BBChina

Master Program
on Bio-Based Circular Economy

Course of Renewable Energy Technologies

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

Students:

Xuemin Lu	Tongji University
Yijun Yang	Tongji University
Zhiqi Wang	Tongji University
Wei Wang	Tongji University

Co-funded by the Erasmus+ Programme of the European Union

Table of Contents

BBChina
Co-funded by the Erasmus+ Programme of the European Union

Co-funded by the Erasmus+ Programme of the European Union

1 Background of renewable energy power generation

Primary energy mainly includes fossil energy and renewable energy. Nowadays, the excessive use of fossil energy has brought serious problems such as air pollution, environmental degradation and climate change, and it is extremely urgent to promote the transformation of fossil energy to renewable energy. As another important part of the energy supply system, renewable energy drives energy supply and energy consumption to be diversified, clean, green and low-carbon. In addition, the renewable energy industry covers a wide range of fields, contributes to the development of related industries, creates new jobs, and contributes to macroeconomic development. It is an important force for the transformation of economic development pattern. Therefore, accelerating the development and utilization of renewable energy has been paid more and more attention by the international community. Renewable energy will occupy an increasingly important position in energy production and consumption and become a key component of energy strategies of all countries in the world. Renewable energy is mainly used for power generation, but at present, the cost of renewable energy power generation is relatively high, lack of significant competitive advantage, in the case that the dominant position of fossil energy is difficult to change in the short term, the development of renewable energy is facing many problems and challenges.

1.1 The development and utilization of renewable energy has become an international development trend

Accelerating the development and expansion of renewable energy is of great significance to addressing global climate change, protecting the ecological environment, and ensuring the security of energy supply. It has drawn increasing attention from the international community. The development of renewable energy has become an important strategy for the global response to climate change and energy transformation. As for tackling climate change, many international energy organizations (THE International Renewable Energy Agency, the International Energy Agency and the Intergovernmental Panel of Experts on Climate Change) believe that developing renewable energy is an important measure to achieve the goals of tackling climate change. The United States, Japan, The United Kingdom, the European Union and other developed countries have taken the development of renewable energy as an important way to reduce greenhouse gas emissions. In Germany, for example, renewable energy has become mainstream and an important part of the country's low-carbon development.

As for the global energy transition, that is, the transition from a traditional fossil energy era to a green, low-carbon renewable energy era, more than 90 percent of the countries that signed the Paris

Agreement have formulated renewable energy development goals and energy transition strategies with renewable energy as the core. Therefore, a large amount of funds have been invested in the research and development of renewable energy technology and the development of renewable energy industry. In recent years, more than 60 percent of the new power generation capacity in Europe and the United States comes from renewable energy. The share of renewable energy generation in the United States is increasing year by year; India, Brazil, South Africa, Saudi Arabia and other countries have also stepped up efforts to actively develop and build renewable energy power generation projects [1]. An important manifestation of the global energy transformation is the structural transformation of the global power system. In 2015, the world's newly installed power generation capacity of renewable energy exceeded that of fossil energy for the first time.

Under the above trend, renewable energy will become the strategic commanding height of new-generation energy technology, the representative industry of new-generation manufacturing technology and the global strategic emerging industry, and become an important new field of economic development and international competition.

1.2 China's excessive consumption of fossil energy has caused ecological and environmental problems

After four decades of reform and opening up, China's economy has developed rapidly, but the rapid economic development has brought huge energy consumption and ecological and environmental problems. China's total primary energy consumption increased from 570 million tons of standard coal in 1978 to 4.36 billion tons in 2016, with coal accounting for 65 percent, oil for 21 percent and natural gas for 6 percent. Non-fossil fuels accounted for 13 per cent and renewables 11 per cent [2]. In recent years, China's tertiary industry and other terminal energy consumption grow rapidly, but the industrial terminal energy consumption still accounts for a high proportion of the total terminal energy consumption. Coal is the main energy product for China's terminal energy consumption. In 2016, China's total terminal energy consumption reached 3.23 billion tons of standard coal, among which industrial sector accounted for 61%, transportation sector accounted for 21%, and construction sector accounted for 14%. Coal consumption accounted for 39% of total terminal energy consumption in 2016. In addition, petroleum accounts for 27%, electricity for 19%, natural gas for 7%, district heating for 5%, and biomass energy for 2%. In the power sector, renewable energy accounted for 26% of the country's electricity generation in 2016, while non-fossil energy accounted for 29.5%. In addition, 67 percent of the country's electricity generation comes from coal

and 3 percent from natural gas. Despite the tremendous growth in renewable energy in China over the past decade, the current energy system is still far from being clean, efficient, safe and sustainable.

The coal-based energy consumption structure inevitably brings severe ecological and environmental problems, the most obvious example is the haze weather in most Chinese cities. Coal-fired power plants, coal-burning industries and cars powered by fossil fuels are responsible for the heavy air pollution in most Chinese cities. Some parts of China are heavily dependent on the coal economy, including coal mining and power generation, leading to a "lock-in" effect on coal consumption, which has hampered efforts to reduce China's coal consumption. Moreover, current fossil energy prices do not fully reflect the full cost to society of fossil energy use. Environmental costs are not real, and other support mechanisms for fossil fuels distort competition between different energy technologies. Compared with thermal power, renewable energy power generation is more environmentally friendly, which is the inevitable choice for the sustainable development of the power industry.

1.3 China is committed to a high proportion of renewable energy development path

The Chinese government has placed "ecological civilization construction" in a strategic position to lead economic development, while "green development" has become the new development concept. The economic development in the future cannot follow the same path as that of the past 20 years, especially since the reform and opening up. Although energy demand will continue to grow along with economic growth, energy supply and consumption must strictly abide by the ecological red line of sustainable development. As China's economic development enters a new normal, its energy development will also enter a new stage of transformation from total expansion to quality and efficiency improvement.

December 29, 2016, the national development and reform commission, the national energy administration in printed and distributed to the strategy of energy production and consumption revolution (2016-2030) "made in: by 2020, the total energy consumption to less than five billion tons of standard coal, non-fossil energy consumption ratio of 15%, compared with 2015 unit of gross domestic product (GDP) of a 18% drop in carbon dioxide emissions, energy consumption per unit of GDP fell by 15% in January 2015; Between 2021 and 2030, the total energy consumption should be less than 6 billion tons of standard coal, the proportion of non-fossil energy consumption should reach around 20%, and the proportion of natural gas consumption should reach around 15%. The energy consumption demand for economic development should be met mainly through clean energy, and carbon dioxide emission per unit of GDP should be reduced by 60-65% compared with 2015. By

Co-funded by the Erasmus+ Programme of the European Union

2050, total energy consumption will enter a period of stability, with non-fossil energy consumption accounting for more than 50%, and a modern energy system will be established. The revolutionary Strategy for Energy Production and Consumption (2016-2030) also calls for non-fossil energy to account for 50% of all electricity generation by 2030.

Moreover, China is gradually assuming the leadership role in multilateral cooperation on climate change. The Chinese government has made its intended Nationally determined contribution to the Paris Agreement, pledging to reduce carbon intensity by 40-45% by 2020 and 60-65% by 2030, based on the 2005 baseline. Economic development is the "bottom line", ecological environment is the "red line" and green power is the "lifeline", which determine that China's energy transformation and development path is the development path of high-proportion renewable energy.

1.4 China's renewable energy development faces many challenges

Although China's renewable energy development has made significant achievements, performance make substantive progress in technical development, industrialization of taking shape, show a good momentum of development in the future, but compared with developed countries gap is bigger, still faces several constraints, obstacles and challenges:

one is the current electric power operation mechanism. The power operation mechanism is not perfect and the power system is not flexible enough. The existing power system is dominated by traditional fossil energy, which generates relatively stable electricity, while wind power, solar energy and other renewable energy generation often has intermittenency and volatility. Therefore, the existing power system cannot meet the requirements of grid operation of renewable energy, so it cannot meet the needs of large-scale expansion of renewable energy.

Second, cost barriers. Compared with traditional fossil energy power generation, wind power, solar power, biomass power and other renewable energy power generation still have high cost and insufficient competitive advantages, which leads to its high dependence on policy support and limited sustainability of development. In addition, the current energy price mechanism and energy tax policy cannot fully reflect the external environmental costs of various types of energy, so the market competition environment for the development of renewable energy is still unreasonable, imperfect and imperfect. Therefore, the cost barrier requires to further reduce the cost of renewable energy generation through the establishment of a fair and reasonable market price mechanism.

Third, technical challenges. The grid connection of large-scale renewable energy power generation is still weak, and the technical management system for coordinated development with

Co-funded by the Erasmus+ Programme of the European Union

fossil energy power generation has not been established. Limited by technology, the potential of sustainable development of renewable energy has not been fully tapped. Although the installed capacity of renewable energy is increasing year by year, the developed electricity cannot be effectively utilized, and water, wind and light are seriously abandoned, resulting in low utilization efficiency.

