities, and whether it can be specifically established also involves the corresponding site selection issues. This paper aims to establish a corresponding economic benefit analysis model, and collect corresponding data according to the data required by the model, so as to provide a reference for economic benefits during construction.Of course, this article does not cover the maintenance costs of internal facilities of the factory, and further research and analysis are needed to improve the analysis of economic benefits.

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