Focus on the investment of Waste Incineration in China—Based on PEST-SWOT analysis

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Abstract. Due to the rapid development of economy and the increase of population, the number of municipal solid waste in China is increasing, and the harmless disposal of waste is the urgent problem to be solved. The paper use PEST-SWOT model to analyze the investment environment of waste incineration power generation industry. Also it analyzed the investment environment of waste incineration power generation industry from four aspects of policy, economy, society and technology, and point out the opportunities, threats, strengths and weaknesses of it, which can provide the reference for inventors. Based on the analysis, the paper put forward corresponding policy recommendations. It has far-reaching significance for the healthy development of waste incineration power generation industry in China.

1. Introduction

With the construction of China's low carbon society, as well as the urgent need for waste disposal facilities, waste incineration power generation industry will enter a period of rapid development. In the future, waste incineration power generation industry will become a rapidly growing industry, so studying its investment prospects is of great value. We use the PEST-SWOT model to analyze the investment environment of waste incineration power generation industry from the four aspects of policy, economy, society and technology, and point out the specific direction for the companies in the industry and the companies about to enter the industry, and put forward the corresponding suggestion according to the current weaknesses and threats waste incineration power generation industry is facing.

2. Methods

SWOT analysis is a qualitative analysis method which is widely used, but there are still some limitations. By combining the use of PEST and SWOT, it is easier to operate and analyze in depth (Tong et al., 2015). PEST-SWOT analysis model from the overall grasp of the external factors and internal factors of the development of the industry, each according to different analysis of the object from the political, economic, social and technological aspects of the specific analysis of four. Through the combination of the two models, we have a more in-depth and comprehensive identification of the investment environment of the current waste incineration industry. After the extensive reading of related literature, the PEST-SWOT model of the investment of China's waste incineration power generation industry is established according to the characteristics of the waste incineration industry, which is presented in Table 1.
Table 1. The PEST-SWOT model of the investment of China's waste incineration power generation industry

| PEST-SWOT     | Politics(P)                              | Economy(E)                      |
|---------------|------------------------------------------|---------------------------------|
| Internal factor | Strengths(S)                            | ES1: High corporate profitability|
|               |                                          | ES2: low cost of domestic equipment|
| Weaknesses (W) |                                          | EW1: large initial investment cost|
|               |                                          | EW2: Increasing operating costs|
| External factor | Opportunities (O)                        | PO1: support of national policy |
|               |                                          | PO2: waste disposal subsidies   |
| Threats(T)     | PT1: The government's standards for pollution discharge are constantly improving. | ET1: Low price competition |
|               | PT2: Garbage classification system is not perfect and law enforcement is not enough | ET2: difficulties of collecting the waste disposal fee |
|                |                                          | EO1: Carbon trading market       |
|                |                                          | EO2: CCER subsidies              |

| PEST-SWOT     | Society(S)                              | Technology(T)                   |
|---------------|-----------------------------------------|---------------------------------|
| Internal factor | Strengths(S)                            | TS1: The process is simple and reliable. |
|               |                                          | TS2: make waste profitable      |
| Weaknesses (W) |                                          | SW1: fly ash disposal           |
|               |                                          | SW2: High location requirements |
| External factor | Opportunities (O)                        | SO1: Lack of land resources     |
|               |                                          | SO2: demand for waste treatment growth with the increasing of urban population |
| Threats(T)     | ST1: Residents’ environmental awareness is low | TT1: calorific value problems   |
|               | ST2: Adjacent avoidance effect           | TT2: Leachate treatment is not mature |

### 3. Results
Using the PEST-SWOT model, from the Politics, Economy, Society and Technology to analyze the internal and external factors of the industrial development can provide reference for the investment decision. It has far-reaching significance for the development of waste incineration power industry.

#### 3.1. POLITICAL ENVIRONMENTAL FACTORS

**3.1.1. The external political opportunities**
The government intensively issued policies and plans from the aspects of industry, economy and technology, which has greatly promoted the development of waste incineration power generation industry (China Environment News, 2012). During "13th Five-Year" period, the investment space of waste incineration power generation market will grow steadily which bringing huge benefits under the support of the government.

