

An Overview of the Development of Waste to Energy Plants in China

Xu Haiyun

China Urban Construction Design & Research Institute Company Limited, China

Abstract: Material recycling is enough and lack of statistics in Chinese Mainland. After material recycling the WTE (Waste to Energy) has developed rapidly in the last ten years. By the end of 2018, about 364 WTE plants had been built and put into operation. With the development of WTE industry in China, the Equipment manufacturing, construction and operating level of WTE has continuously improved, and the profitability of WTE Plants also been enhanced. With more and more WTE plants are put into use, more and more skilled workers needed. Supervision of WTE plants and fly ash treatment need to be further strengthened. The electricity price subsidy policy effectively promotes the development of WTE. Although there is uncertainty in the future, WTE Plants will continue to develop for rural and town garbage treatment.

Key words: municipal solid waste, waste to energy

1. Material Recycling Is Enough and Lack of Statistics in Chinese Mainland

Municipal solid waste treatment can be divided into three types: recycling, incineration and landfill. Up to now, most of the residents in China collect waste paper, plastic bottles, cans and other high-value wastes as waste products separately in their families, and then sell them to “recyclers” (commonly known as “pickers” or “scavengers”). Most of them come from rural areas and collect waste goods in urban residential areas, which are mobile or semi-fixed. “Recyclers” purchase waste material or resident sell waste material to “recyclers”. The main body of recyclable garbage collection is the “recyclers” is not municipal environmental sanitary worker. In fact, the level of MSW recycling and utilization in China is already very high, higher than any developed country. For example, although the recycling rate of waste paper is less than 50%, the content of waste paper in MSW is only 5%,

which is significantly lower than that in developed countries. Paper consumption level is low, waste paper recovery rate can not be high. In 2018, the per capita paper consumption was 75 kilograms, which was only one third of that in developed countries (see Fig. 1).

The recycling rate of waste plastics is also very high, but there is a lack of statistics. According to the output and plastic material recycling statistics, the estimation of plastic recycling rate of waste plastics in China is higher than 30% (see Fig. 2).

2. Development of Waste to Energy in Chinese Mainland

Compared with landfill disposal, MSW incineration has the advantages of less land occupation, easy site selection, short disposal time and significant reduction (generally 70% weight loss and 90% volume reduction). It has been widely used in developed countries because of its thorough harmlessness and recyclable waste heat from waste incineration. In many areas of our country, the population density is high and the land resources are very valuable (see Fig. 3). Incineration treatment has gradually developed into an

Corresponding author: Xu Haiyun, Chief Engineer; research area/interest: municipal solid waste. E-mail: xuhaiyun@263.net.

important means of MSW treatment in this area. Waste incineration has developed rapidly in the last ten years, and the capacity of WTE plants has reached the level of

developed countries. In 2018, more than 60 WTE plants (excluding expansion projects) were put into operation.

