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Master Program
on Bio-Based Circular Economy

Course of Renewable Energy Technologies

Feed-in-tariff for Renewables in China: legislative aspects

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Summary

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Feed-in-tariff for Renewables in China: legislative aspects

Abstract

In this article, we reviewed the technical characteristics of wind power, solar power and biomass power generation and their current situation in China, and analyzed the feed-in tariffs of renewable energy power generation in China from the perspective of policy changes and advantages and disadvantages , And finally put forward a plan for China's renewable energy on-grid tariff for future implementation of financial support to RES.

Chapter 1 Renewable energy power generation related technologies and their characteristics

1.1 The main types of renewable energy

Renewable energy mainly includes wind power, biomass power and solar power. Wind energy is the kinetic energy produced by the flow of air. Biomass power generation mainly includes power generation by direct combustion of agricultural and forestry biomass, power generation by garbage, and biogas power generation. Solar energy is a kind of renewable energy too, which refers to the sun’s thermal radiation energy.

1.2 Related technologies and characteristics of solar power generation

Solar thermal power generation refers to the technology that collects sunlight and converts it into high-temperature thermal energy of working fluid, and then converts it into electrical energy through conventional heat engines or other power generation technologies[1].

The solar energy supply is unstable and discontinuous, and the thermal power generation system needs to operate stably. In order to solve this contradiction, there are currently two main solutions: one is to configure an energy storage system in the system to store the collected solar energy, so as to provide heat energy for the power station at night or cloudy weather to ensure continuous power generation; another one is to combine solar energy with other energy sources to form a complementary power generation system. When the solar energy supply is insufficient, the energy is supplied by other energy sources, which can ensure the continuous and stable operation of the system[1].

1.3 Related technologies and features of biomass power generation

1.3.1 Types of biomass power generation

Biomass power generation is a process that uses steam heated by burning biomass fuel to drive a turbine. Biomass fuel mainly refers to plant fuels such as straw, straw, and bagasse, as well as forestry residues, industrial waste, and municipal waste. Biomass energy is increasingly recognized due to its relatively abundant and low emission levels of sulfur dioxide, nitrogen oxides and carbon dioxide [2]. Figure 1 lists the types of biomass power generation, including combined combustion, direct straw combustion, gasification power generation, biogas power generation and waste incineration.

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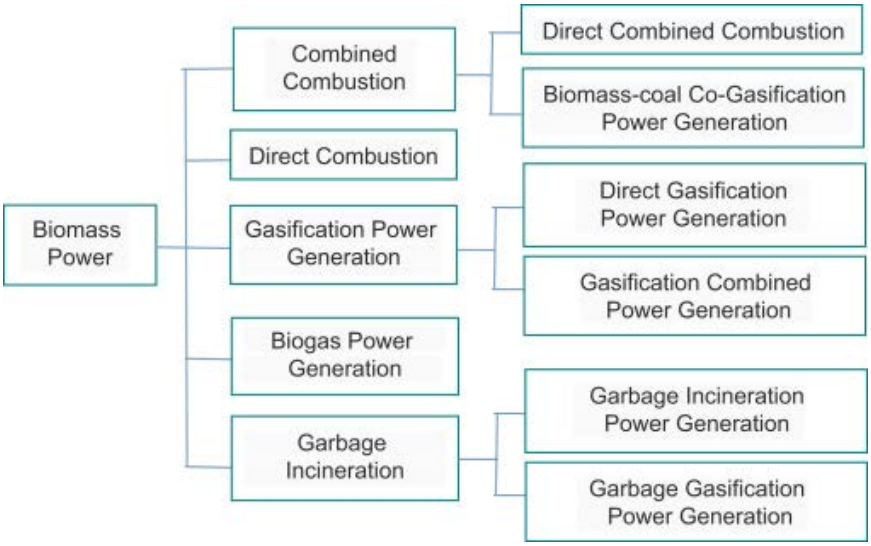

Fig. 1. Types of biomass power generation

1.3.2 Characteristics of biomass power generation

1. Rich raw materials and renewable raw materials. Regardless of whether it is agricultural and forestry waste power generation, garbage combustion power generation or biogas power generation, the raw materials available for power generation in my country, such as crop residues and industrial city waste, are rich in reserves and renewable.

2. Recycling of waste. Domestic garbage, straw, etc. were originally the wastes of people in the process of production and life. Using them to generate electricity not only solves the problem of waste disposal but also realizes the reuse of waste.

3. It has a wider application range than other renewable energy sources. Hydropower, wind power and solar power generation have high requirements on the geographical environment of the region and are regional. As long as the biomass power plant solves the problem of raw material transportation, the restrictions on the location of the project are not so large.

4. The technical requirements are relatively simple. The principle is basically the same as coal power, and the power generation process is single. Compared with hydropower, etc., the initial investment cost of boilers is relatively low.

1.4 Related technologies and features of wind power generation

After the world oil crisis in 1973, fossil fuels such as coal and oil became increasingly depleted, and environmental problems such as air pollution became more and more serious. Wind power has received more and more attention as a renewable clean energy[3]. In October 2001, the installed capacity of wind power generation in the world exceeded 20,000 MW, of which the newly added capacity reached 5,000 MW. Wind energy has become an important renewable energy source.

Wind power generation technology is a comprehensive high-tech system engineering involving multiple subjects such as aerodynamics, mechanical transmission, motors, power electronics, automatic control, mechanics, and materials science. After decades of development of wind power generation technology, although there have been tremendous developments in terms of increasing unit capacity, improving power regulation methods, obtaining maximum wind energy at variable speed operation, development of generators and power electronic devices, there are still many needs to be solved and improved Technical issues, including wind power quality, mechanical structure, aerodynamics, unit control technology and wind farm construction, etc. [3].

In the process of converting wind energy into electrical energy, it only reduces the velocity of the airflow, without causing any pollution to the atmosphere. Therefore, wind power generation is

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of great significance for protecting the environment and ecological balance and improving the energy structure.

Chapter 2 Current status of renewable energy power generation in China

China now has the world largest power capacity and electricity generation, reaching 1507 GW and 5550 TWh respectively in 2015. In addition, China has achieved electricity access for its all population by end of 2015, providing electricity for the last 2.73 million people who lives in remote areas in three years since 2012 (NEA, 2015). At the same time, power sector contributed to 33% of NOx, 23% of SO2, and 8% of particulate matter (PM), and 50% of the energy related carbon emission in China. Power sector plays a unique role in achieving national targets and international commitment, and more importantly, to supply clean energy, air, and water to its people[1].

China initiated development of wind, solar power and biomass energy at different times. Judged by current installed capacity and future development plans, China now leads the world in all three sectors. As of the end of 2019, China's renewable energy power generation (excluding hydropower) installed capacity was 437 GW, accounting for 21.7% of the total installed power, of which wind power installed capacity was 210 GW, photovoltaic power installed capacity was 204 GW, and biomass power generation installed capacity was 22.54 GW. In 2019, China's renewable energy power generation (excluding hydropower) generated 741.1 TW, accounting for 10.2% of all power generation, of which wind power generation was 405.7 TW, accounting for 5.5% of total power generation, and photovoltaic power generation was 224.3 TW. At that time, it accounted for 3.1% of the total power generation, and biomass power generation was 111.1 TW, accounting for 1.5% of the total power generation[5].

2.1 Wind power

In the past decade, China’s wind power has also been developing rapidly. In 2010, China’s installed wind power capacity surpassed that of the US to become the world’s largest. By the end of 2015 it had increased to 145.1 GW, equivalent to the total capacity of six Three Gorges Hydropower Stations[1]. Figure 2 depicts the new and cumulative installed wind power capacity in China from 2008 to 2018[6]. China is in the process of building nine wind power bases (each with a total capacity larger than 10 GW), including Xinjiang Hami, Gansu Jiuquan, coastal areas of Hebei, Jilin, Jiangsu, the eastern and western regions of Neimenggu, Shandong and Jiangsu offshore wind power bases. Figure 3 depicts the cumulative installed wind power capacity of China's provinces (regions and cities) by the end of 2018[6]. It can be seen that Inner Mongolia is the province with the largest installed wind power capacity. Accordingly, China plans to increase its installed wind power capacity to 250 GW in 2020.