**3.1.2. The external political threats**
The government revised the standards for pollution control of domestic waste incineration (GB18485-2014) in 2014. After the amendment, the standard adds pollution control requirements of domestic sewage and general industrial solid waste incineration furnace and the start, stop, failure or accident of life waste incinerator, and changes the emission standards for waste incineration plant particles, SO2, HCl, NXOX, heavy metals and their compounds, dioxin and other pollutants.
The new standards have set a new benchmark for the planning, investment building and operation management of municipal solid waste incineration projects, and this will be conducive to the long-term and healthy development of China's waste incineration power generation industry. On the other hand, the introduction of the new standards promoted the municipal solid waste processing facilities related inputs, make operating emission standards of refuse incinerator more strict, which greatly improve the construction and operation cost of waste incineration power plants and bring challenges to the investment of enterprises. As a result, small and medium-sized enterprises will quickly withdraw from the market, and the large companies with financial and technological advantages are expected to become bigger and stronger in the waste incineration power generation industry.

3.2. ECONOMIC ENVIRONMENTAL FACTORS

3.2.1. The internal economic strengths
The operation of waste incineration power generation has two characteristics, one is that the cash flow is stable, and the other is that it is regional monopoly. The internal rate of return is generally between 6% and 12%, and the recovery period is generally between 5 and 10 years (The economist, 2016). The source of revenue for the operation of enterprises includes the on-grid price (from the power grid) and waste disposal fees (from the government) and carbon emission reduction. At present, the level of subsidy for waste disposal around China is closely related to the type of incineration equipment, and the grate furnace costs most has relatively high subsidy (generally 10-22 dollar / ton); the fluidized bed with lower subsidy cost relatively less (generally 7-13 dollar / ton) (The Arctic star energy saving and environmental protection network, 2016). In addition, qualified waste incineration power generation project can also be applied for the CCER project to obtain income from carbon emission reduction. When a waste incineration power plant officially put into operation, it can provide stable cash flow for investors. It is a very attractive investment projects.

3.2.2. The internal economic weaknesses
At the beginning of the development of waste incineration, government investment accounts for the most, but in recent years the government direct investment gradually fades out, turning to the government granting the right to a qualified enterprise, which is responsible for the investment, financing, design, installation, and debugging of the waste incineration power plant, namely the BOT pattern. After all aforementioned procedures get completed, the waste incineration power plant provides waste disposal services to the government according to the contract and use the heat from waste incineration for power generation at the same time.

3.2.3. The external economic opportunities
China will start national carbon trading market in 2007, and waste power generation will face a new opportunity. As an important area of carbon emission reduction, developing carbon trading in the industry will have an important impact on the production pattern, technical reconstruction, operational management, energy-saving and emission-reduction and many other aspects of the enterprises. Enterprises can reduce emissions and make profits by trading carbon dioxide quota in the carbon trading market, which can promote waste power enterprises to achieve energy-saving, emission reduction and sustainable development. The society and enterprises can both get benefit from it.

3.2.4. The external economic threats
Since 2015, the bid price of waste incineration projects continued to decline. With the progress of the technology of waste incineration, the cost reduction is inevitable. The fierce competition in the waste incineration power generation industry led to the low price competition phenomenon, and the current prices in the industry has fell down sharply. Take the company called “Dynagreen” as an example, it is the main force in the industry, and it got a period of 30 years of franchise rights of municipal solid waste incineration power plant of Bengbu City at a price of about 4 dollars/ton. If the environmental
requirements are met, the disposal fee of a BOT project usually needs about 22 dollars/ton, which is generally higher than the actual price of the current market. For the waste incineration power generation industry, the price is too low to earn profit, and some companies even try to maintain their normal operation at the expense of the environment.

3.3. SOCIAL ENVIRONMENTAL FACTORS

3.3.1. The internal social strengths

In order to deal with the increasingly severe problem of climate warming, low carbon economy with core idea of low energy consumption, low pollution and low emission is imperative. Under this background, the enterprise can realize the sustainable development by implementing the low carbonization measures. As a industry with high pollution and high carbon emission, waste power generation has been sparing no effort to promote and implement low-carbon production mode. The low carbon production behavior of the waste power generation enterprises refers to saving energy and reducing emissions of pollutants by fully using technology, policy and management measures in the process of manufacture while ensuring sustainable profitability.

3.3.2. The internal social weaknesses

Due to the fly ash produced in the process of waste incineration, China's waste incineration plants encountered many obstacles. Once the fly ash without solidification is released or improperly handled, a large number of carcinogens in the fly ash such as dioxin will cause severe pollution to the air, water and soil, which will harm people’s health. Because there are a lot of PVC plastic in the waste, about 1 ton of waste will produce 5~8 kg of fly ash. There are 3 types of collecting fly ash, namely is dry, semi-dry and wet process. Dry process was often used, but it cannot meet the EU indicators; semi-dry process is often used, and it doesn’t cost much; wet process is used the most. The wet process using cement and chelating agent together, which can control the fly ash emissions to the minimum, but is costs much. Environmental protection industry is one of the hottest industries, and the market competition is pretty fierce. In order to increase profits, the phenomenon that some waste incineration plants don’t meet the emission standards does occasionally occur. The pollution problem is no longer a technical problem, it is a problem of business management.