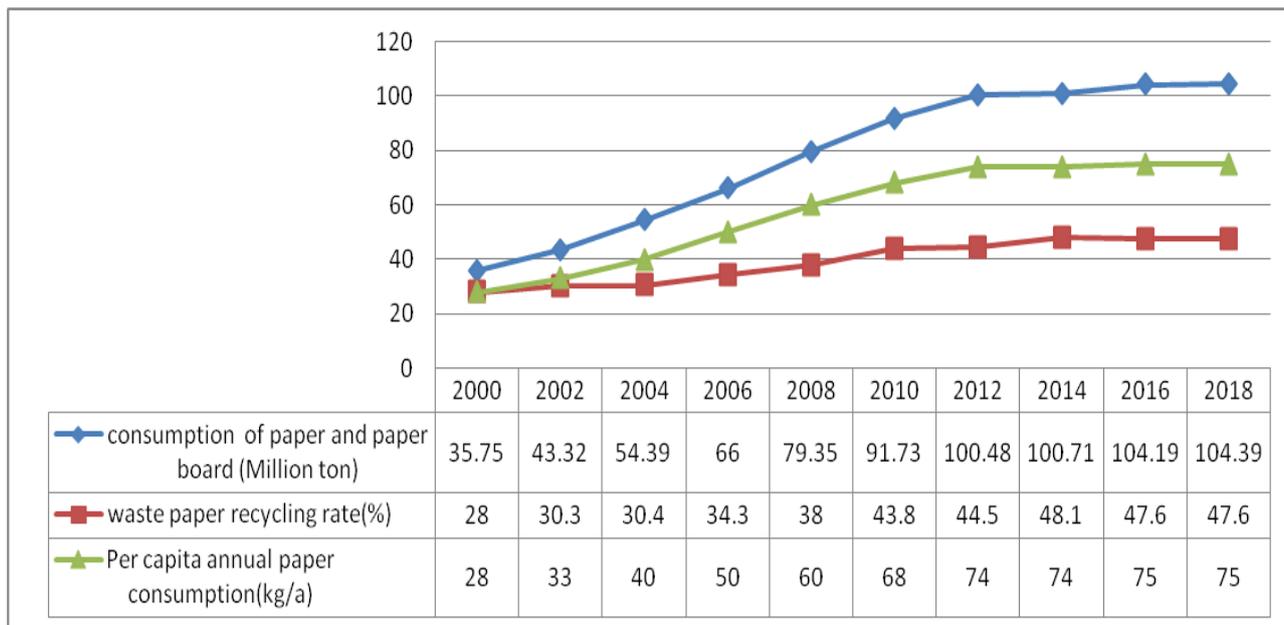


Fig. 1 Per capita Paper Consumption and Waste Paper Recovery Rate in Chinese Mainland, 2000-2018 [1].

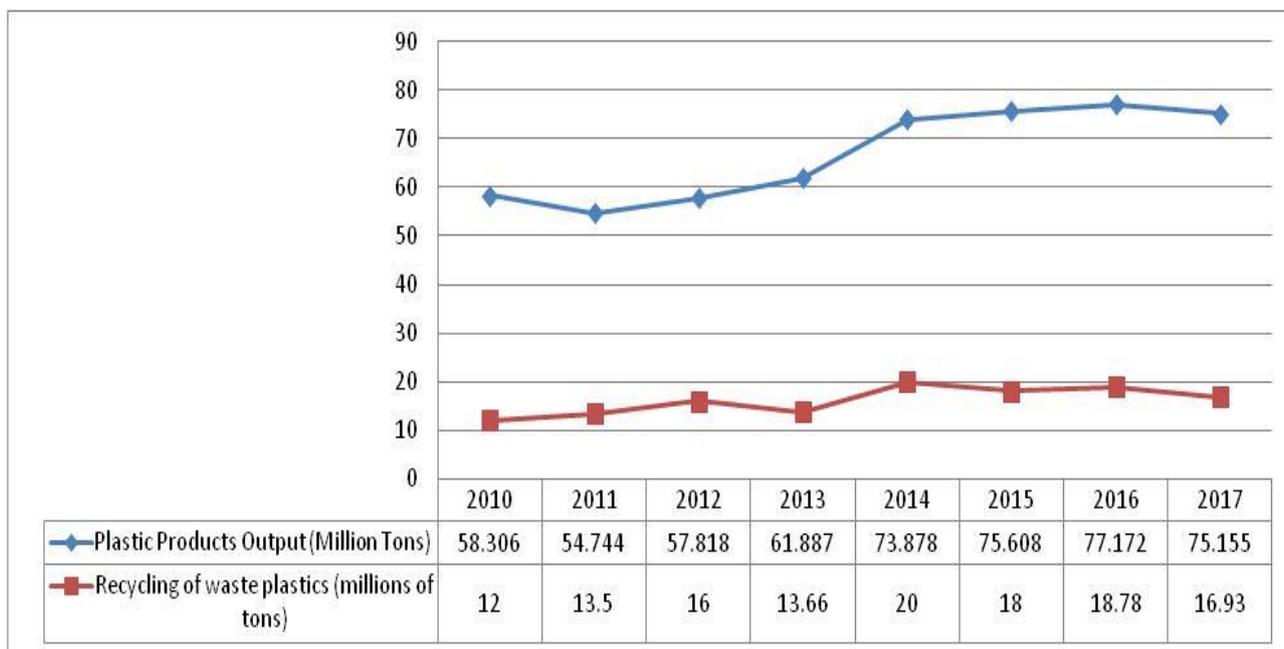


Fig. 2 Plastic output and waste plastic recycling in Chinese Mainland, 2010-2017 [2].