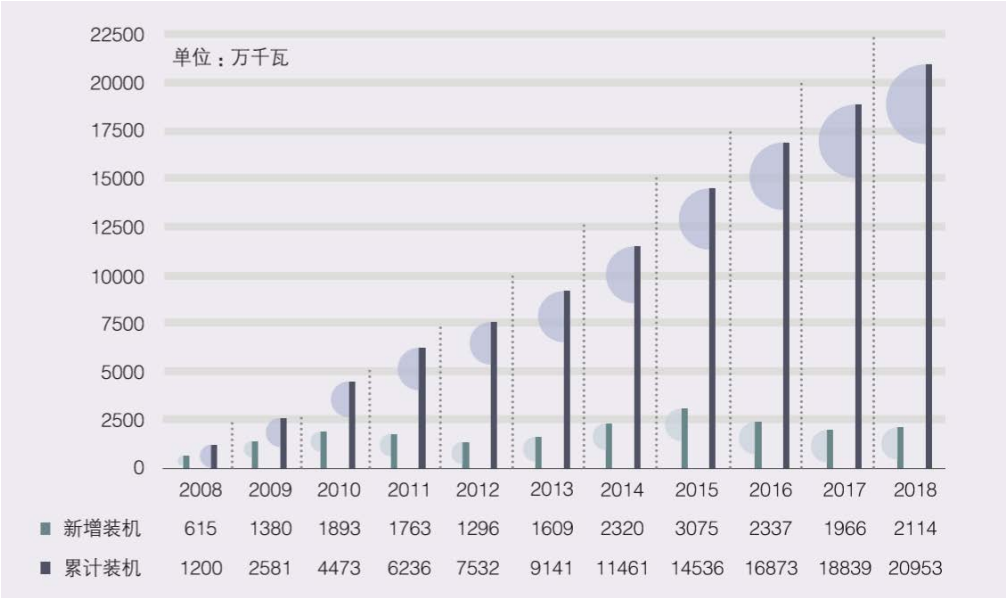

Fig. 2. New and cumulative wind power installed capacity in China from 2008 to 2018[6]

Fig. 3. By the end of 2018 China's provinces (autonomous regions and municipalities) the cumulative installed wind power capacity[6]

2.2 Solar power

China's solar photovoltaic industry started slightly later than Western countries. In the early days, it mainly focused on solar cell manufacturing. The United States and the European Union are important export markets for my country's photovoltaic products. Since the outbreak of the international financial crisis in 2008, the economies of developed countries in Europe and the United

States have been greatly affected, leading to a decline in employment rates and increasing protectionist momentum. In this context, many export industries in China, including the photovoltaic industry, have encountered increasingly serious trade frictions. The huge punishment measures taken by the United States and the European Union on Chinese photovoltaic products in 2012 and 2013 had a huge negative impact on the development of Chinese photovoltaic companies at that time. Against this background, a large number of less competitive companies withdrew from the industry. Since 2013, with the joint efforts of the Chinese government and photovoltaic companies, my country's photovoltaic industry has ushered in a turning point. With good industrial supporting advantages, human resource advantages, cost advantages and strong national support policies, taking full advantage of the opportunity of the rise of the domestic photovoltaic market, through the combination of independent innovation and the introduction of digestion and absorption and innovation, China's photovoltaic industry has gradually formed a The characteristic industrial technology system has gradually become one of the few strategic emerging industries with international competitive advantages in China. Figure 4 describes the solar power installed capacity in major countries from 2010 to 2017 (Unit: GW)[7].

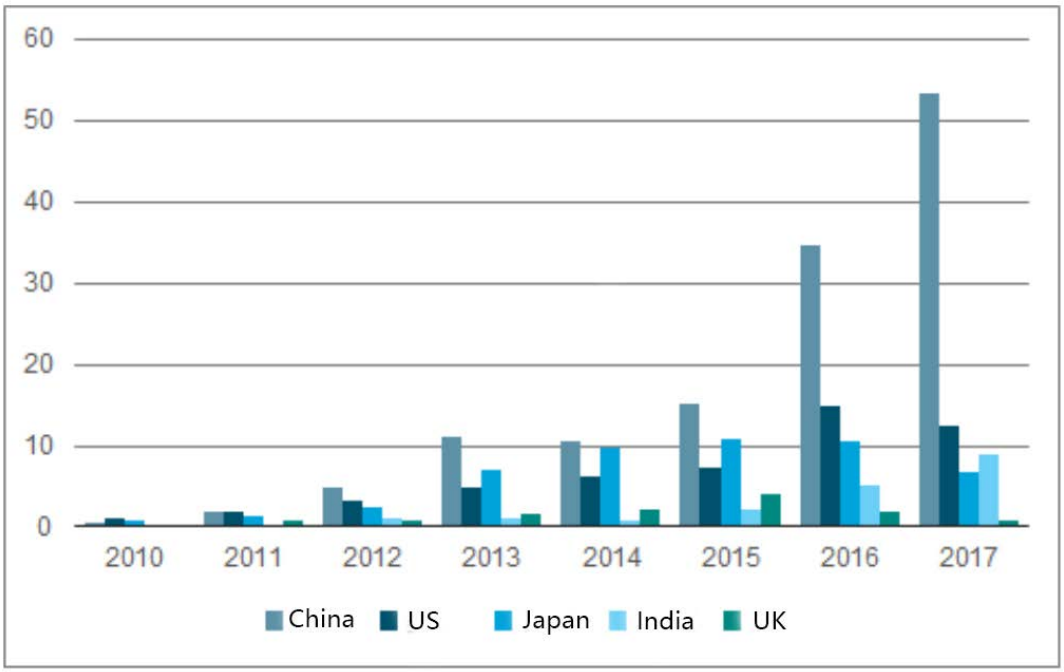

Fig. 4. 2010-2017 China, the United States, Japan, India and the United Kingdom installed solar capacity(Unit: GW)[7]

China's "Thirteenth Five-Year Plan for Solar Energy Development" stipulates that by the end of 2020, the installed capacity of solar power generation will exceed 110 GW, and the cost of solar power generation will be less than 0.8 yuan/kWh in 2020, which is about 50% lower than that in 2015. The use of energy will reach 140 million tons of standard coal. Solar heating and industrial heating have certain market competitiveness.

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2.3 biomass power generation

China is one of the leading countries in promoting biomass power generation. A series of regulatory arrangements have been introduced to facilitate the development of biomass electricity generation in the past decade, including the Medium and Long-term Development Plan of Renewable Energy (MLDP), the Twelfth Five-Year Plan of Biomass Energy Development, the Renewable Energy Law, the Energy Saving Law. The last decade or so has witnessed a significant increase in China's biomass electricity generation (Fig. 5)

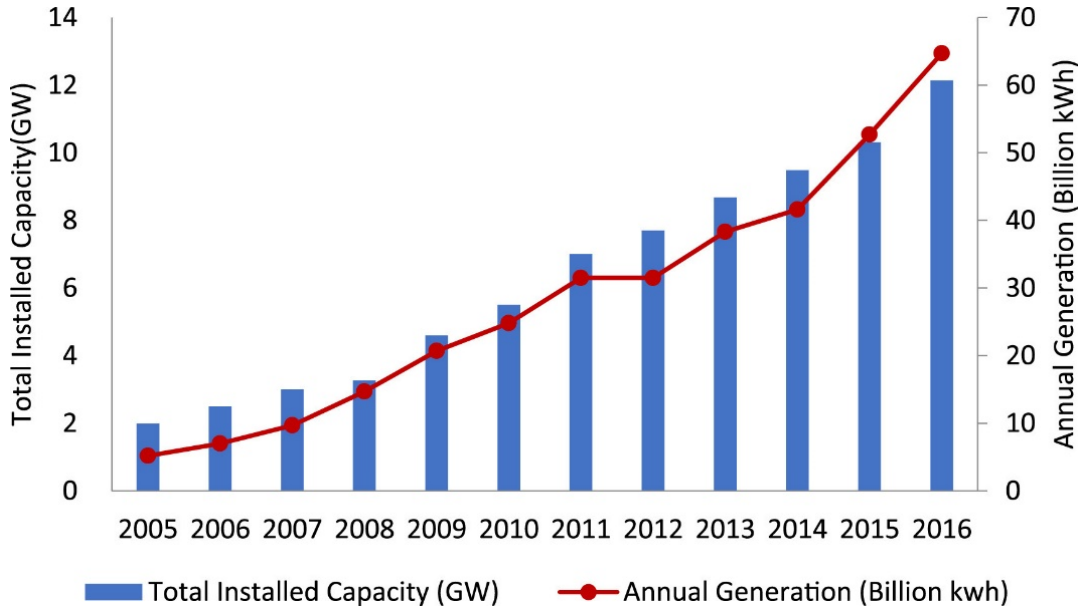

Fig. 5. Total installed biomass electricity capacity and electricity generation in China[8].

Straw (i.e. agricultural and forest residues), waste to energy, biogas and gasification are four main biomass power generation technologies. Figure 6 shows the distribution of biomass power generation capacity of these four major biomass power generation technologies in China. The first three biomass electricity generation technologies are most common in China, accounting for nearly 100% of the total biomass electricity generation capacity.