Co-funded by the Erasmus+ Programme of the European Union

2 The development and current situation of Renewable energy power generation in China

China's renewable energy industry has entered a stage of comprehensive and large-scale development during the 12th Five-Year Plan period, showing the characteristics of large-scale incremental replacement and regional stock replacement.

In 2015, China's renewable energy consumption accounted for 10.1 percent of total primary energy consumption, reaching 436 million tons of standard coal. When nuclear power is taken into account, China's non-fossil energy use accounts for 12% of total primary energy consumption, up 2.6 percentage points from 2010. By the end of 2015, the installed capacity of hydropower, wind power and photovoltaic power in China had reached 320 million kilowatts, 129 million kilowatts and 43.18 million kilowatts respectively. The scale of solar thermal utilization ranks first in the world, with the application area exceeding 400 million square meters. The annual utilization of biomass energy of all kinds reaches 35 million tons of standard coal, showing a trend of diversified development. By the end of 2015, the total amount of renewable energy generation reached 1380 TWh, accounting for 25% of the total electricity consumption of the whole society, among which non-hydropower renewable energy generation accounted for 5%[1]. In promoting the optimization and adjustment of energy mix, the role of renewable energy has been deepened and strengthened.

By 2016, China's total renewable energy supply will account for 10.8 percent of total primary energy consumption, reaching 480 million tons of standard coal. The total installed capacity of renewable energy power generation increased from 254 million kw in 2010 to 570 million kW at the end of 2016, and its share in China's total installed capacity increased from 26 percent in 2010 to 34.6 percent at the end of 2016. In 2016, the total generating capacity of renewable energy reached 1505.8 TWh, accounting for 25.4 percent of the total generating capacity, up from 18 percent in 2010.

In recent years to promote the development of the renewable energy, national energy made a lot of fruitful work, by the competent department of national energy bureau recently issued a series of documents, its core is to smooth the restriction of wind power, photovoltaic industry parity Internet institutional hurdles, create a good environment for development, in order to speed up the elimination to pave the way, positive results have been achieved.

In general, the proportion of renewable energy in electricity consumption will continue to increase (Figure 1). Currently, it has entered the stage of incremental replacement. In the future, it will accelerate its development and gradually realize stock replacement. By the end of 2018, China's installed capacity of renewable energy power generation had reached 7.28×108kW, up by 12% year-

Co-funded by the Erasmus+ Programme of the European Union

on-year. The installed power generation capacity of renewable energy accounts for about 38% of the total power generation capacity, up 1.7 percentage points year on year, and the clean replacement role of renewable energy is increasingly prominent [3].

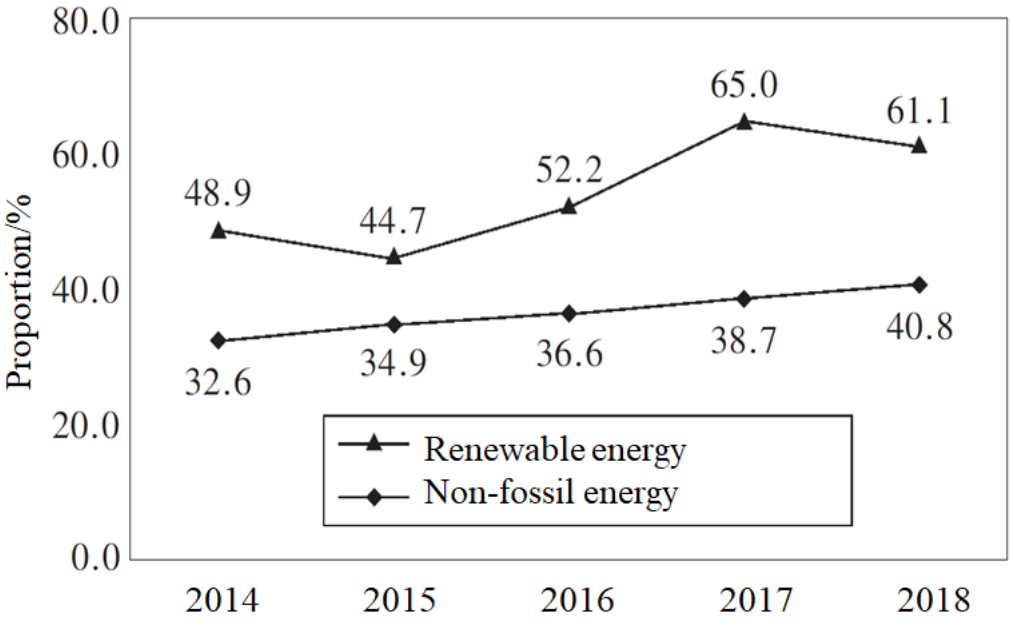


Figure 1 The proportion of new installed capacity of renewable energy in that year [3]

With the support of national policies, China's wind power and photovoltaic power generation industries have achieved rapid scale development and made remarkable achievements. China's wind power accumulative installed capacity has ranked first in the world for eight consecutive years, and photovoltaic power generation has ranked first in the world for three consecutive years. It has fostered a number of world-leading wind power and photovoltaic manufacturing enterprises, and formed a complete and internationally competitive wind power and photovoltaic industrial chain. The renewable energy represented by wind power and photovoltaic power generation gradually shows an exciting trend of developing from alternative power to mainstream power. By the end of 2018, China's installed wind power capacity is 1.84×108kW, and photovoltaic power capacity is 1.74×108kW, accounting for 19% of the country's installed power generation capacity (Figure 2).

Co-funded by the Erasmus+ Programme of the European Union

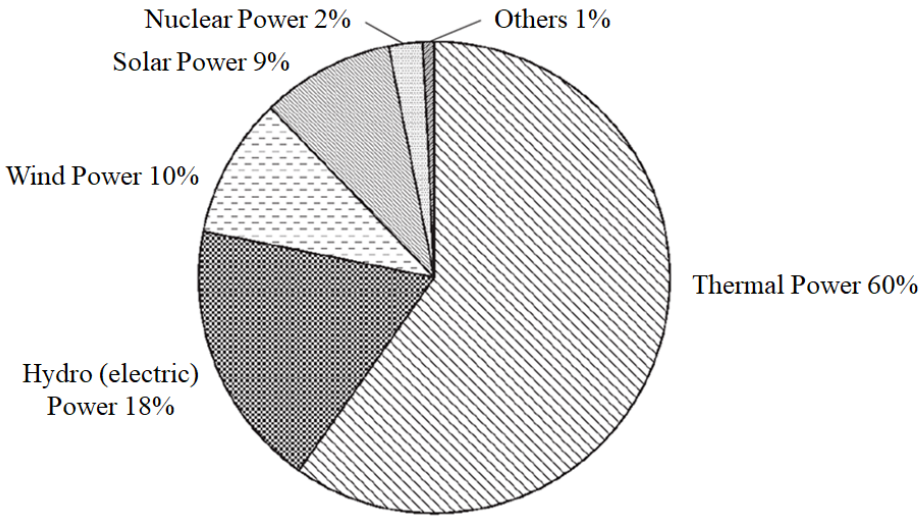


Figure 2 In 2018 the proportion of all types of installed power generation capacity in China [3]

3 Feed-in tariffs for renewable energy

3.1 Feed-in Tariff

Feed-in Tariff refers to the metering price at the point where the power generation enterprise is connected to the main grid when the power grid purchases the power and electricity generated by the power generation enterprise. The on-grid electricity price is an important aspect of coordinating the power grid, the self-owned power plant and the relationship with the state, which must be determined according to the principle of fairness and rationality.。

3.2 The formation method of feed-in tariff

There are three ways to form feed-in tariff: individual cost pricing, standard cost pricing and competition forming [4].

(1) Individual cost pricing: In essence, it is a "cost plus" model, that is, based on the cost, expense and tax of each power plant, the price of electricity is set with a certain return. China has long used this approach to set feed-in tariffs.

(2) Standard cost pricing method: the power production enterprises are divided into several types according to a certain method, and various standard costs are formulated by referring to the average cost of each type, and on this basis, the on-grid electricity price of each type of power production enterprises is determined.

(3) Competition forming method: also known as market pricing method, refers to the buyers and sellers in the market through fair trade to form a price. It can be divided into price competition and price competition. Competition at the same price can mean that the buyer gives an acceptable price and multiple sellers compete at the same price. It can also be that the seller offers an acceptable price and multiple buyers compete at the same price. Price competition is to use the price advantage to compete, multiple seller quote us the price of period of time and can provide the quantity, the buyer in accordance with the requirements according to the price high and low, in order to meet the balance between supply and demand during final offer (marginal price), as the time of sale price, clinch a deal is not greater than the price of all press clinch a deal the price settlement, is more than clinch a deal the price, in this period of time missed out by bidding is realized in dynamic network homogeneity with same price; In addition, the trading time can be divided into spot price and futures price.