By the end of 2018, about 364 WTE plants had been built and put into operation in the Chinese Mainland, with a total capacity of 370,000 tons per day (see Table 1 and Fig. 4), and a total installed power capacity of

about 7780 MW. Among them, 284 WTE plants with grate furnace have a total capacity of 297,000 tons per day and installed power capacity of 5970 MW.

The development of MSW incineration in the

Chinese Mainland is mainly based on grate furnace. The WTE plants mainly distribute in economically developed regions and cities. According to the provincial ranking, the processing capacity of Jiangsu and Guangdong provinces is relatively large, and the

number of WTE plants in Zhejiang and Shandong provinces is relatively large. With the development of economy, more and more cities will build WTE plants in the Chinese Mainland.

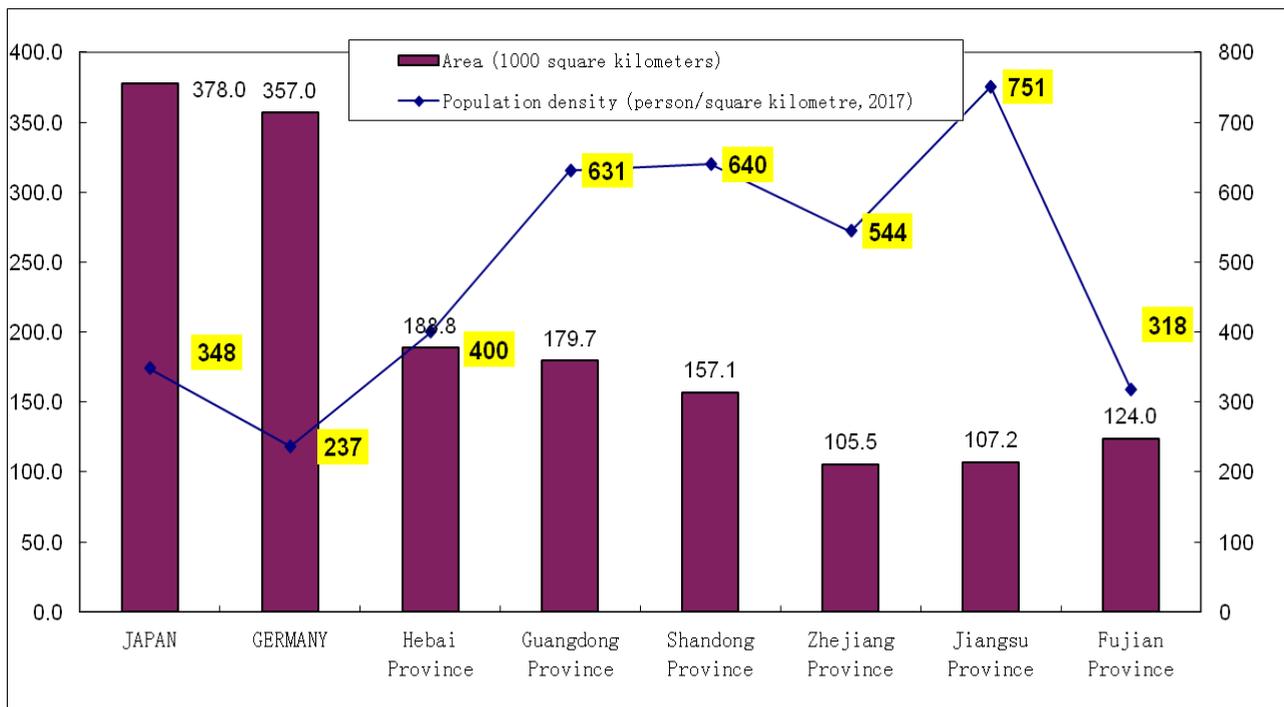


Fig. 3 Population density comparison of some provinces in Chinese Mainland.