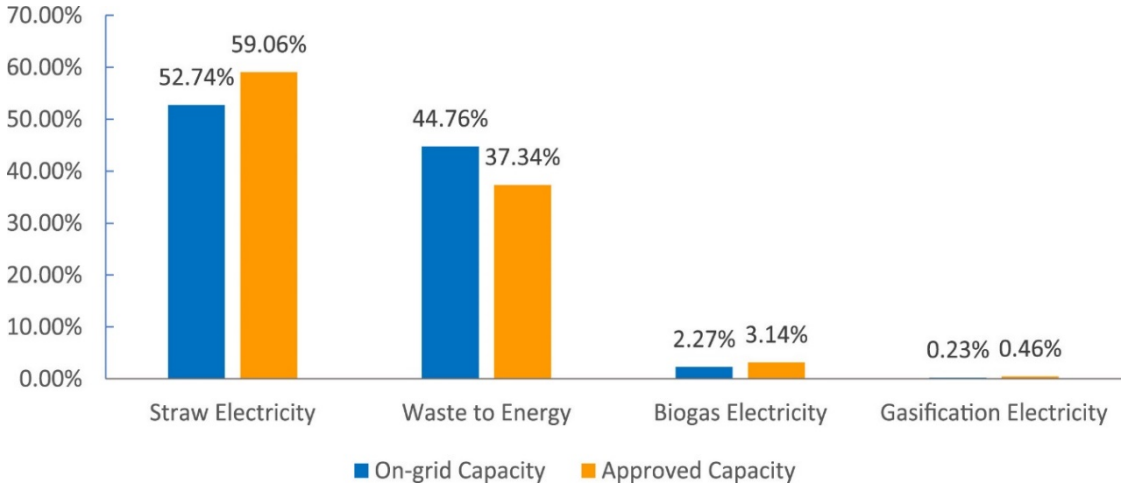

Fig. 6. Biomass electricity generation capacity by technology.

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In addition, in terms of strategic goals, seven plans have mentioned biomass power development targets since 2006, summarized as follows (see Table 2). In 2010 and 2015, the installed capacity of biomass power plants in China reached 5500MW and 10300MW respectively. China successfully completed the strategic objectives set out in the plan in 2010, but did not achieve the target in 2015.

Main content	To 2010	To 2015	To 2020
Installed capacity	5500 MW	13000 MW	23340 MW
Generating capacity		78 TW	140 TW
Demonstration project	Direct-firing power; gasification power	Direct firing power; co-firing power; combined heat and power	
Biomass planting			The forest used as energy covers about 20 million ha
Technology research	Power generation technology	New equipment; boiler corrosion control; measure and test of co-firing	

Table 2. Strategic goals of biomass power generation development[6].
Source: summarized according to "12th Five-Year Plan for Renewable Energy Development", "Mid- and Long-Term Plan for Renewable Energy Development", etc.

Chapter 3 China's renewable energy feed-in tariff

3.1 Renewable energy feed-in tariff policy changes

3.1.1 Time-scale policy changes

The “Interim Measures for the Administration of Special Funds for Renewable Energy Development” issued by Ministry of Finance of the People's Republic of China in February 2006 established a special fund for the development of renewable energy and formulated the additional standard for renewable energy power is RMB 0.001 per kWh.

National Development And Reform Commission (NDRC) issued the “Improving Policies on the Feed-in Tariff of Wind Power” in July 2009, which introduced benchmark wind power tariffs for four different regions in China: RMB 0.51, 0.54, 0.58, 0.61 per kWh. Different costs reflect differing wind resources in each region. Power costs above the cost of coal- fired generation to be split between provincial grid operators and the central government. “Notice of Adjusting the Electricity Price of

Northwest Power Grid" issued by Ministry of Finance of China in September 2009 formulated the additional standard for renewable energy power is increased to RMB 0.004 per kWh.

NDRC issued the "Improve Policies on the Agricultural and Forestry Biomass Power Generation Price" in July 2010. It formulated agricultural and forestry biomass power generation subsidy is RMB 0.75 per kWh.

"Improve Policies on the Solar Photovoltaic Power Generation Grid Price" issued by NDRC in July 2011 formulated the subsidy for photovoltaic power generation is RMB 1.15 per kWh.

Ministry of Finance of the People's Republic of China issued the "Interim Measures for the Administration of Additional Subsidy Funds for Renewable Energy Electricity Prices" in February 2012. It introduced the additional standard for renewable energy power is increased to RMB 0.008 per kWh. "Improve Policy on the Waste Incineration Power Generation Price" issued by NDRC in April 2012 formulated the subsidy for waste-to-energy power generation is RMB 0.65 per kWh.

Ministry of Finance of the People's Republic of China issued the "Adjustment of Additional Standards for Electricity Prices of Renewable Energy" in August 2013. It formulated the additional standard for renewable energy power is increased to RMB 0.015 per kWh. "Exerting Price Leverage to Promote the Healthy Development of Photovoltaic Industry" issued by NDRC in September 2013 formulated benchmark electricity prices for the three types of solar energy regions in China: RMB 0.90, 0.95, 1.00 per kWh.

NDRC issued the "Improve Policies on Benchmark Electricity Price Policy for Onshore Wind Power and Photovoltaic Power Generation" in December 2015, which adjusted benchmark wind power tariffs for four different regions in China to RMB 0.47, 0.50, 0.54, 0.60 per kWh and benchmark solar photovoltaic power tariffs for three types of solar energy regions in China to RMB 0.80, 0.88, 0.98 per kWh.

The "Notice on Issues Related to Raising the Collection Standards for Renewable energy Development Funds" issued by Ministry of Finance of the People's Republic of China in January 2016 formulated the additional standard for renewable energy power is RMB 0.019 per kWh.

NDRC issued the "2018 Photovoltaic Power Generation Project Price Policy" in May 2018. It decreased benchmark solar photovoltaic power tariffs for three types of solar energy regions in China to RMB 0.50, 0.60, 0.70 per kWh.

The "Improve Policies on the Solar Photovoltaic Power Tariff" issued by NDRC in April 2019 further decreased benchmark solar photovoltaic power tariffs for three types of solar energy regions in China to RMB 0.40, 0.45, 0.55 per kWh. NDRC issued the "Improve Policies on the Wind Power Tariff" in May 2019. It further decreased benchmark wind power tariffs for four different regions in China to RMB 0.34, 0.39, 0.43, 0.52 per kWh.

3.1.2 Policy analysis of wind power, photovoltaic and biomass power

Tariffs of wind power in China have experienced four stages: approval tariff stage, coexistence of bidding price and approved tariffs stage, bidding plus consenting stage and fixed tariffs stage, as shown in Fig. 7[9].

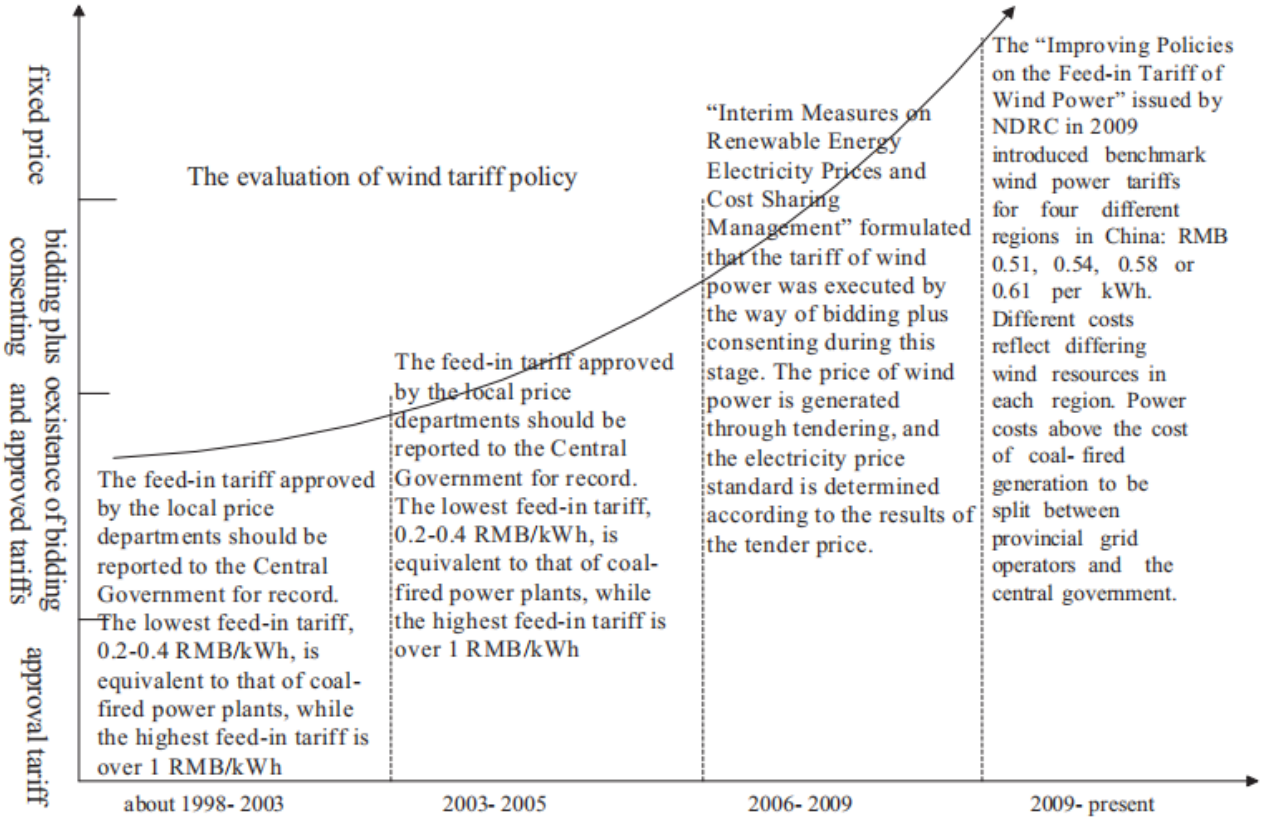

Fig.7 Tariff policy evolution of wind power.