3.3 Development of wind power subsidies and feed-in tariff

As early as 2003, China's wind power projects started, when the wind power electricity price was implemented in the "dual-track system", and the price setting mode of bidding and approval

electricity price was maintained for three years. The Renewable Energy Act of March 2005 sets out the principles governing electricity tariffs for renewable energy. In 2006, the National Development and Reform Commission, together with the Electricity Regulatory Commission, formulated the Interim Measures for the Management of Renewable Energy Power generation Prices and Cost sharing, and proposed that "the on-grid price of wind power generation projects shall be guided by the government, and the price standards shall be determined by the power price authority under the State Council according to the price formed by bidding". According to this law according to the provincial wind power project bidding price as a reference, determined the approved on-grid price within the province, each province is different.

In July 2009, the National Development and Reform Commission issued the Notice on Perfecting the on-grid Tariff Policy for wind power generation, which improved the on-grid tariff policy for wind power generation. The article stipulates that the country is divided into four types of wind energy resource zones according to the wind energy resource status and engineering construction conditions, and corresponding wind power benchmark on-grid price is set. The country is divided into four types of wind energy resource zones, with benchmark electricity prices of 0.51 yuan, 0.54 yuan, 0.58 yuan and 0.61 yuan per KW • h respectively. In June 2014, the National Development and Reform Commission issued the Notice on The Unit Price Policy for Offshore Wind Power, which stipulated that the feed-in tariff for offshore wind power projects before 2017 should be 0.85 yuan per kilowatt hour (including tax, the same below). The feed-in tariff for inter-tidal wind power projects should be 0.75 yuan per kW·h.

The method of determining and approving the electricity price by region has been continued up to now, but the price has experienced many changes and the subsidy has been reduced year by year. At the end of 2014, the National Development and Reform Commission issued the Notice on The Appropriate Adjustment of Benchmark Feed-in tariff for onshore wind power. The policy "reduces the benchmark feed-in tariff for wind power in the category I, II and III resource areas by 2 cents per kilowatt hour. The adjusted benchmark feed-in tariff is 0.49 yuan, 0.52 yuan and 0.56 yuan per kilowatt hour respectively. The benchmark feed-in tariff for wind power in category IV resource areas remains unchanged at the current $0.61 per kW·h. On December 22, 2015, the Notice of the National Development and Reform Commission on Improving the On-grid benchmark Electricity Price Policy for Wind power and PHOTOVOLTAIC power Generation on the Road implemented the price policy of gradually reducing the on-grid benchmark electricity price for onshore wind power along with the

development scale, and stipulated the wind power subsidy standard in 2016 and 2018. The specific electricity price and regional classification are shown in the table below.

Resource partitions	The detailed areas of each resource partition	Feed-in tariff for wind power (RMB/kwh)			
		2014	2015	2016	2017
I	The Nei Monggol Autonomous Region (except Chifeng, Tongliao, Hinggan League, Hulun Buir cities) and the Xinjiang Uygur Autonomous Region (Urumqi Municipality, Kazak Autonomous Prefecture of Ili, Hui Autonomous Prefecture of Changji, Karamay City and Shihezi city)	0.51	0.49	0.47	0.44
II	Zhangjiakou and Chengde cities in Hebei Province, Chifeng, Tongliao, Hinggan League, Hulun Buir cities in the Nei Monggol Autonomous Region and Zhangye City, Jiayuguan City, Jiuquan City in Gansu Province	0.54	0.52	0.50	0.47
III	Baicheng, Songyuan City, Jilin Province, Jixi City, Shuangyashan City, Qitaihe City, Suihua, Yichun City and Daxinganling region in Heilongjiang Province, Gansu Province (except Zhangye City, Jiayuguan City, Jiuquan City), the Xinjiang Uygur Autonomous Region (except Urumqi Municipality, Kazak Autonomous Prefecture of Ili, Hui Autonomous Prefecture of Changji, Karamay City and Shihezi city) and the Ningxia Hui Autonomous Region	0.58	0.56	0.54	0.51
IV	Others areas except Ⅰ Ⅱ Ⅲ	0.61	0.61	0.60	0.58

On May 24, 2020, the latest regulation of the National Development and Reform Commission changed the onshore wind power benchmark feed-in tariff and offshore wind power benchmark feed-in tariff to guide price, and the newly approved feed-in tariff was determined through competition.

3.4 The development of photovoltaic subsidies and feed-in tariff

In 2008, the feed-in tariff of Inner Mongolia Ordos and Shanghai Chongming solar power station was approved to be 4 RMB/ kW·h. In 2009, the on-grid electricity price of Gansu solar thermal project was determined to be 1.09 RMB/ kW·h through bidding. In 2010, the on-grid electricity price of 13 solar thermal projects approved by the state was determined to be 0.72-0.99 RMB/ kW·h through bidding. In July 2011, the National Development and Reform Commission issued the Notice on Improving the Feed-in tariff Policy for Solar Photovoltaic power generation, which stipulates that the benchmark price is 1 RMB/kW·h for solar photovoltaic power generation projects approved on or after July 1, 2011 or completed and put into operation after December 31, 2011, except in Tibet. The benchmark feed-in tariff for solar photovoltaic power generation projects in Xizang is 1.15 RMB/kW·h.

In September 2013, the Notice of the National Development and Reform Commission on Bringing into play the Role of price Lever to Promote the Healthy Development of photovoltaic industry divided the country into three types of solar energy resource zones, and set the benchmark on-grid price of photovoltaic power stations accordingly. The part of the benchmark feed-in price of photovoltaic power stations higher than that of local coal-fired units (including desulfurization and other environmental protection electricity price) shall be subsidized through the renewable energy development fund. Distributed photovoltaic power generation will be piloted in accordance with the

policy of full power subsidy, the price subsidy standard is 0.42 yuan per kilowatt-hour (including tax).

Since 2016, the benchmark feed-in tariff for photovoltaic power generation has been adjusted annually. In 2016, the National Development and Reform Commission issued the Notice on Improving the Benchmark Electricity Price Policy for onshore wind and photovoltaic power generation (expired). In 2017, NDRC issued the Notice of National Development and Reform Commission on Adjustment of benchmark On-grid Tariff for photovoltaic power generation on onshore wind power (expired).

The Notice of the National Development and Reform Commission on the Price Policy of Photovoltaic Power Generation Projects in 2018 sets the subsidy standards for 2018, which are as follows:

Resource partitions	The detailed areas of each resource partition	Pv feed-in tariff (RMB/kwh)			
		Before 2015	2016	2017	2018
Ⅰ	Ningxia, Haixi of Qinghai, Jiayuguan, Wuwei, Zhangye, Jiuquan, Dunhuan, Jinchang cities in Gansu Province, Hami, Tacheng, Altay, Karamay in Xinjiang Province, the Nei Monggol Autonomous Region (except Chifeng, Tongliao, Hinggan League, Hulun Buir cities)	0.90	0.80	0.65	0.55
Ⅱ	Beijing, Tianjin, Heilongjiang, Jilin, Liaoning, Sichuan, Yunnan, Chifeng, Tongliao, Hinggan League, Hulun Buir cities in the Nei Monggol Autonomous Region, Chengde, Zhangjiakou, Tangshan, Qinhuangdao in Hebei Province, Datong, Shuozhou, Xinzhou, Yangquan in Shanxi Province, Yulin, Yan 'an in Shaanxi Province, Qinhai, Gansu, Xinjiang Province (except the areas in Ⅰ)	0.95	0.88	0.75	0.65
Ⅲ	Others areas except Ⅰ Ⅱ	1.00	0.98	0.85	0.75
Special areas	Tibet Autonomous Region	/	1.05	1.05	1.05

In 2020, the National Development and Reform Commission will continue to set guiding prices for centralized photovoltaic power generation and encourage local governments to introduce targeted supporting policies to support the development of photovoltaic industry [5]. Taking into account various factors such as market bidding and technological progress in 2019, the guiding prices of new centralized photovoltaic power stations in class I to III resource areas covered by state financial subsidies will be set at 0.35 yuan (tax included, the same below), 0.4 yuan and 0.49 yuan per kW·h, respectively. If the guided price is lower than the base price of coal-fired power generation at the project location (including the electricity price of desulfurization, denitration and dust removal), the guided price shall be implemented according to the base price of local coal-fired power generation. In principle, the on-grid price of the newly added centralized photovoltaic power station shall be determined by means of market competition and shall not exceed the guiding price of the resource area where it is located.