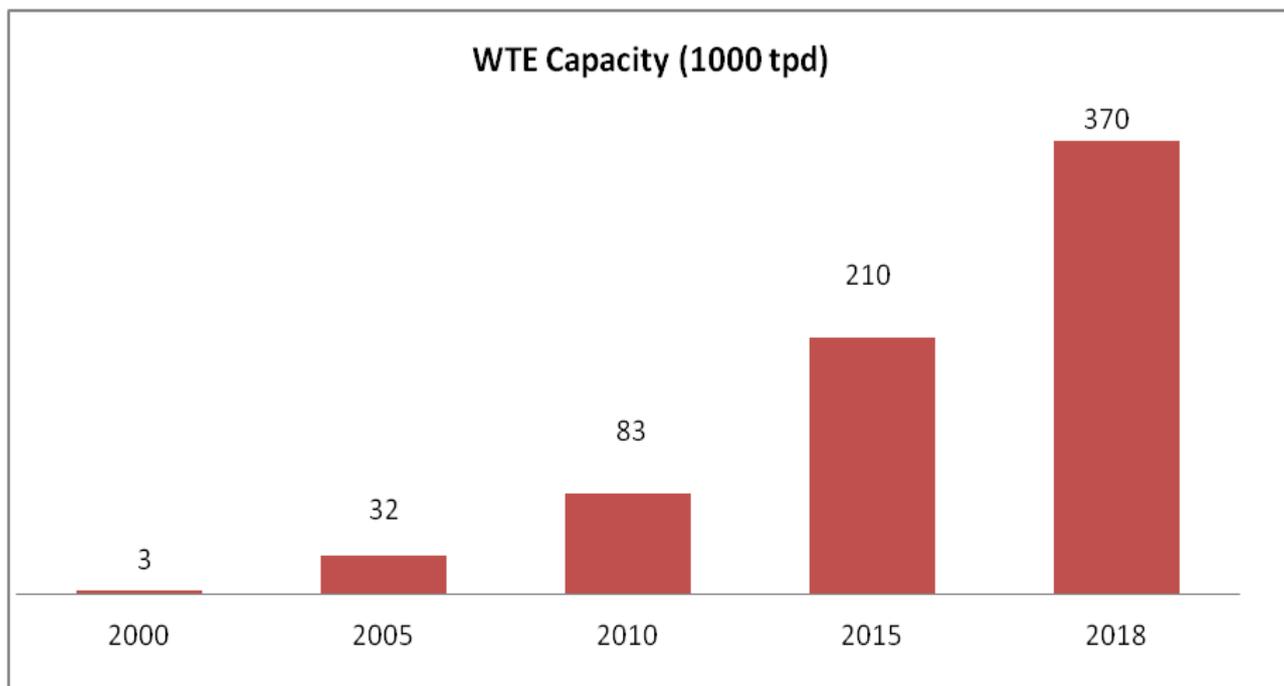


Fig. 4 MSW incineration capacity from 2000 to 2018 in Chinese Mainland.

Table 1 WTE Plants in Operation (by the end of 2018).

TYPE	Number of WTE Plant	Facilities Design capacities (1000t/d)	Generator capacities (MW)
Mass burn with grate	284	297	5970
CFB	80	73	1810
Total	364	370	7780

According to the statistics of the Statistical Yearbook of Urban Construction of the Ministry of Housing and Construction (February 2019),

comparisons by province in the Chinese Mainland of 2017, the provinces with higher incineration rate of MSW are Jiangsu Province, Hainan Province, Fujian Province, Zhejiang Province and Shandong Province (see Fig. 5); the provinces with more incinerated MSW quantity are Jiangsu Province, respectively. Guangdong, Shandong, Zhejiang and Fujian provinces (see Fig. 6).