The specific implementation of wind power feed-in tariff is as follows: before 2003, the lowest feed-in tariff of wind power was0.38 RMB/kWh, while the highest was more than 1 RMB/kWh[10]. After 2003, the NDRC organized a few of wind power concession projects, for which investors were selected via public tendering. However, the prices formed through concession bidding were generally low, about 0.38–0.5 RMB/kWh, while the prices without concession bidding approved by the local government were generally high, at 0.5–0.8 RMB/kWh. In July, 2008, the price level of 48 wind power projects approved by the NDRC was between0.51 and 0.61 RMB/kWh[11]. The "Improving Policies on the Feed-in Tariff of Wind Power" promulgated by NDRC in August 2009, enacted a fixed feed-in tariff. The whole country is divided into four classes of wind energy resource regions with the benchmark feed-in tariffs were 0.51, 0.54, 0.58 and 0.61 RMB/kWh according to the policy[12].

Tariffs of solar photovoltaic power in China have gone through the approval tariff stage, bidding price stage and fixed price stage, as shown in Fig.8[9].

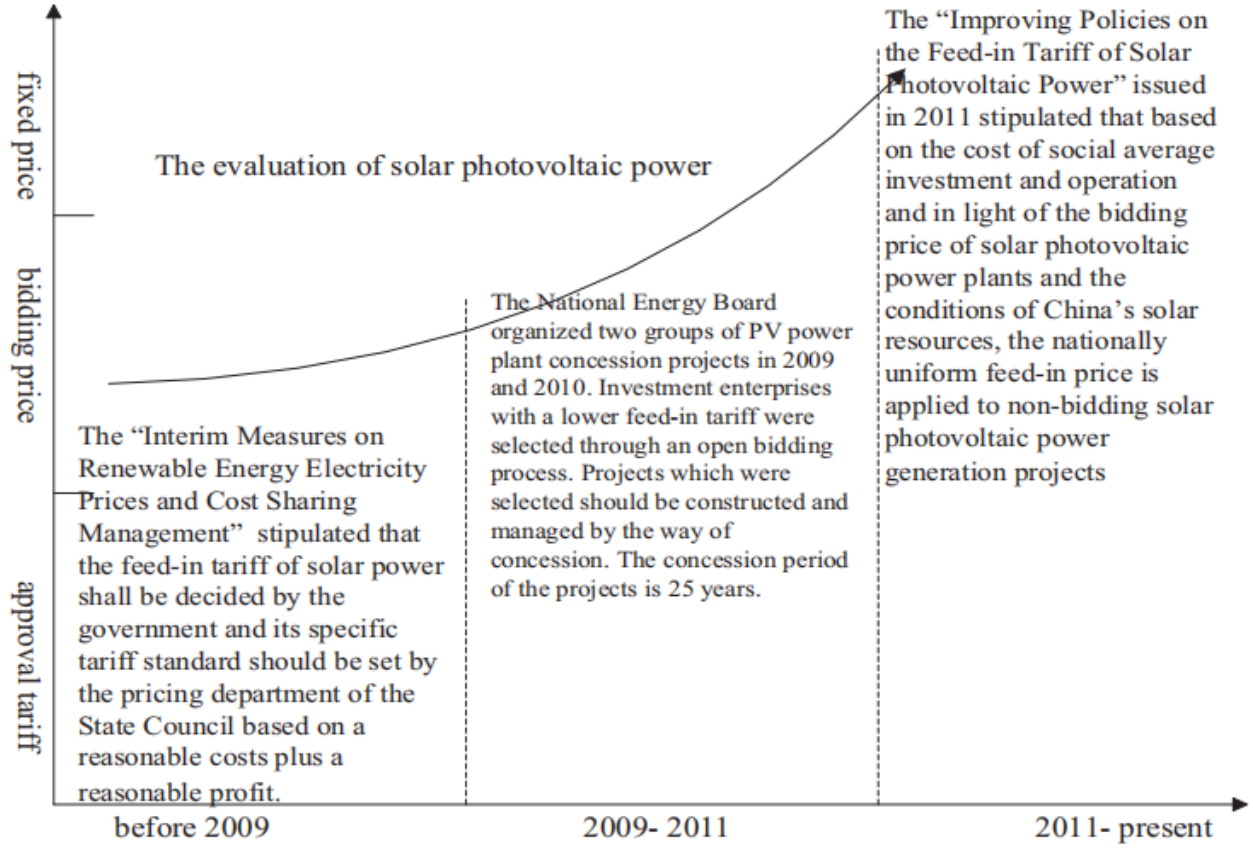

Fig.8 Tariff policy evolution of solar photovoltaic power.

The specific implementation of solar photovoltaic feed-in tariffis as follows: in 2007, the solar power price of Inner Mongolia, Shanghai and Chongming approved by NDRC was 4 RMB/kWh. In 2009, the feed-in tariff for the first batch of concession projects was 1.09 RMB/kWh, while the temporary feed-in tariff for solar photovoltaic power plant project in Ningxia was 1.15 RMB/kWh in April, 2010. In October, 2010, the lowest feed-in tariff for the second batch of concession projects was 0.73 RMB/kWh, while the highest was 0.99 RMB/kWh; in July, 2011, China's energy regulator announced a new circular on the feed-in tariff for solar photovoltaic power. The "Improving Policies on the Feed-in Tariff of Solar Photovoltaic Power" issued in 2011, introduced a unified feed-in tariff for solar photovoltaic power projects. The national feed-in tariff is RMB 1.15/kWh for projects completed by December31, 2011, and RMB 1.0/kWh for projects approved by July, 2011, but not completed before the end of the year. The NDRC will from time to time adjust the price according to certain factors such as investment cost changes and technical advances[13].

Tariffs of biomass power in China have undergone governmental designated price and governmental guided price.

The specific implementation of biomass power feed-in tariff is as follows: before the establishment of a nationwide biomass feed-in tariff, under the policy set in 2007, the national feed-in tariff of biomass power exercised governmental designated price, which was equal to 0.25

RMB/kWh plus the 2005 benchmark desulfurized coal price in the area, where the facility was located for a period of 15 years[14]. On July, 2010, The “Improving Policies on the Feed-in Tariff of agriculture and forestry biomass power ”issued in 2011 set at the feed-in tariff of the agriculture and forestry biomass power projects was 0.75 RMB/kWh[15].

3.2 Strengths of China's feed-in tariff policy

The FIT scheme improves investors’ enthusiasm for developing renewable energy projects. On the one hand, FIT scheme can make renewable energy power compete in the market at a lower on-grid price to ensure that power grid enterprises acquire renewable energy power in priority. On the other hand, it can ensure that renewable energy power investors legitimately recover the cost of investment[16].

Subsequent empirical research results also show that China's renewable energy feed-in tariff subsidy policy (FIT) is indeed conducive to promoting investment in renewable energy project construction, and the policy effect is significant.

By comparing the 2020 target data published in the "Thirteenth Five-Year Plan for Renewable Energy" with the actual data for 2018, it can be found that in terms of installed capacity and power generation, China has basically achieved or even exceeded its target by the end of 2018.

Table1 Comparison of China's renewable energy development goals in 2020 with actual installed power generation in 2018[17]

project	2020 goals	2018
Wind power installation /GW	210	184.0
Grid connected wind power /TW· h	420	366.0
Solar installation /GW	110	175
Solar power generation /TW· h	144.5	177.55
Biomass energy installation /GW	15	17.81
Biomass power generation /TW· h	90	90.6
Proportion of renewable energy power generation /%	27	26.7
Consumption proportion of non water renewable energy /%	9	9.2
Proportion of non fossil energy consumption /%	15	14.73
Abandonment rate /%	5	7
Light rejection /%	3	3

3.3 Weaknesses of China's feed-in tariff policy

Although Chinese government endeavored to improve renewable energy policies to develop its FIT, it still faces with a few problems.