3.5 Biomass power subsidies and feed-in tariff development

In 2006, the National Development and Reform Commission, together with the Electricity Regulatory Commission, formulated the Interim Measures for the Management of The Price and Cost Sharing of Renewable Energy power generation. The feed-in tariff for biomass power generation projects is set by the government, and the benchmark tariff is set by the power price department of the State Council in different regions. The price standard is composed of the benchmark feed-in tariff for desulphurization coal-fired units and the subsidized price in 2005 in all provinces, autonomous regions and municipalities directly under the Central Government. The subsidized price is 0.25 RMB/kW·h. The power generation project shall enjoy the subsidized electricity price within 15 years from the date of putting into operation; After 15 years of operation, the subsidized electricity price will be abolished. In July 2010, the National Development and Reform Commission issued a Notice on Improving the Price Policy of Agroforestry Biomass Power Generation, which uniformly implemented the benchmark on-grid price of 0.75 yuan per kilowatt hour (including tax).

Co-funded by the Erasmus+ Programme of the European Union

4 History and current status of China's renewable energy feed-in tariff

China's on-grid electricity price still adopts the government pricing method. Basically, all on-grid electricity prices use a single electricity price method, but different electricity generation methods have different on-grid electricity price levels, of which hydropower is the lowest, followed by coal power, nuclear power, gas power, and biomass power generation. , Wind power and solar photovoltaic power prices are relatively high [6].

4.1 Trial Measures for Renewable Energy Power Generation Prices and Expenses Sharing Management

In order to promote the development of renewable energy power generation industry, it is based on the "Renewable Energy Law of the People's Republic of China" and "Price Law".

Renewable energy power generation price and cost sharing standards are formulated on the principles of promoting development, improving efficiency, regulating management, and fair burden.

Renewable energy power generation prices are implemented in two forms: government pricing and government guidance. The government-guided price is the winning price determined through bidding. Renewable energy power generation price is higher than the local desulfurized coal-fired power unit benchmark on-grid electricity price difference, which is shared among the electricity sales of provincial and higher power grids across the country.

4.2 "Regulations on the Supervision and Purchase of Renewable Energy Electricity by Power Grid Enterprises"

In order to promote the grid-connected generation of renewable energy, regulate the behavior of grid companies to fully purchase electricity from renewable energy sources, according to the “Renewable Energy Law of the People’s Republic of China”, the “Regulations on Electricity Regulations” and relevant national regulations, the “Complete Purchase of Power Grid Enterprises Measures for Supervision of Renewable Energy

The term “renewable energy power generation” as mentioned in these Measures refers to hydroelectric power generation, wind power generation, biomass power generation, solar power generation, ocean power generation and geothermal power generation.

The biomass power generation mentioned in the preceding paragraph includes power generation by direct combustion of agricultural and forestry wastes, power generation by gasification of agricultural and forestry wastes, power generation by garbage incineration, power generation by landfill gas, and power generation by biogas.

Co-funded by the Erasmus+ Programme of the European Union

The State Electricity Regulatory Commission and its dispatched agencies (hereinafter referred to as electric power regulatory agencies) supervise the situation in which grid companies fully purchase the grid-connected power of renewable energy grid-connected power generation projects within the coverage of their grids in accordance with these Measures.

Electric power enterprises should engage in the construction, production and trading of renewable energy power in accordance with the relevant provisions of laws, administrative regulations and rules, and accept the supervision of power regulatory agencies in accordance with the law.

Grid enterprises shall fully purchase the on-grid electricity of renewable energy grid-connected power generation projects within their power grid coverage, and renewable energy power generation enterprises shall assist and cooperate.

4.3 Hydropower price

The hydroelectricity on-grid electricity price policy presents a diversified pattern. The hydroelectricity on-grid electricity price is determined by the three methods according to the situation: the on-grid electricity price during the operation period, the benchmark on-grid electricity price, and the reverse inversion based on the average on-grid electricity price in the power receiving market.

In April 2001, the former State Planning Commission issued the "Notice on Relevant Issues Concerning the Regulation of Electricity Price Management" (Calculation Price [2001] No. 701), which stipulates that the on-grid electricity price shall be subject to the payment of the loan repayment period according to the power generation project. The interest rate is changed to the average on-grid price based on the operating period of the power generation project. If the existing power generation enterprises have verified the on-grid electricity price according to the loan repayment period, they will also change to the average on-grid electricity price according to the remaining operating period.

In 2004, the National Development and Reform Commission's "Notice on Issues Relating to Contradictions in Electricity Prices in North China, South China, Central China, East China, Northeast China, and Northwest China" (NDRC price [2004] Nos. 1036, 1037, 1038, 1039, 1124, and 1125) for hydropower In more abundant areas, benchmark electricity prices for hydropower have been approved.

Due to the large differences in development costs of different hydropower stations, different adjustment capabilities, and differences in hydropower tax rates, it is difficult for a unified hydropower benchmark electricity price policy to meet hydropower pricing requirements. Therefore,

the national hydropower benchmarking policy has gradually canceled the hydropower benchmark electricity prices in various regions (November 2009 20th price adjustment to cancel Qinghai etc.).

At present, only the Three Gorges Hydropower Station is a power station that determines the on-grid electricity price based on the market situation in the power receiving area. The Three Gorges Electricity Pricing Mechanism (NDRC price [2001] No. 2668) approved by the State Council was: Before the implementation of "bidding on-grid", the Three Gorges on-grid electricity prices were the average on-grid electricity prices of various provinces and cities minus the nationally approved transmission electricity price The city's average electricity price level fluctuates with changes; after the implementation of "competitive on-grid", the Three Gorges Power participates in the competition in the local electricity market according to the direction and quantity allocated by the state, and the market supply and demand relationship forms the electricity price.

On January 11, 2014, the "Notice of the National Development and Reform Commission on Improving the Formation Mechanism of Hydropower On-grid Electricity Prices" (NDRC Price [2014] No. 61), the benchmark hydroelectricity on-grid electricity prices of various provinces (autonomous regions and municipalities) were averaged by the provincial provincial grid enterprises Based on the purchase price of electricity, the overall consideration is given to the changes in the supply and demand of the electricity market and the cost of hydropower development. Provinces (autonomous regions and municipalities) with a large proportion of hydropower can, based on hydroelectricity benchmark on-grid electricity prices, implement high and low time-of-use electricity prices or classified benchmark electricity prices based on the role of hydropower stations in the power system.

On July 31, 2014, the "Notice of the National Development and Reform Commission on Issues Concerning the Improvement of the Price Formation Mechanism of Pumped Storage Power Stations" (NDRC Price [2014] No. 1763), further improved the price formation mechanism of pumped storage power stations. Before the formation of the electricity market, pumped storage power stations implemented a two-part tariff. The price of electricity is determined on the principle of reasonable cost plus permitted income.

4.4 Wind power price

In 2003, the Notice of the General Office of the National Development and Reform Commission on the preparatory work for the construction of large-scale wind farms nationwide (NDRC Energy [2003] No. 408).

Co-funded by the Erasmus+ Programme of the European Union

In 2003, the National Development and Reform Commission issued a notice on the preliminary work management measures of wind power concession projects and related technical regulations (NDRC Energy [2003] No. 1403).

From 2003 to 2005, it was the "dual-track" phase of wind power tariffs. Bidding and approval of tariffs coexisted. The boundary between this phase and the previous phase was the first phase of concession bidding. In 2003, the National Development and Reform Commission organized the first phase of the national wind power concession project bidding, introduced the competition mechanism into wind farm development, and determined the wind power on-grid price in a market-oriented manner. However, projects within the scope of provincial (regional) project approval still adopt the method of approving electricity prices, and there is a situation in which both bidding electricity prices and approval electricity prices coexist.

In March 2005, the "Renewable Energy Law" was promulgated to regulate the principles of electricity price management for renewable energy.

In 2006, the National Development and Reform Commission and the State Electricity Regulatory Commission formulated the “Interim Measures for the Administration of Renewable Energy Power Generation Prices and Expenses Sharing” [2006] No. 7 and proposed that “on-grid tariffs for wind power generation projects shall be subject to government guidance. The competent authority shall determine the electricity price according to the bidding." According to the document, some provinces (autonomous regions and municipalities), such as Inner Mongolia, Jilin, Gansu, Fujian, etc., organized bidding for several provincial wind power concession projects, and used the winning bid price as a reference to determine the approval of other wind farm projects in the province. Electricity price.

The installed capacity of the wind farm is below 50MW, and the on-grid electricity price is determined in the form approved by the province. The approved electricity price varies greatly from place to place, but generally the local desulfurized coal-fired power plant's on-grid electricity price plus a grid subsidy of not more than 0.25 yuan/kWh is adopted.