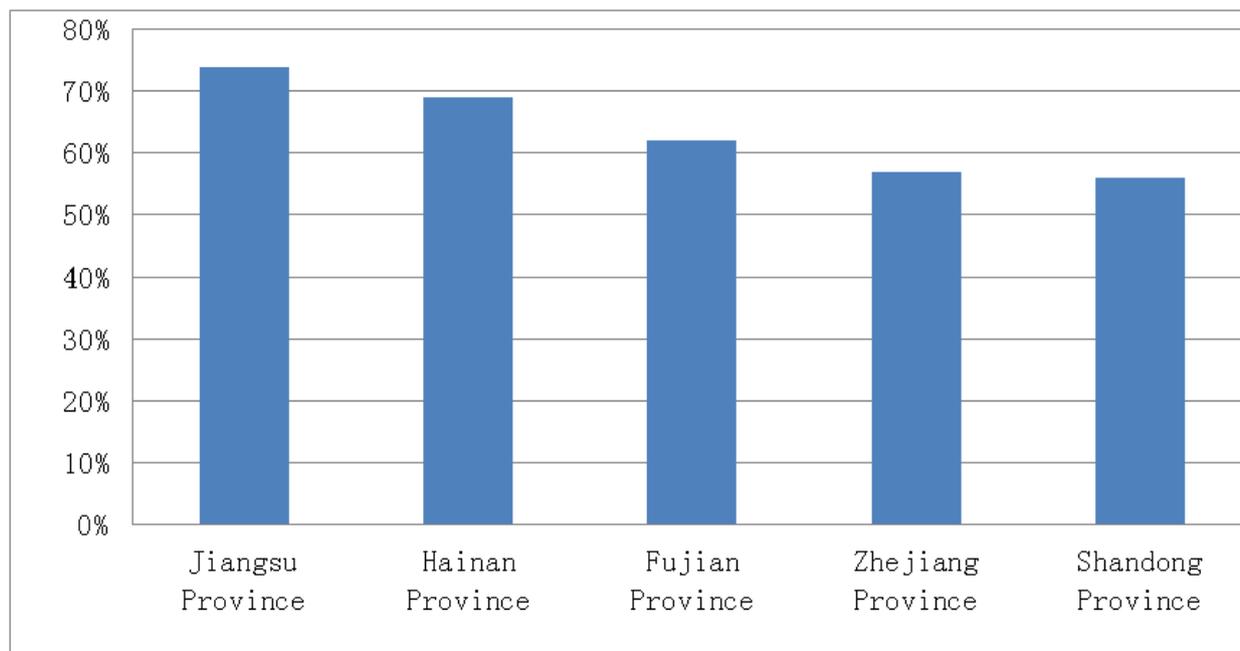


Fig. 5 Provinces with a relatively high proportion of MSW incineration in 2017 (calculated according to the amount of MSW collected) [3].

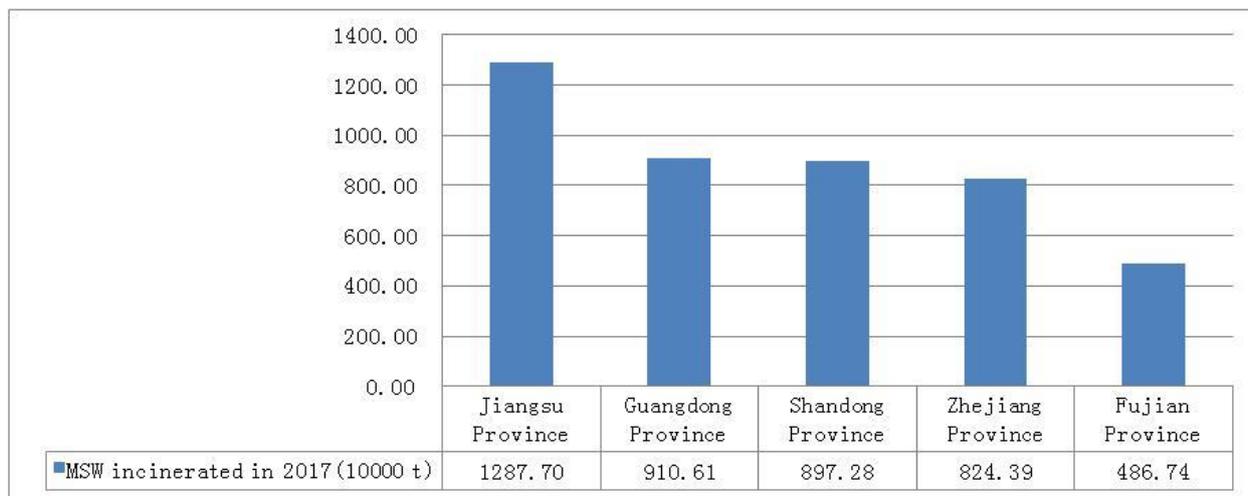


Fig. 6 Provinces with more incinerated MSW in 2017 [3].