First, China’s FIT scheme did not take into consideration the China’s uneven resources distribution. In China, the resources are concentrated in the regions of Northwest, North, and South, and the developed administrative regions are short of resources. Therefore, some electricity supply companies in the developed administrative regions have little interest to produce the renewable power, which hinders the implementation of FIT scheme.

Second, China's tariff for renewable power was insufficient to provide incentives for generators compared with the international average level. The private generators are reluctant to get involved in other energies to produce power.

Third, the permanent benchmark tariff can not provide guidance for the generators to obtain certain return on investment. It's hard for the generators to make a response to market price signals which result in increasing peak-valley deviation and obvious anti-peaking effect[18].

In addition, the subsidy retreat is one of the core designs of the feed-in tariff subsidy policy. China's subsidy retreat is implemented in the form of reducing subsidy electricity prices and limiting the total capacity of subsidies. Subsidy level changes are promulgated by the National Development and Reform Commission from time to time. As the cost of renewable energy decreases, the level of subsidies enjoyed by various types of power generation technologies has gradually declined, and the capacity restrictions included in the list of subsidies have also become stricter. At the same time, the practice of promulgating from time to time can cause problems. In order to reduce the impact on the market, there is often a certain buffer time between notification and entry into force. Our common phenomenon of rush to install and other phenomena often occurs during this time. Policy discontinuities and uncertainties have adversely affected the stability of renewable energy investments.

Chapter 4 A scenario for future implementation of financial support to RES

China's renewable energy implement a fixed electricity price system, which played a great role in promoting the development of China's renewable energy in the early stage. However, with the rapid expansion of China's renewable energy industry and the gradual deepening of the reform of the electricity market, the current electricity price mechanism is encountering with the financial subsidy fund gap and the increasing difficulty of subsidy pricing, which has become a constraint on wind power, photovoltaic power generation and so on. In order to promote the sustainable and healthy development of China's renewable energy, it is urgent to adjust the current electricity price system[19].

4.1 The function of Renewable Energy Certificate(REC)

From the international mature experience and China's national conditions, the Renewable Energy Certificate (REC) trading system based on renewable energy quota is an effective way to promote the sustainable and healthy development of China's renewable energy industry. The main functions of the system include:

1. It is a long-term mechanism to solve the problem of renewable energy consumption from the consumer side.

2. It is an effective way to achieve the target of the proportion of non-fossil energy consumption.

3. It is an important measure to reduce the intensity of subsidies.

4.2 Suggestions for China's renewable energy policy

Based on the review of the development course of China's renewable energy policy and the evaluation of the effectiveness of China's renewable energy policy, and focusing on the new

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challenges China's renewable energy development is facing, we put forward some suggestions to further improve China's renewable energy policy.

1. Improve the trading system of green power certificate for renewable energy.
2. Establishing a market mechanism for energy storage technology.
3. Promote the construction of a carbon finance system[17].

4.3 Conclusion

The power industry is one of the industries that is most closely integrated with the national economy and people's livelihood, and renewable energy in the power market for traditional energy replacement will also go through a long process. The renewable energy industry is examined on the basis of short-term changes. However, in the long run, market fluctuations, policy uncertainty and other external factors will have a complex impact on the development of renewable energy. In the promotion policy system of renewable energy industry, although the direct subsidy policy is the core of the policy system, it is still inseparable from many other means such as financial policy, research and development incentives and so on[20].

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Master Program on Bio-Based Circular Economy

Course of Renewable Energy Technologies

Feed-in-tariff for Renewables in China: legislative aspects

Students: Siying Qin, Yushan Deng, Juan Luo, Ting Zhang, Taoyu Wang

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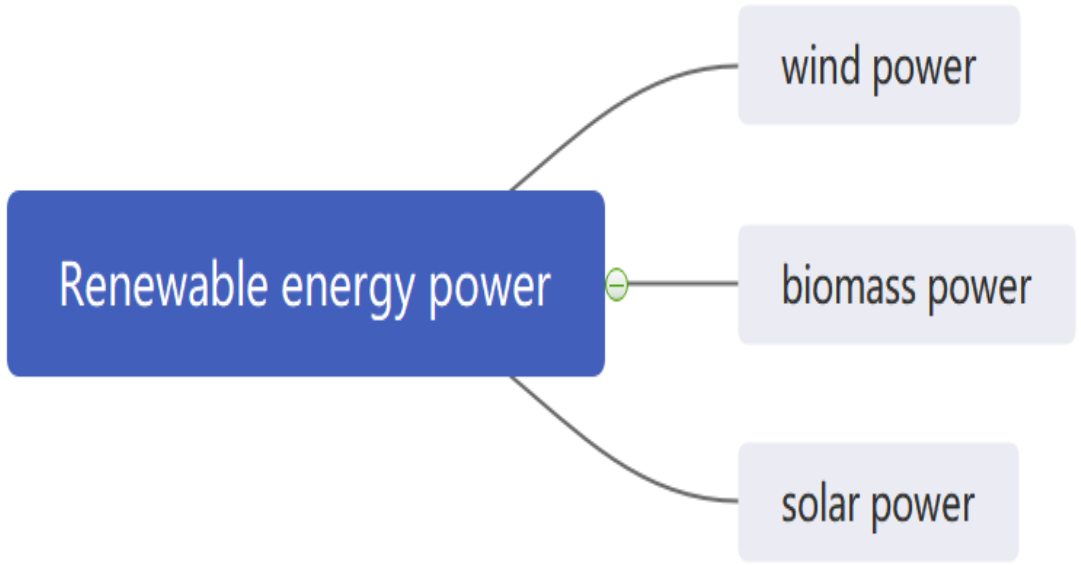
1.1 The main types of renewable energy



Renewable energy mainly includes wind power, biomass power and solar power.

Wind energy is the kinetic energy produced by the flow of air. A form of conversion of solar energy.

Biomass power generation mainly includes power generation by direct combustion of agricultural and forestry biomass, power generation by garbage, and biogas power generation.

Solar energy is a kind of renewable energy. Refers to the sun's thermal radiation energy.

1.2. Related technologies and characteristics of solar power generation

- Solar thermal power generation refers to the technology that collects sunlight and converts it into high-temperature thermal energy of working fluid, and then converts it into electrical energy through conventional heat engines or other power generation technologies .

1.3. Related technologies and features of biomass power generation

- Biomass power generation is a process that uses steam heated by burning biomass fuel to drive a turbine. Biomass fuel mainly refers to plant fuels such as straw, straw, and bagasse, as well as forestry residues, industrial waste, and municipal waste.

Figure 1 lists the types of biomass power generation, including combined combustion, direct straw combustion, gasification power generation, biogas power generation and waste incineration.