In July 2009, the National Development and Reform Commission issued the "Notice on Improving the Wind Power Generation Tariff Policy" (NDRC Electricity Price [2009] No. 1906), which improved the wind power generation tariff policy. The document stipulates that the country is divided into four types of wind energy resource areas according to the status of wind energy resources and project construction conditions, and wind power benchmarking grid-connected electricity prices

are set accordingly. The country is divided into four types of wind energy resource areas, and the benchmark electricity price level of wind power is 0.51 yuan, 0.54 yuan, 0.58 yuan, and 0.61 yuan per kW·h.

In June 2014, the National Development and Reform Commission issued the "Notice on Offshore Wind Power On-grid Tariff Policy" (NDRC Price [2014] No. 1216), which stipulated that the on-grid tariff of offshore wind power projects put into operation before 2017 (excluding 2017) is per kilowatt At 0.85 yuan (including tax, the same below), the on-grid tariff for intertidal wind power projects is 0.75 yuan per kW·h.

The method of approving electricity prices by region has continued to this day, but prices have undergone many changes, and subsidies have decreased year by year. At the end of 2014, the National Development and Reform Commission issued the "Notice on Appropriate Adjustment of Onshore Wind Power Benchmark Electricity Tariffs." The policy "reduces the wind power benchmark electricity tariffs of Category I, II, and III resource areas by 2 cents per kWh. The benchmarked on-grid electricity prices in the future are 0.49 yuan, 0.52 yuan, and 0.56 yuan per kWh, respectively; the benchmark on-grid electricity prices for wind power in the Category IV resource areas remain unchanged at 0.61 RMB per kW·h."

On December 22, 2015, the "Notice of the National Development and Reform Commission on Improving the Benchmark Electricity Price Policy for Onshore Wind Power Photovoltaic Power Generation" (NDRC Price [2015] No. 3044), the implementation of onshore wind power and photovoltaic power generation (photovoltaic power stations, the same below)) A price policy in which the benchmark electricity price on the grid gradually decreases with the scale of development.

Related to electricity prices is the additional standard for renewable energy electricity prices. In June 2006, 1%/kW·h was levied, and the scope of levy was electricity other than agricultural production. It was increased to 2%/kW·h in July 2008, 4% in November 2009, and 8% in December 2011. Cent/kW·h, increased to 1.5 cents in September 2013 (except Tibet and Xinjiang), and increased to 1.9 cents in January 2016.

In order to implement the requirements of the Energy Development Strategy Action Plan (2014-2020) of the General Office of the State Council on wind power to achieve grid-level grid-connected electricity in 2020, scientific and reasonable guidance for new energy investment, efficient use of resources, promote fair competition and the survival of the fittest, promote The healthy and

sustainable development of the wind power industry, the relevant issues of improving the wind power on-grid tariff policy are now notified as follows.

At this stage, my country's wind power industry has changed its traditional rapid development model, which is mainly based on scale expansion, and is developing in a refined direction of improving quality and efficiency. Combined with the national "Energy Development Strategic Action Plan (2014~2020)" on wind power to achieve the goal of parity grid, from 2019 to 2020, in terms of price mechanism, it is urgent to accelerate the pace of wind power subsidies to decline, combined with the industry's overall competitive allocation requirements To change the traditional fixed on-grid electricity price mechanism, determine the on-grid electricity price through competition, promote the continuous technological progress and cost reduction of the industry, and realize the healthy and sustainable development of the wind power industry.

On May 21, 2019, the "Notice of the National Development and Reform Commission on Improving the Policy of On-grid Electricity Prices for Wind Power" (NDRC Price [2019] No. 882) changed the benchmark on-grid electricity prices for onshore wind power and offshore wind power to guide prices, newly approved The on-grid tariffs for centralized onshore wind power projects and offshore wind power are all determined by competition and shall not be higher than the guide price of the resource area where the project is located; the on-grid tariffs determined by competitive means for offshore wind power in the intertidal zone shall not be higher than onshore in the resource area where the project is located Guide price for wind power.

4.5 Photovoltaic price

In 2008, the on-grid price of solar photovoltaic power stations in Ordos, Inner Mongolia and Chongming, Shanghai was approved at RMB 4 per kWh. In 2009, the bidding price for Gansu solar thermal projects was 1.09 RMB/kWh. In 2010, the country approved 13 solar thermal projects successively, with bidding prices ranging from 0.72-0.99 RMB/kWh.

In July 2011, the National Development and Reform Commission issued the "Notice on Improving the On-grid Tariff Policy for Solar Photovoltaic Power Generation" (NDRC Price [2011] No. 1594), which stipulates that, except for the Tibet region, approval or approval on or after July 1, 2011 After December 31, 2011, the solar photovoltaic power generation project was completed and put into operation, and the benchmark on-grid electricity price was 1 RMB/kWh. The benchmark on-grid electricity price for solar photovoltaic power generation projects in Tibet is uniformly 1.15 RMB/kWh.

Co-funded by the Erasmus+ Programme of the European Union

July 2013, "Several Opinions of the State Council on Promoting the Healthy Development of the Photovoltaic Industry" (NDRC [2013] No. 24)

In September 2013, the Announcement of the National Development and Reform Commission on the Use of Price Leverage to Promote the Healthy Development of the Photovoltaic Industry (NDRC Price [2013] No. 1638) divided the country into three types of solar energy resource areas, and accordingly set a benchmark for photovoltaic power plants to go online Electricity price. Part of the photovoltaic power station benchmark on-grid electricity price higher than the local coal-fired unit benchmark on-grid electricity price (including environmental protection electricity price such as desulfurization) is subsidized through the Renewable Energy Development Fund. For distributed photovoltaic power generation, the policy of subsidizing all electricity is implemented, and the subsidy standard for electricity price is 0.42 RMB per kWh (including tax).

Since 2016, the benchmark on-grid electricity price of photovoltaic power generation will be adjusted once a year. In 2016, the National Development and Reform Commission issued the "Notice of the National Development and Reform Commission on Improving the Onshore Wind Power PV On-grid Benchmark Electricity Price Policy" (Expired) In 2017, the National Development and Reform Commission issued the "National Development and Reform Commission's Notice on Adjusting the Onshore Wind Power PV Onshore Benchmark Electricity Price" (Expired))

In 2018, the National Development and Reform Commission's "Announcement on the Price Policy of Photovoltaic Power Generation Projects in 2018" issued by the National Development and Reform Commission stipulates the latest subsidy standards for 2018: "Spontaneous use, excess For the distributed photovoltaic power generation project of the "online" mode, the subsidy standard for full electricity consumption is reduced by 0.05 yuan, that is, the subsidy standard is adjusted to 0.37 RMB per kWh (including tax)."

On April 28, 2019, the Notice of the National Development and Reform Commission on Relevant Issues Concerning the Improvement of the On-grid Pricing Mechanism for Photovoltaic Power Generation (NDRC Price (2019) No. 761), the benchmark on-grid power price of centralized photovoltaic power plants was changed to the guide price, newly added The grid-connected electricity price of the centralized photovoltaic power station shall be determined in principle through market competition, and shall not exceed the guidance price of the resource area where it is located. The competent energy departments shall implement industrial and commercial distributed projects in a unified manner in market competition. The price formed by market competition shall not exceed the

guidance price of the resource area where they are located, and the subsidy standard shall not exceed 0.10 RMB per kWh.

According to the "Notice on the Pricing Policy for Solar Thermal Power Generation Benchmarks", relevant local government departments are encouraged to adopt measures such as tax reductions, financial subsidies, green credits, and land concessions for solar thermal power generation enterprises, and take multiple measures to support the development of the solar thermal power generation industry.

"Notice on Relevant Matters of the Photovoltaic Power Generation Tariff Policy in 2020" (NDRC Price [2020] No. 511) 1. Continue to formulate guidelines for centralized photovoltaic power generation. Taking into account various factors such as market-oriented bidding in 2019, technological progress and other factors, the guiding prices of newly added centralized photovoltaic power stations in the I to III resource areas included in the national financial subsidies are determined to be 0.35 RMB per kWh (including tax, The same below), 0.4 yuan, 0.49 yuan. The grid-connected electricity price of the newly added centralized photovoltaic power station shall be determined in principle through market competition, and shall not exceed the guidance price of the resource area where it is located. Reduce subsidy standards for industrial and commercial distributed photovoltaic power generation. Reduce the subsidy standard for household distributed photovoltaic power generation. The grid-connected electricity price of village-level photovoltaic poverty alleviation power stations (including Liancun power station) that meets the relevant management regulations of national photovoltaic poverty alleviation projects remains unchanged. Encourage local governments to issue targeted support policies to support the development of the photovoltaic industry.