3.3.3. The external social opportunities

Landfill often covers a large area, including the urban construction land and rural farmland. Landfill sites usually become totally useless after closure which greatly waste the land resource. A landfill site covering an area of 200-300 acres can only be used for 10 years. If it take 30 years to deal with some waste by landfill, it will need 600-1000 acres of land. In economically developed areas, land resources have become increasingly valuable, and in the rural-urban fringe zone and even the countryside, to find the site used as a landfill site is becoming increasingly difficult. While a municipal solid waste incineration plant that can be permanently used needs far less land.

With the steady growth of population, promotion of urbanization, and increasing of economic, the amount of waste in China is increasing continuously which increases the demand of waste disposal, and the existing waste disposal facilities can’t meet the demand anymore. Waste incineration power generation has the advantages of high treatment efficiency, small land occupation, relatively small impact on the environment, and it will be the main method of waste disposal in the future.

3.3.4. The external social threats

As a developing country, China is in the process of rapid industrialization and city construction. China's environmental problem is not only the focus of attention of the country but also the whole world, and it bring enormous pressure and responsibility to China. Although the people’s awareness of environmental protection is increasing, there are still a lot of people throw waste at will, and many residents did not implement the waste classification, which brings great difficulties to the waste disposal. At present, the
Chinese residents generally lack of the awareness of environmental protection, participation in environmental protection is not enough, and some people do not actively cooperate with the government's environmental protection work. Only when people’s environmental awareness is raised, can a good living environment be created.

3.4. Technological environmental factors

3.4.1. The internal technological strengths
At present, most of the waste incineration plant in China use domestic incinerators, which are suitable for the waste without sorting and with lower calorific value. Therefore, the waste incineration power plant can directly use the equipment after simply sorting and pretreatment. In addition, waste heat boiler, steam power cycle, combined heat and power generation and other related technologies are mature and reliable. The production mode of fully enclosed industrialization can be basically not affected by the impact of natural conditions and run all day long, and its life expectancy is about 20 years.

3.4.2. The internal technological weaknesses
Many waste incineration plants in China use domestic incinerators, and usually need 20% coal to help to combust. As a result, the amount of slag is up to 30-40%, and the waste reduction is greatly reduced. Theoretically, if high temperature is achieved during decomposition, dioxin emissions will be relatively reduced. However, China is difficult to maintain a stable temperature at present because the burning furnace technology is not mature.

3.4.3. The external technological opportunities
In order to develop waste incineration power generation equipment and incineration flue gas treatment system that suitable in China, and break the technical barriers of foreign countries, National Development and Reform Commission put the waste incineration power generation technology into the country's key popularized low carbon technology list. By means of increasing financial support for the relevant research institutions and colleges and universities in China, key technologies of waste incineration power generation are greatly encouraged, and waste incineration power generation equipment with independent intellectual property rights were developed, which significantly reduced the equipment price compared to the imported products.

3.4.4. The external technological threats
Waste classification is the first step in waste incineration. Without the classification to remove harmful, bulky or renewable raw materials, most plants can’t reach the low calorific value level of the combustion furnace, and coal and other auxiliary fuels with high heat value are needed to help to combust. These MSW with high moisture content and low heat value contain lots of NaCl, KCl and other chemicals. The organic substances in the waste will react with chlorine and produce carcinogenic gas dioxin when burning, and dioxin can cause reproductive and developmental problems, damage the immune system, interfere with hormones secretion, and cause cancer.

4. Conclusions and policy recommendations
The results of our analysis indicate that in terms of the aspects of politics, economy, society and technology, the waste incineration power generation industry in China has both advantages, and disadvantages. The current environment has brought huge investment opportunities but also certain threats. The promotion of the waste incineration power generation industry must rely on the necessary institutional arrangements and supporting policy tools. Related policy recommendations are as follows:

(1) Actively promote garbage classification.
(2) Strengthen the supervision of the operation of waste incineration power generation.
(3) Promote the research and development of waste incineration technology and equipment.
(4) Resist the low price competition.
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