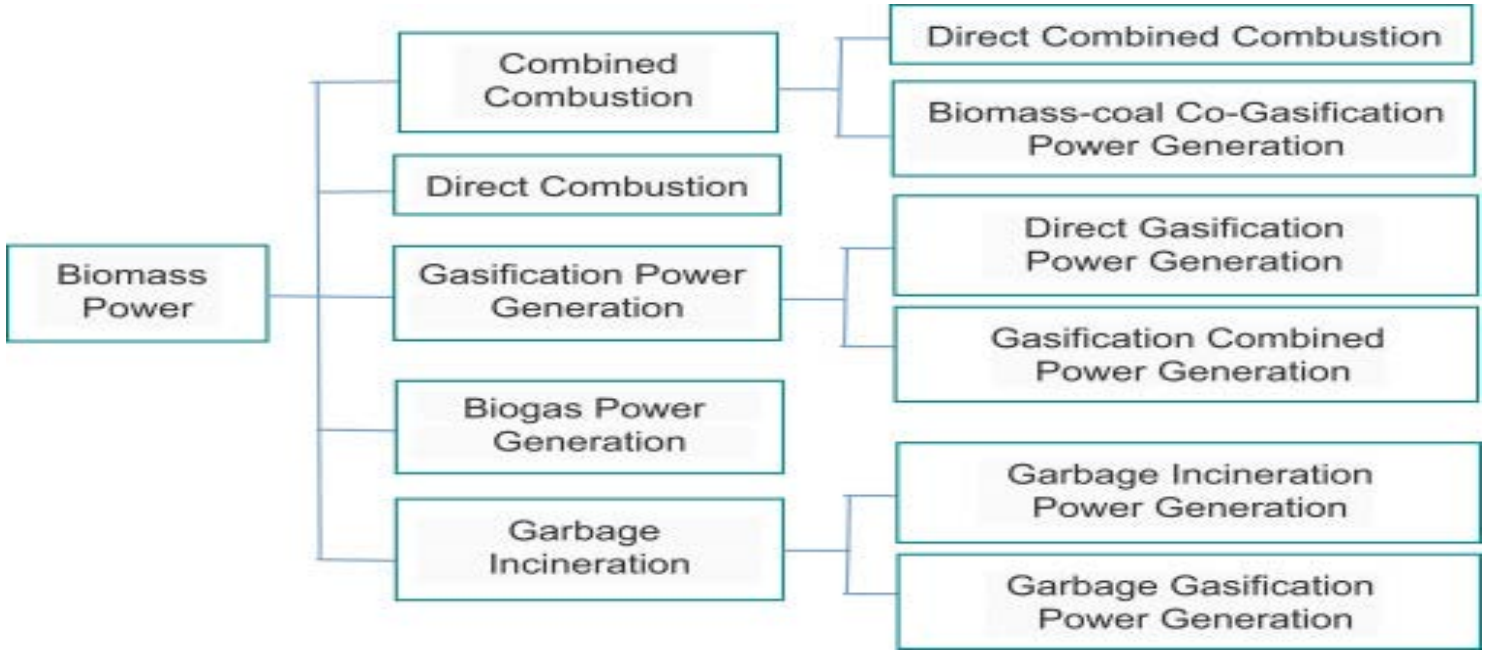


Figure 1 Types of biomass power generation

1.3.2 Characteristics of biomass power generation

- 1. Rich raw materials and renewable raw materials. Regardless of whether it is agricultural and forestry waste power generation, garbage combustion power generation or biogas power generation, the raw materials available for power generation in my country, such as crop residues and industrial city waste, are rich in reserves and renewable.
- 2. Recycling of waste. Domestic garbage, straw, etc. were originally the wastes of people in the process of production and life. Using them to generate electricity not only solves the problem of waste disposal but also realizes the reuse of waste.
- 3. It has a wider application range than other renewable energy sources. Hydropower, wind power and solar power generation have high requirements on the geographical environment of the region and are regional. As long as the biomass power plant solves the problem of raw material transportation, the restrictions on the location of the project are not so large.
- 4. The technical requirements are relatively simple. The principle is basically the same as coal power, and the power generation process is single. Compared with hydropower, etc., the initial investment cost of boilers is relatively low.

1.4. Related technologies and features of wind power generation

- In the process of converting wind energy into electrical energy, it only reduces the velocity of the airflow, without causing any pollution to the atmosphere. Therefore, wind power generation is of great significance for protecting the environment and ecological balance and improving the energy structure.

2. Current status of renewable energy power generation in China

2. Current status of renewable energy power generation in China

- China now has the world largest power capacity and electricity generation.
- Judged by current installed capacity and future development plans, China's hydropower, wind power and solar power are all in the world's leading position.

- As of the end of 2019, China's renewable energy power generation (excluding hydropower) installed capacity was **437 GW**, accounting for **21.7%** of the total installed power

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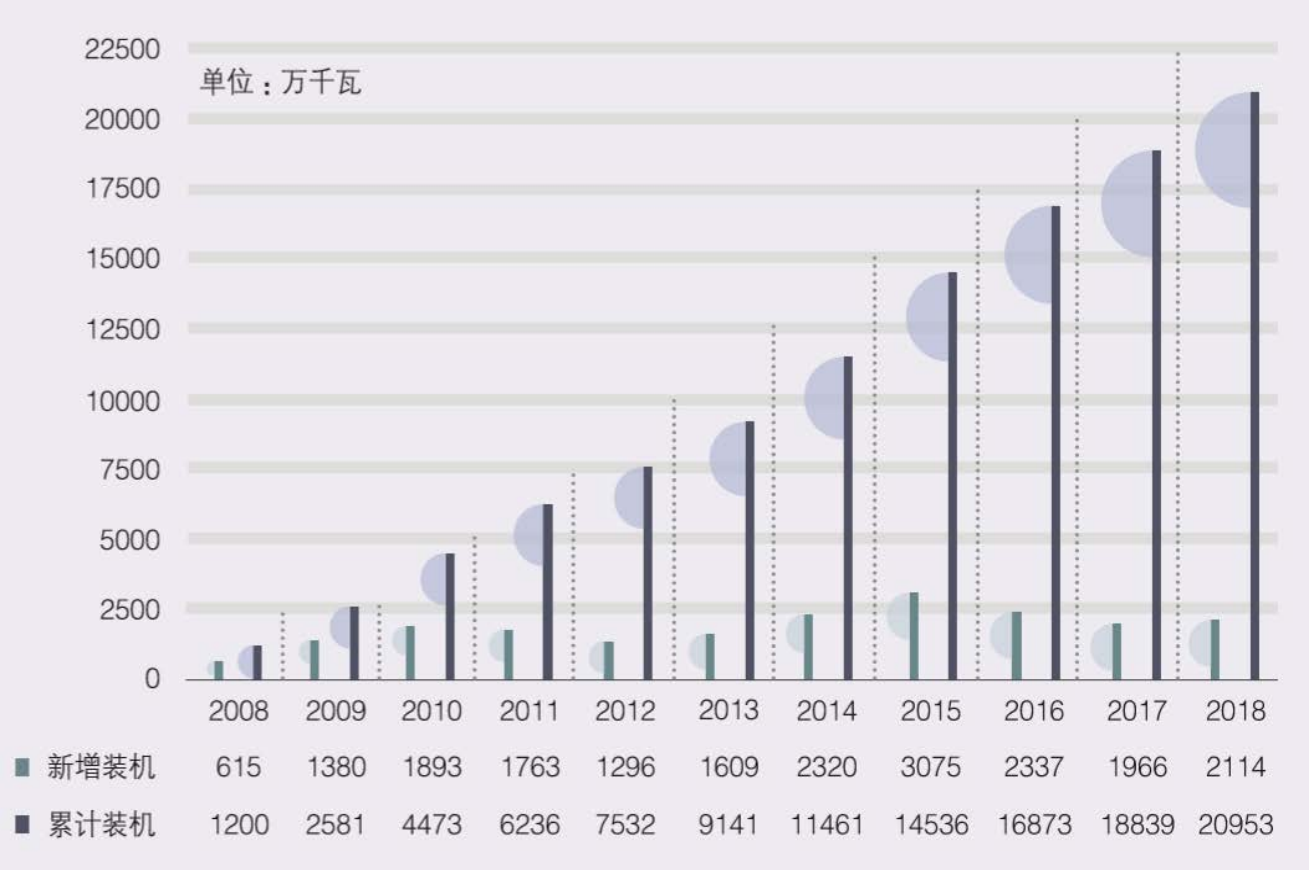
2.1 Wind power



New and cumulative wind power installed capacity in China from 2008 to 2018

- In 2010, China's installed wind power capacity surpassed that of the US to become the world's largest.
- In 2019, China's wind power generation was **405.7 TWh**, accounting for **5.5%** of total power generation.

2.1 Wind power

By the end of 2018 China's provinces (autonomous regions and municipalities) the cumulative installed wind power capacity

- China is in the process of building **nine wind power bases** (each with a total capacity larger than 10 GW), including **Xinjiang Hami, Gansu Jiuquan, coastal areas of Hebei, Jilin, Jiangsu, the eastern and western regions of Neimenggu, Shandong and Jiangsu offshore wind power bases.**