4.6 Biomass electricity price

In 2006, the National Development and Reform Commission and the State Electricity Regulatory Commission formulated "Interim Measures for the Administration of Renewable Energy Power Generation Prices and Expenses Sharing" [2006] No. 7 document.

The on-grid electricity price for biomass power generation projects is subject to government pricing. The electricity pricing department of the State Council sets the benchmark electricity price by region, and the electricity price standard consists of the benchmark on-grid electricity price of the desulfurized coal-fired units of the provinces, autonomous regions, and municipalities plus the subsidized electricity price in 2005. The subsidy electricity price standard is 0.25 RMB/kWh. Power

Co-funded by the Erasmus+ Programme of the European Union

generation projects enjoy subsidized electricity prices within 15 years from the day of commissioning; after 15 years of operation, subsidized electricity prices are cancelled.

The biomass power generation project of the investor determined through bidding shall be executed at the price determined by the winning bid, but it shall not exceed the biomass benchmark electricity price. Since 2007, a temporary electricity price subsidy of 0.1 RMB per kWh has been granted to the straw direct combustion project.

In order to encourage technological progress, the trial approach also made it clear that "from 2010, the subsidy electricity price of newly approved and approved power generation projects every year will be reduced by 2% from the subsidy electricity price of newly approved and approved construction projects in the previous year."

In July 2010, the Notice of the National Development and Reform Commission on Improving the Agricultural and Forestry Biomass Power Generation Price Policy (NDRC Price [2010] No. 1579), uniformly implemented the benchmark on-grid electricity price of 0.75 RMB per kWh (including tax).

In November 2011, the "Interim Measures for the Administration of the Collection and Use of Renewable Energy Development Funds" raised the charging standard to 4%/kWh again. In March 2012, the Interim Measures for the Administration of Supplementary Subsidy Funds for Renewable Energy Electricity Prices raised the standard to 8%/kWh. In December 2012, "Renewable Energy Tariff Additional Accounting Treatment Regulations" raised the standard to 1.5 cents/kWh. In January 2016, the renewable electricity price surcharge was increased to 1.9 cents/kWh, which is still used today.

The benchmark electricity prices of various renewable energy sources have been declining year by year, and the additional standards for electricity prices have been increasing year by year. The loopholes in subsidies are still increasing. On the one hand, it shows the rapid development of renewable energy in China, but on the other hand, it also shows that renewable energy The policy support for power generation needs to be improved, and the technology needs to be improved, so that the cost of renewable energy can be reduced. This is the real way to long-term development. At the opening ceremony of the 2017 Beijing International Wind Energy Conference, Liang Zhipeng, deputy director of the New Energy and Renewable Energy Department of the National Energy Administration, said that after decades of development of wind power, it is necessary to get rid of subsidy dependence among new energy sources. The basic idea is to gradually withdraw by type,

area, and region, and basically realize the development of wind power independent of subsidies from 2020 to 2022.

4.7 Waste-to-energy electricity price

In April 2012, the National Development and Reform Commission's "Notice on Improving the Pricing Policy for Waste Incineration and Power Generation" (NDRC Price [2012] No. 801), based on the amount of waste entering the factory, converted into on-grid electricity for settlement. The electricity is tentatively set at 280 kWh, and the national unified garbage power generation benchmark electricity price is 0.65 RMB per kWh (including tax); the remaining on-grid electricity is implemented at the same local electricity price for coal-fired generating units.

4.8 Nuclear power unit

The proportion of installed nuclear power capacity in my country is relatively small. Like general thermal power units, the cost of nuclear power mainly consists of construction costs, operation and maintenance costs, and fuel costs. The cost of nuclear power also has the characteristics of long-term cost reduction, significant regional differences, etc.

Because nuclear power technology is not suitable to participate in market competition, before 2013, my country basically implemented one plant and one price for nuclear power.

On June 15, 2013, the National Development and Reform Commission issued the "Notice on Relevant Issues Concerning the Improvement of the On-grid Pricing Mechanism for Nuclear Power" (NDRC Price [2013] No. 1130), and implemented a benchmark on-grid electricity price for new nuclear power units built after January 1, 2013 Policy (According to the current average social cost of nuclear power and the supply and demand of the electricity market, the national benchmark on-grid price of nuclear power is 0.43 RMB per kWh); the national benchmark on-grid price of nuclear power is higher than the benchmark on-grid price of coal-fired units where nuclear power units are located (including desulfurization and denitration markups) , The same below), after the new nuclear power unit is put into production, the local coal-fired power unit benchmark online price will be implemented; the first or first nuclear power unit or demonstration project that undertakes the tasks of nuclear power technology introduction, independent innovation, and localization of major special equipment will be online The electricity price can be increased appropriately [7].

4.9 On-grid electricity price policy and renewable energy development

Electricity price policy has greatly promoted the development of renewable energy in China

1) Drive the large-scale development of the market at a lower economic cost.

2) Promote the growth of renewable energy power generation manufacturing industry with the scale of the market.

3) my country has become a big country in wind power and photovoltaic manufacturing, and a big country in wind power market.

4) In the future, it will drive the transformation to a renewable energy technology and manufacturing power.

Renewable energy power generation has strengthened its position in the national energy strategy and has become an important force in achieving the target of non-fossil energy share and the reduction of carbon dioxide intensity by 2020.

1) By 2020, 15% of non-fossil energy sources will be targeted, with wind power, solar power, and biomass power generation accounting for 3-4%.

2) Be economically competitive after 2020 and will become a new energy source.

Co-funded by the Erasmus+ Programme of the European Union

5 Strength and Weaknesses of Chinese feed-in tariffs

5.1 Weaknesses

5.1.1 Problems with feed-in tariffs for different types of renewable energy

(1) Feed-in tariffs for wind power

Because the feed-in tariff is bidding and approved in accordance with every single project, there is no definite signal for investor to exploit wind resource, which results in the investments for wind power from foreign and private companies will be inevitably affected. With the trial implementation of the policy, the investors of wind power projects are mainly large state-owned power generation and energy companies, regardless of tendering by the central government organizations or approving by the local authorities, which are likely to cause industry monopoly and not conducive to the formation of wind power competitive market [8].

Besides, the pricing way of the wind power feed-in tariff is not fair. For example, wind farms at the junction of two different tariff levels owned similar wind resources may be significant differences in the feed-in tariff. This unfair phenomenon led to two negative results that the tariff signal is not clear and cannot play the role of guiding wind power investment.

(2) Feed-in tariffs for solar photovoltaic power

China's long-term fixed PV (PV) feed-in tariff policy cannot adapt to the cost reduction of PV equipment, and the excessively broad regional pricing will inhibit the development of distributed PV power generation (DPVG) to some extent.

For solar photovoltaic power generation, the problems of non-tender projects with unified feed-in tariff policy include: unified feed-in tariff is contrary to the distribution of resource in China. China's solar resource is divided into four regions based on the richness of the solar resource, using a unified benchmark price will against to the development of solar power. Solar power investors, with a unified benchmark price, will increase the installed capacity of solar photovoltaic power in western regions where sunshine resources are abundant. However, the grid support technology in western region is poor, and the grid connection problem is also not resolved, which may result in the waste of investment and will reversely have impact on a balanced development of the Chinese solar photovoltaic power industry.

Second, with the limitations of solar resources, the investment recovery period of solar power generation projects in eastern China is longer compared with western China, which hinders the

Co-funded by the Erasmus+ Programme of the European Union

development of photovoltaic power generation in that region. As a result, the development of relevant industries in the east and west will face imbalance predicament.

(3) Feed-in tariffs for biomass power generation

For biomass power, first, biomass power industry is still in its infancy in China, with the lower level of technology and higher costs, biomass power feed-in tariff is relatively high, which makes the biomass power generation companies unable to compete with conventional energy companies in the electricity market [9]. Under the circumstances, the development of biomass energy industry will suffer adverse effects from the high feed-in tariff.

Second, there could be adverse consequences for using various biomass resources effectively with a unified feed-in tariff. Based on the current renewable energy tariff management approach, the price of biomass power generation uses the same standard in the same area, but this is obviously contrary to the status quo of China's economic development and resources distribution. Currently, the economic development level in eastern China is much faster than that in western region. The imbalance of economic development among different provinces causes that the difference among technical level, financial strength and the labour costs is huge, which results in the biomass power generation cost of the various provinces is also different. As is known to all, formulating a unified tariff for the different costs of power generation is contrary to the principles of economics.

Third, the pricing policy of co-firing biomass power generation projects is not clearly enough. The co-firing power price policy has not been introduced, because monitoring is difficult, and the necessary technical means for monitoring are also scarce, which will not be conducive to the diversity development of biomass energy [8].

5.1.2 Big surcharge subsidy gap for renewable energy price

China's renewable energy has developed rapidly and its total installed capacity has become the world's NO.1. However, the top design of renewable energy price policy still has great problems.