The total capacity of WTE with grate furnace in operation in 2018 is 297,000 tons per day, of which the following 10 enterprises have 60% incineration capacity, of which China Everbright International Co., Ltd. has more than 30,000 tons per day. Based on built-up WTE capacity in 2018, the top 10 Companies (with grate furnaces) in China are listed below:

- Everbright International (HK0257)
- Chongqing Sanfeng Environmental Industry Group Co., Ltd.
- Shanghai Environment (SH 601200)
- Green Power Environment Protection (HK01330)
- China Energy Conservation and Environmental Protection Group Corporation
- Zhejiang Weiming Environmental Protection Co., Ltd. (SH603568)
- Guangzhou Environmental Protection Investment Group Co., Ltd.
- Hanlan Environment (SH600323)
- Shenzhen Energy (SZ000027)
- Yuefeng Environmental Protection (HK01381)

3. Opportunities and Problems

The number and capacity of WTE plants in China has reached the first place in the world. In 2016, the WTE capacity in the Chinese Mainland reached

238,000 tons per day, surpassing Japan as the world's first, by the end of 2018, the number of WTE plants built and put into operation in the Chinese Mainland reached more than 360, and becomes the largest country in the world. As the largest developing country, China has a high degree of marketization and openness in the field of MSW treatment field, and the industrialization of WTE has entered a rapid development stage. On the whole, the WTE industry belongs to the industry with high investment and stable income. With the gradual accumulation of technical experience in equipment manufacturing, construction and operation, China's advantages in this field have gradually emerged. At present, compared with developed countries, the construction investment of WTE plants of the same scale is only one third of that of developed countries, and the construction period is only half of that of developed countries. With the development of WTE industry in China, the Equipment manufacturing, construction and operating level of WTE has continuously improved, and the profitability of WTE Plants also been enhanced. For example, Everbright International is the largest and fastest growing Company in the WTE industry field in China and its main business income in the WTE industry field reached more than \$2 billion in 2018.



Fig. 7 Shanghai Laogang WTE plant is the largest in the world (first phase was put into use in 2013 with 3000 ton/day and second phase was put into use in June 2019 with 6000 ton/day).



Fig. 8 Baiguoyuan WTE plant in Chongqing City is the largest in the western China (It was put into use in 2018 with 4500 tpd).

The research of WTE technology is insufficient. For example, dry process, semi-dry process, wet process, NSCR, SCR denitrification process and so on are needed for WTE plant flue gas treatment. These technologies and equipment mainly come from foreign related companies, and the related research innovation is obviously insufficient.

Human resources and management capabilities are inadequate. With more and more WTE plants are put into use, more and more skilled workers needed. Some enterprises lack the experience and ability of operation and management of WTE plants, and the WTE plants run by these enterprises often have low operation level.

Supervision of WTE plants needs to be further strengthened. The operation and management of WTE plants need a lot of on-line monitoring and sampling detection. Monitoring and detection are facing huge market demand, but there are also many challenges, such as dioxin detection still has obvious uncertainty.

Fly ash treatment is the weakness that restricts the development of WTE. Although fly ash is defined as

hazardous waste, but there is not enough hazardous waste volumes for fly ash landfilling. For WTE plants using fluidized bed technology, the production of fly ash is very large. If they are strictly managed according to existing policies, it will be difficult for these incineration power plants to operate.

4. Prospects

WTE plants construction will continue to develop rapidly. In 2019, WTE projects will continue to face fierce competition and rapid development. It is expected that the new WTE plants that will put into operation in 2019 will be more than 60 and maintain the higher growth trend as same as in 2018. The mechanical grate furnace can better adapt to the change of the composition and calorific value of garbage, and the garbage does not need to be pretreated separately; it is reliable and convenient to operate, and it has relatively low operating cost; the equipment has long service life, stable and reliable, convenient operation

and maintenance, and the domestic mature technology and equipment are available.

WTE Plants will continue to develop for rural and town garbage treatment. At present, there is debate on how to deal with rural garbage, especially in economically underdeveloped areas, where population density is low and economic capacity is weak, and the collection and transportation of rural garbage is facing greater challenges. According to the existing practice and experience, moderate concentration and WTE are needed for the treatment of garbage in villages and towns.

It is a challenge for WTE plants to get timely subsidies for electricity income. According to the national regulating the price policy of WTE, based on the amount of waste incineration in the WTE plant, for each ton of MSW, it is subsidized maximum 280 KWh. and carrying out the national unified waste generation

benchmark tariff of 0.65 Yuan RMB/KWh (including tax and the same); The rest of electricity is according to the price of electricity from local coal-fired generators. Now there is not enough subsidized fund for WTE Plants and the electricity subsidized policy change will have a significant impact on the development of WTE in the future.

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