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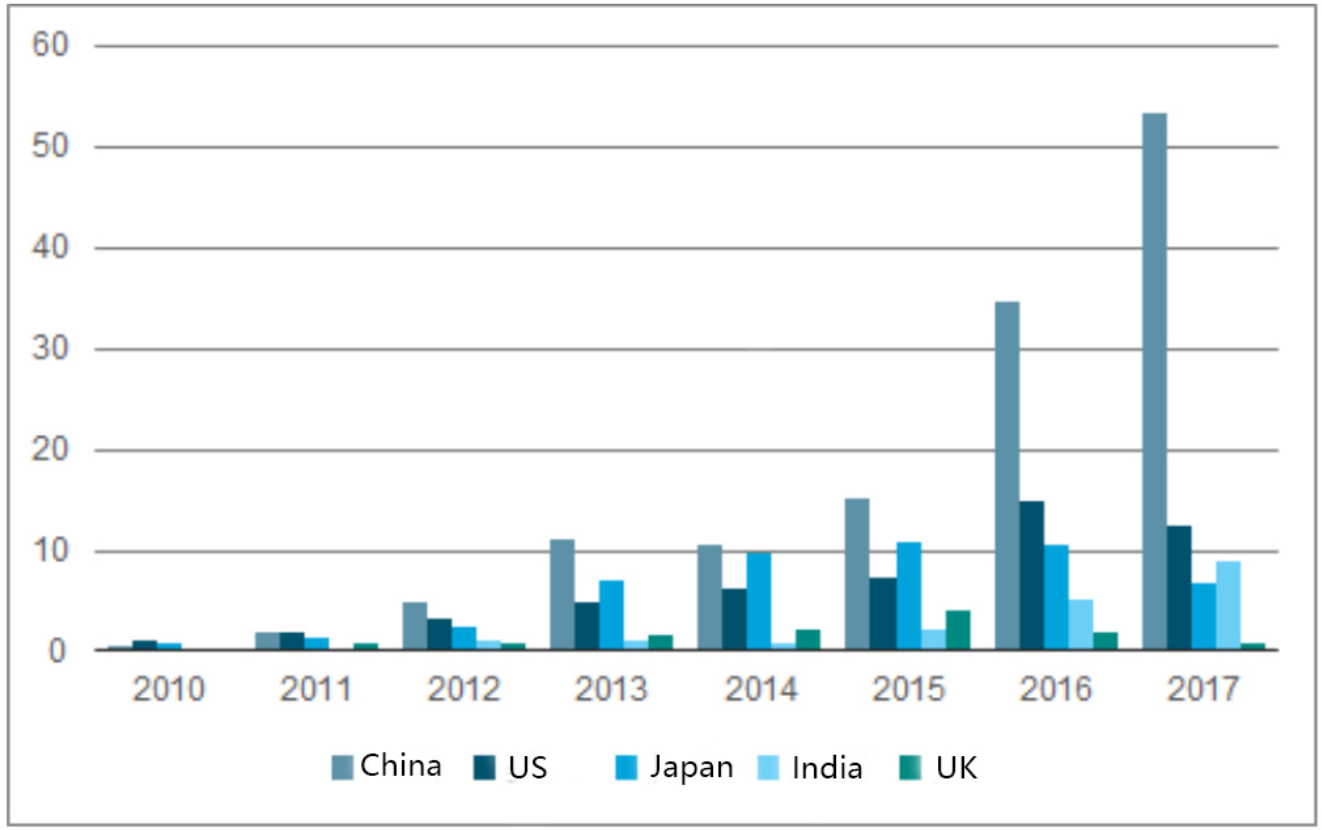
2.2 Solar power



2010-2017 China, the United States, Japan, India and the United Kingdom installed solar capacity (Unit: GW)

- Since 2013, with the joint efforts of the Chinese government and photovoltaic companies, China's photovoltaic industry has ushered in a turning point.
- In 2019, China’s solar energy generation was **224.3 TWh**, accounting for **3.1%** of total power generation.

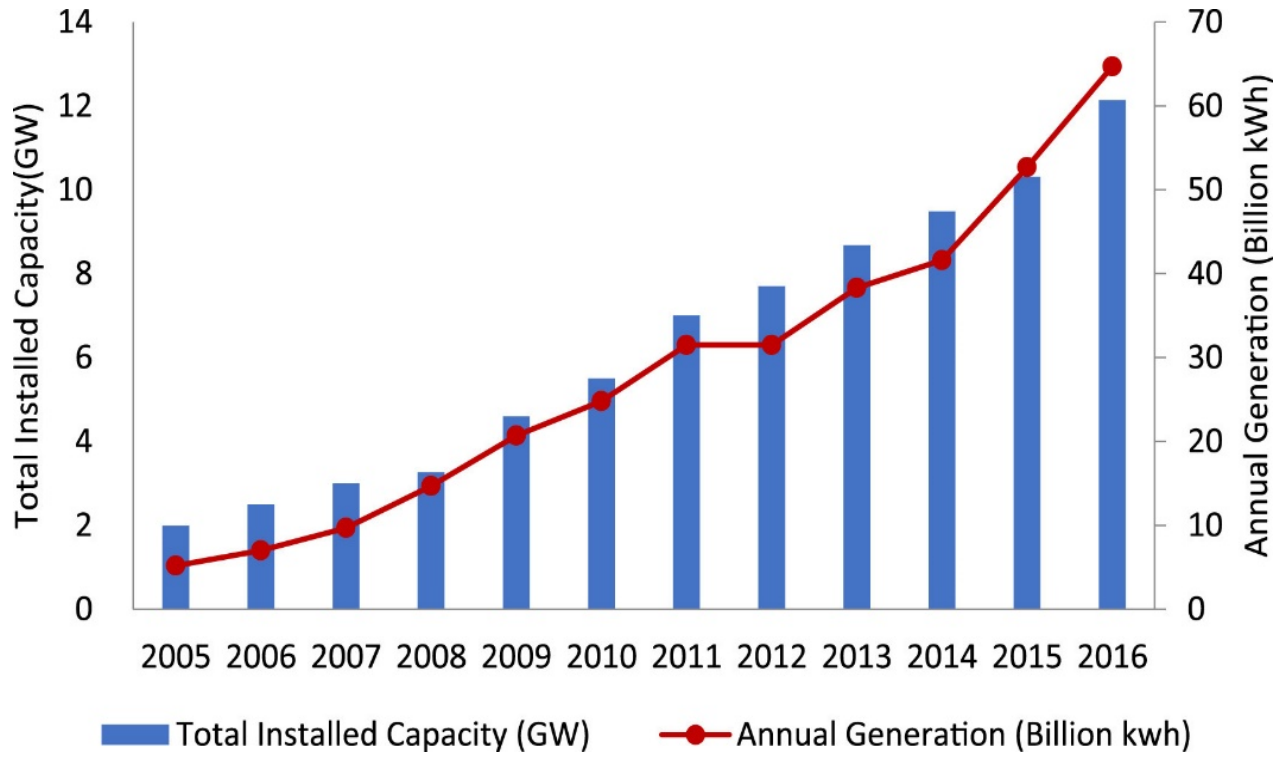
2.2 Solar power

China's "***Thirteenth Five-Year Plan for Solar Energy Development***" stipulates that by the end of 2020:

Installed capacity: 110 GW

Solar power cost: less than 0.8 yuan/kWh

2.3 biomass power generation

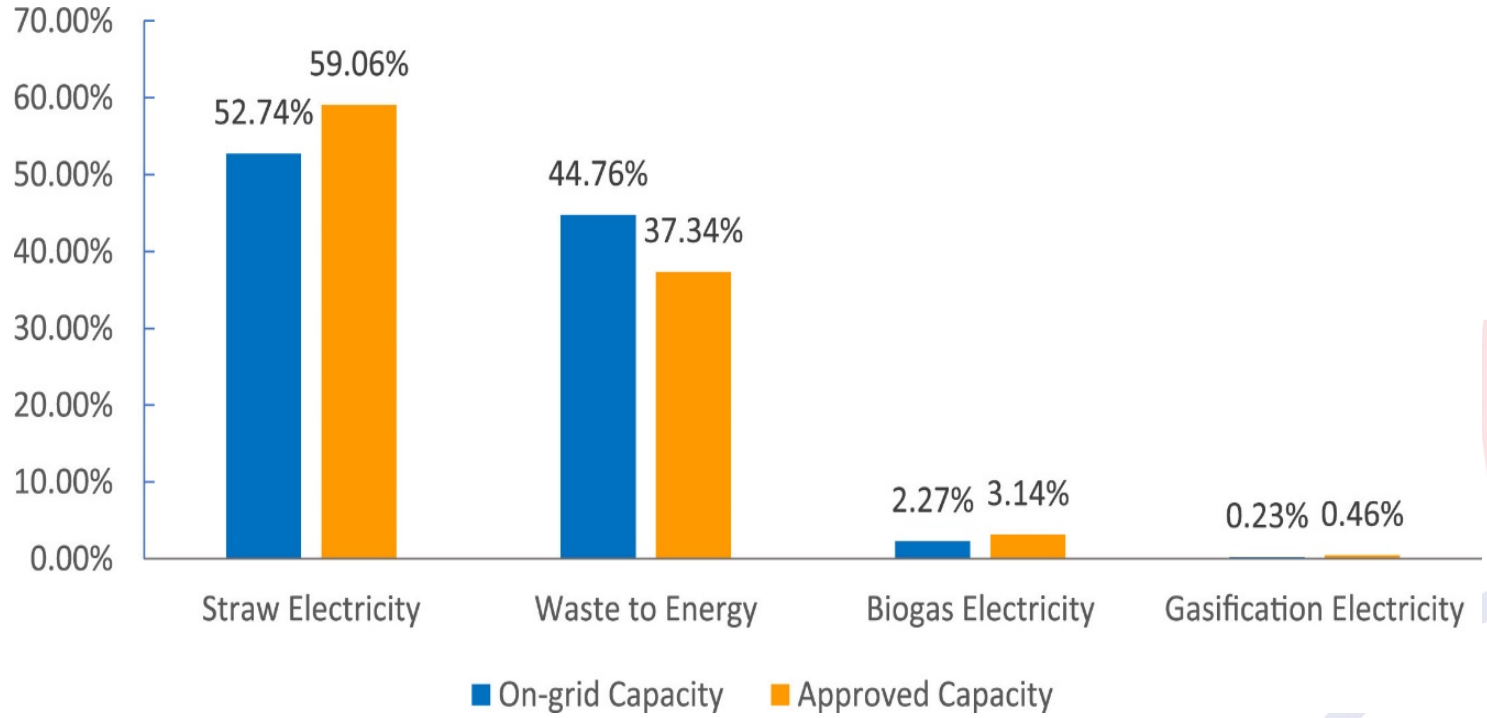


Total installed biomass electricity capacity and electricity generation in China

- In 2019, China's solar energy generation was **111.1 TWh**, accounting for **1.5%** of total power generation.