(1) In the process of promoting marketization, subsidy mechanism and market price mechanism are in great contradiction.

Article 20 of the Renewable Energy Law stipulates that if the cost incurred by a power grid enterprise in purchasing renewable energy electricity according to the feed-in tariff set forth in Article 19 of this Law is higher than the cost incurred in calculating the average feed-in tariff for generating

electricity according to conventional energy sources, the difference shall be added to the sales price for apportionment.

The figure one shows the additional subsidies for renewable energy prices in different years. Starting January 1, 2016, the renewable energy surcharge on electricity used for purposes other than household and agricultural production will rise from 0.015 RMB per kilowatt-hour to 0.019 RMB.

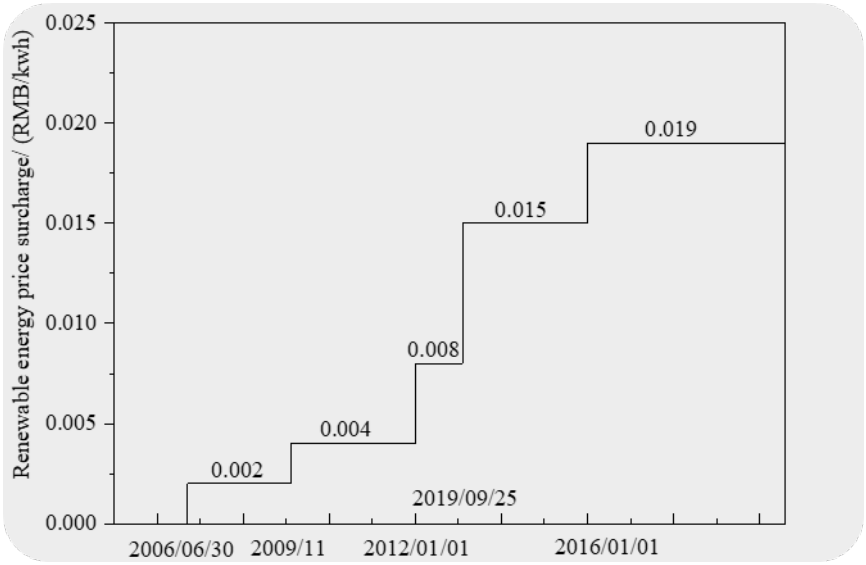


Fig. 1 The renewable energy price surcharge/ (RMB/kW·h) [10]

According to the current subsidy mechanism, for renewable power enterprises that participate in market transactions, the market settlement price is adopted, so it is difficult to obtain subsidies, which will affect the enthusiasm of renewable energy to participate in the market and affect renewable energy consumption [11].

(2) The subsidy gap of renewable energy price is large, and there are still many inconsistencies between the mechanism of green license and the current subsidy mechanism.

The surcharge on renewable energy prices is currently the only source of funding to subsidize renewable energy generation from the grid. However, the rise in tariff subsidies standard is limited. The growth rate of renewable energy production will be much higher than that of taxable electricity of tariff surcharge, which means that the subsidy gap will be widening. By the end of 2016, this subsidy fund gap has reached about 70 billion RMB [12].

Currently, the subsidy gap in the catalogue exceeds 200 billion RMB. Considering that the scale of increase is determined by both revenue and expenditure and the subsidy is reduced, no additional

Co-funded by the Erasmus+ Programme of the European Union

subsidy gap will be added to the incremental projects. The annual gap of stock projects is about 40 billion RMB, and it is estimated that the gap will peak at about 800 billion RMB around 2033 [11].

There is still much to be done to replace the existing subsidies through green certificate transactions. In addition, the construction of auxiliary service market mechanism lags behind, which affects the development and utilization of renewable energy.

5.2 Strength

5.2.1 Push the rapid development of the renewable energy power

In the background of rapid economic growth, the feed-in tariff policy has promoted a substantial increase in the installed capacity of renewable energy. Benefit by the feed-in tariff, China has also achieved impressive progress, achieving the largest installed capacity of renewable energy in the Asia-Pacific region. In 2013, the installed capacity of solar energy increased by 10,950 MW, and in 2015, the installed capacity of solar PV reached 15,000 MW.

Renewable energy grid connection is an important means to promote economic growth and transformation. In recent years, every country in the world is seeking a new path for economic development. The implementation of renewable energy grid-connected work can effectively enhance the competitiveness of industries and promote economic development [13].

The on-grid electricity price policy that compensates renewable energy power producers through long-term fixed electricity prices or market electricity prices plus additional subsidies is another commonly used renewable energy incentive measure. This mechanism can not only promote the growth of renewable energy installed capacity, and help investors avoid the various uncertainties they may face. In the European market, the feed-in tariff policy was once the main means to stimulate the development of renewable energy [14].

5.2.2 Regionally differentiated feed-in tariffs

In 2009, the feed-in tariff (FIT) scheme for wind power replaced the concessional tendering system to promote renewable energy generation. Electricity prices vary regionally to mitigate the uneven spatial distribution of renewable energy projects. Similarly, a regional solar grid policy was announced in 2013.

Regional differences in electricity prices have mitigated the uneven distribution of China's wind and solar industries [15].

According to the estimation results, the adoption of regional differentiation of tariffs effectively enhanced location diversification of renewable projects, at least for a limited distance around the FIT boundary. In the case of wind power industry, we find that a higher tariff rate leads to an increase in the utilization rate of wind turbines in counties located in resource-poor regions by approximately 8.26%, as compared with the mean wind facility utilization rate of 5.69% throughout the northern counties. In addition, when considering the FIT's effect on the installation of wind power plants, we find that the annual wind capacity additions caused by FIT adoption are about 77.8 MW. Besides, the results indicate that enlarged tariff gap will result in greater positive impact of the regionally differentiated FIT on wind capacity installations in the resource-poor region. The effect of regionally differentiated FIT is also found in the case of solar energy. The annual increase in cumulative installed capacity of solar power plants through adoption of the FIT is estimated at about 99.6 MW in 2016, the year when the significant cut in solar tariff was proposed. Before that, the FIT for on-grid solar power did not have a significant effect on promoting the location diversification of the solar power industry [15].

Co-funded by the Erasmus+ Programme of the European Union

6 Propose a scenario for future implementation of financial support to RES

6.1 Impact of epidemic situation on renewable electricity feed-in tariff

At the beginning of 2020, the sudden new crown epidemic has hit all walks of life, and China's wind power and photovoltaic industries are no exception. However, when the affairs of the whole society, including the "two sessions" and the college entrance examination, were postponed or slowed down due to the epidemic, the central government decided to maintain a timetable for the cessation of renewable energy subsidies. This makes the industry, especially the wind power industry, feel more pressure. For them, not only to restore production capacity and supply chain, but also to complete the installation and grid connection before the state subsidy is cancelled. For China, the price of wind power and photovoltaics leaving the state subsidies for "independent survival" gradually compares with the traditional coal-fired benchmark electricity price, and it is a shift that can no longer be delayed. Behind this change, there are both the unsustainable reality of the subsidized electricity price policy for many years, and the strategic considerations of optimizing the industry with competition.

The severe new crown epidemic made it difficult to complete the grid connection before the subsidy window closed. Qin Haiyan, Secretary General of the Wind Energy Professional Committee of the China Renewable Energy Society, wrote on the WeChat public account of the agency on March 30 that many project development companies made plans in accordance with the above policy window period, but the delay in the construction period caused by the epidemic will be thorough Disrupting the original plan, most of the planned and ongoing projects are difficult to complete within the specified grid connection time, which means that they cannot enjoy the subsidy electricity price when the project is approved. However, the feasibility study plans and investment decisions of these projects are made on the basis of subsidized conditions. The original electricity price cannot be obtained, and the investment income is not guaranteed. These projects are bound to be shelved or cancelled.

6.2 Supporting energy storage facilities

Policies supporting renewable energy storage will be intensively introduced in 2020. The wind power project construction plan issued by the Liaoning Provincial Development and Reform Commission this year pointed out that priority will be given to projects with energy storage facilities that are conducive to peak shaving. Henan Province has proposed that in parity wind power projects, priority will be given to new parity projects with energy storage allocation. The Energy Bureau of the Inner Mongolia Autonomous Region stated that it will give priority to supporting the construction of

photovoltaic + energy storage projects, and that the energy storage capacity of photovoltaic power plants is not less than 5% and the energy storage duration is more than 1 hour.

The above policies are mainly based on positive encouragement, and State Grid Shanxi Electric Power Company can be said to be a direct enlargement. It is mandatory to connect a wind farm and a photovoltaic power plant with a voltage level of 35KV and above to carry out a frequency modulation transformation. New energy stations must be put into operation Only one frequency modulation function can be connected to the network. Retrofitting methods include retaining active power reserve and configuring energy storage equipment. Since reserve power reserve will limit the scale of power generation, it is expected that many wind power photovoltaic enterprises will choose energy storage.