2.3 biomass power generation

- Straw (i.e. agricultural and forest residues), waste to energy, biogas and gasification are four main biomass power generation technologies, the first three biomass electricity generation technologies are most common in China.



Biomass electricity generation capacity by technology

3. China's renewable energy feed-in tariff

Renewable energy feed-in tariff policy changes

The "Interim Measures for the Administration of Special Funds for Renewable Energy Development" issued by Ministry of Finance of the People's Republic of China in 2006 established a special fund for the development of renewable energy and formulated the additional standard for renewable energy power is RMB 0.001 per kWh

National Development And Reform Commission(NDRC) issued the "Improving Policies on the Feed-in Tariff of Wind Power" in July 2009, which introduced benchmark wind power tariffs for four different regions in China: RMB 0.51, 0.54, 0.58, 0.61 per kWh.

"Notice of Adjusting the Electricity Price of Northwest Power Grid" issued by Ministry of Finance of China in September 2009 formulated the additional standard for renewable energy power is increased to RMB 0.004 per kWh.

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Renewable energy feed-in tariff policy changes

NDRC issued the "Improve Policies on the Agricultural and Forestry Biomass Power Generation Price" in July 2010. It formulated agricultural and forestry biomass power generation subsidy is RMB 0.75 per kWh.

"Improve Policies on the Solar Photovoltaic Power Generation Grid Price" issued by NDRC in July 2011 formulated the subsidy for photovoltaic power generation is RMB 1.15 per kWh.

Ministry of Finance of the People's Republic of China issued the "Interim Measures for the Administration of Additional Subsidy Funds for Renewable Energy Electricity Prices" in 2012. It introduced the additional standard for renewable energy power is increased to RMB 0.008 per kWh.

Renewable energy feed-in tariff policy changes

"Improve Policy on the Waste Incineration Power Generation Price" issued by NDRC in April 2012 formulated the subsidy for waste-to-energy power generation is RMB 0.65 per kWh.

Ministry of Finance of the People's Republic of China issued the "Adjustment of Additional Standards for Electricity Prices of Renewable Energy" in August 2013. It formulated the additional standard for renewable energy power is increased to RMB 0.015 per kWh.

"Exerting Price Leverage to Promote the Healthy Development of Photovoltaic Industry" issued by NDRC in September 2013 formulated benchmark electricity prices for the three types of solar energy regions in China: RMB 0.90, 0.95, 1.00 per kWh.

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Renewable energy feed-in tariff policy changes

NDRC issued the "Improve Policies on Benchmark Electricity Price Policy for Onshore Wind Power and Photovoltaic Power Generation" in December 2015, which adjusted benchmark wind power tariffs for four different regions in China to RMB 0.47, 0.50, 0.54, 0.60 per kWh and benchmark solar photovoltaic power tariffs for three types of solar energy regions in China to RMB 0.80, 0.88, 0.98 per kWh.

The "Notice on Issues Related to Raising the Collection Standards for Renewable energy Development Funds" issued by Ministry of Finance of the People's Republic of China in January 2016 formulated the additional standard for renewable energy power is RMB 0.019 per kWh.

Renewable energy feed-in tariff policy changes

NDRC issued the "2018 Photovoltaic Power Generation Project Price Policy" in May 2018. It decreased benchmark solar photovoltaic power tariffs for three types of solar energy regions in China to RMB 0.50, 0.60, 0.70 per kWh.

The "Improve Policies on the Solar Photovoltaic Power Tariff" issued by NDRC in April 2019 further decreased benchmark solar photovoltaic power tariffs for three types of solar energy regions in China to RMB 0.40, 0.45, 0.55 per kWh.

NDRC issued the "Improve Policies on the Wind Power Tariff" in May 2019. It further decreased benchmark wind power tariffs for four different regions in China to RMB 0.34, 0.39, 0.43, 0.52 per kWh.

4. Strengths and Weaknesses of China's feed-in tariff policy for renewable energy

4.1 Strengths of China’s FIT policy

China's renewable energy feed-in tariff subsidy policy (FIT) is indeed conducive to promoting investment in renewable energy project construction, and the policy effect is significant.

- FIT scheme can make renewable energy power compete in the market at a lower on-grid price to ensure that power grid enterprises acquire renewable energy power in priority.

- it can ensure that renewable energy power investors legitimately recover the cost of investment.

4.1 Strengths of China’s FIT policy

Table1 Comparison of China's renewable energy development goals in 2020 with actual installed power generation in 2018

project	2020 goals	2018
Wind power installation /GW	210	184.0
Grid connected wind power /TW· h	420	366.0
Solar installation /GW	110	175
Solar power generation /TW· h	144.5	177.55
Biomass energy installation /GW	15	17.81
Biomass power generation /TW· h	90	90.6
Proportion of renewable energy power generation /%	27	26.7
Consumption proportion of non water renewable energy /%	9	9.2
Proportion of non fossil energy consumption /%	15	14.73
Abandonment rate /%	5	7
Light rejection /%	3	3

4.2 Weaknesses of China's FIT policy

- China's FIT scheme did not take into consideration the China's uneven resources distribution.
- China's tariff for renewable power was insufficient to provide incentives for generators compared with the international average level.
- the permanent benchmark tariff can not provide guidance for the generators to obtain certain return on investment.

4.2 Weaknesses of China's FIT policy

- the subsidy decline is one of the core designs of the feed-in tariff subsidy policy:

China's subsidy decline is implemented in the form of reducing subsidy electricity prices and limiting the total capacity of subsidies. Subsidy level changes are promulgated by the National Development and Reform Commission from time to time.

Policy discontinuities and uncertainties have adversely affected the stability of renewable energy investments.

5. A scenario for future implementation of financial support to RES

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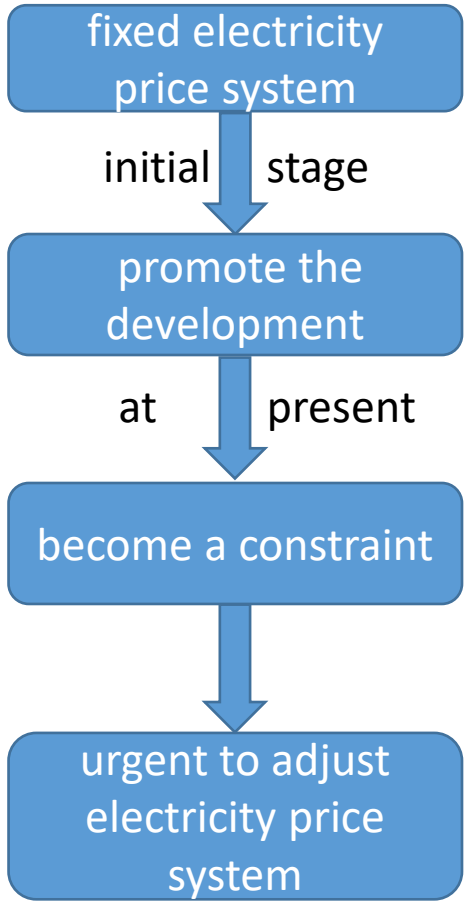

5.1 The function of Renewable Energy Certificate(REC)

①It is a long-term mechanism to solve the problem of renewable energy consumption from the consumer side.

②It is an effective way to achieve the target of the proportion of non-fossil energy consumption.

③It is an important measure to reduce the intensity of subsidies.

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5.2 Suggestions for China's renewable energy policy

①Improve the trading system of green power certificate for renewable energy

②Establish a market mechanism for energy storage technology

③Promote the construction of a carbon finance system

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5.3 Conclusion

The renewable energy industry is examined on the basis of short-term changes. However, in the long run, market fluctuations, policy uncertainty and other external factors will have a complex impact on the development of renewable energy. In the promotion policy system of renewable energy industry, although the direct subsidy policy is the core of the policy system, it is still inseparable from many other means such as financial policy, research and development incentives and so on.

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Thank you for listening

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