The emphasis on energy storage shows the pressure of renewable energy consumption tasks. As mentioned in the “Notice of the National Energy Administration on Relevant Matters Concerning the Construction of Wind Power and Photovoltaic Power Generation Projects in 2020” announced in March, each province should rationally arrange for additional approval (recording) of the project scale based on grid capacity. The notice also requires State Grid Corporation of China, China Southern Power Grid Corporation, and Inner Mongolia Electric Power Company to play the role of grid integration gateways, and strictly arrange the sequence of project grid integration in strict accordance with planning and capacity. It may be understood in this way that the power grid's capacity to absorb will become the upper limit of the scale of wind power photovoltaic projects.

Some provinces' estimates of the province's new consumption capacity also show that there is pressure to develop a higher percentage of renewable energy. State Grid Henan Electric Power Company pointed out in the “Report on the Grid Capacity Absorption of Parity Wind Power and Photovoltaic Power Generation Projects Declared in 2020” that by 2025, the province’s wind power and photovoltaic power generation curtailment rate has exceeded the consumption ceiling and there is no room for new scale .The Hunan Provincial Development and Reform Commission recently issued a special document. In view of the fact that there is no new space for the province's power grid this year, the province has suspended the filing of ordinary ground photovoltaic power generation projects with installed capacity of more than 6MW.

There are many ways to improve the energy consumption capacity, and battery energy storage is one of them. Compared with the construction of transmission channels, improvement of electric energy substitution, and construction of traditional pumped storage power stations, battery energy

storage has a short construction period, flexible configuration, and cost has been steadily decreasing. Therefore, it has been technically recognized by the power industry and has become an enhanced renewable energy. A big choice for energy adjustability and system flexibility. In the past two years, many provincial power grids such as Jiangsu and Henan have begun to build large-scale battery energy storage power stations to enhance the peak and frequency regulation capabilities of local power grids. However, after the transmission and distribution pricing system clarifies that energy storage cannot be included in the transmission and distribution pricing costs of the grid, there is no clear profit model for grid-side energy storage, and the space for grid investment in energy storage construction has become very limited. In the end, the burden of improving energy consumption capacity through supporting energy storage still weighs on the wind power photovoltaic enterprises themselves.

For the energy storage industry, this is naturally a huge business opportunity. However, in the view of wind power photovoltaic companies, this burden can be said to be strong on themselves: unsupplied energy storage may face the problem of grid connection, which is not the case before. And this newly increased project investment, in the process of moving towards parity, it may be difficult to recover costs. Some energy storage companies are also worried. If the wind power photovoltaic companies themselves lack the willingness to invest, just to complete the grid connection requirements, it is possible that they only value the one-time investment cost of energy storage instead of focusing on long-term use, causing energy storage companies to compete for prices And ignore the quality, thus creating a viciously competitive energy storage market.

This is still the result of the lack of a price mechanism. If a set of supporting policies or business models for the coordinated development of renewable energy and energy storage cannot be explored, this "uncomfortable" will persist for a long time.

6.3 Improve the renewable energy on-grid tariff policy

For wind power, first, improving wind power price mechanism is urgently. It is recommended that the part of wind power feed-in tariff paid by the grid companies should be fixed. The main factor that affects the desulfurization benchmark electricity price is the fluctuation of coal prices. In accordance with existing regulations, grid companies firstly pay part of the local desulfurization benchmark price, the rest part should be paid by renewable energy subsidy incomes [16]. However, there are no direct and contrastive relations among wind power feed-in tariff, coal price and coal-fired power feed-in tariff. It is unreasonable for grid companies to pay wind power price based on the rising of desulfurization benchmark feed-in tariff. Therefore, it is a feasible choice that the payment

standard level of grid companies can be fixed by using a desulfurization benchmark price with particular year. Second, this article proposed that the four-wind power benchmark price regions should be reduced to two. One price is for rich wind energy resources region, which combined the current class I and II into a large class with benchmark price of about 0.60 RMB/kWh. Another price is the rest region of the country, which merged the current class III and IV into a large class with benchmark price of about 0.65 RMB/kWh. Third, the preferential wind power feed-in tariff policy should take full account of the assimilative capacity of grid. The tariff policy should always play the role of market signals, which is beneficial to ensure wind power investors make reasonable investment. As a result, the grid companies can maintain a reasonable proportion of wind power capacity in the total capacity, which can prevent the generation capacity from exceeding the actual affordability of the grid.

For solar photovoltaic power, policy-makers need to refine the attractive pricing policies and adjust the price at any time based on the changes of the cost of power generation. The demonstration projects should be put out to tender actively on the basis of establishing reasonable price standards, and the price standards should ensure investors of solar power projects are able to get a reasonable rate of return on investment, which can provide some growth space for the development of solar photovoltaic industry.

For biomass power generation, in view of the externality of electricity products and the raw material costs of biomass power generation, the prices for different types of biomass should be determined according to the principles of encouraging the production of biomass power generation when the market of biomass power generation industry formed to a certain level.

6.4 Renewable energy quota system, auction system or other supporting measures of renewable energy

There is no doubt that to achieve the popularization of renewable energy, the government's policy support for renewable energy investment and development is an indispensable key promoter. Policies and mechanisms such as capacity auctions and renewable energy quotas (RPS) that require major power providers to provide a certain percentage of renewable energy power are very common globally.

Germany, together with Denmark and Spain, was the leading country in the continental electricity price policy of continental Europe. Now, Germany is moving away from this policy. The newly revised "Renewable Energy Law" came into effect in January this year. The amendment abandons

the on-grid electricity price system that previously allowed the development of any feasible project, and instead supports the auction mode.

After this adjustment to the energy transition plan, domestic renewable energy power producers in Germany will compete for feed-in premiums during market-oriented auctions. The German government stated that through the bidding system and the establishment of subsidized renewable energy installation ceilings, the state can better control the development of renewable energy according to the scale of grid expansion, and ensure the safety of developers' planning, which helps reduce public consumption of renewable energy.

In recent years, countries in Europe and other regions have gradually moved away from the feed-in tariff policy and turned to trying more market-oriented promotion mechanisms. At the same time, the European transition to market-driven renewable energy support measures is also one of the goals of the European Commission. Given the high electricity bills of consumers, coupled with the potential imbalance between the supply of renewable energy electricity stimulated by feed-in tariffs and the actual demand of domestic and cross-border power grids, European countries need to have a stronger growth rate for renewable energy installed capacity Ability to control [13].

6.5 Inter-provincial interconnection of the regional power grid

Strengthen the inter-provincial interconnection of the power grid in the region and give full play to the mutual aid. my country has a vast territory, and both wind power and photovoltaic power generation have a good geographical dispersion effect, and the output characteristics of various provincial power grids have certain complementarities. Therefore, by strengthening the interconnection of provincial power grids in the region, it is possible to effectively relieve the more prominent peak shaving pressure in some regions.

6.6 Recommendations to promote the consumption and utilization of renewable energy

One is to improve the supporting price mechanism. Clarify the subsidy method for renewable energy to participate in market-oriented transactions, promote the establishment of supporting grid investment, the cost-sharing mechanism of pumped storage power stations, improve the demand-side response price policy, and promote the establishment of distributed user access prices. The second is to promote the establishment of a power market mechanism that is conducive to large-scale renewable energy consumption. Consider the technical and economic characteristics of renewable energy, improve the spot market mechanism, and accelerate the improvement of the renewable energy on-grid bidding mechanism; deepen the construction of the auxiliary service market, refine the auxiliary

service product system, establish a joint optimization and clearing mechanism with the spot market, and clarify the cost of auxiliary services Conduct to the end user; establish and improve the connection between the green card and carbon certificate trading mechanisms and the existing subsidies to ensure the healthy and sustainable development of renewable energy paths [16].

Co-funded by the Erasmus+ Programme of the European Union

7 References

[1] The 13th five-year plan for renewable energy development in 2016 (可再生能源发展“十三五”规划，2016).

[2] China's Renewable Energy Outlook (中国可再生能源展望，2017).

[3] S.L. Zhong, The necessity and relevant policy Suggestions of steadily promoting the affordable access to Renewable energy in China. The Chinese and foreign energy, 2019, 24(05): p.15-20. 仲苏亮.稳步推进中国可再生能源平价上网的必要性及相关政策建议[J].中外能源,2019,24(05):15-20.

[4] Feed-in tariff _ Baidu Baike (上网电价_百度百科): https://baike.baidu.com/item/%E4%B8%8A%E7%BD%91%E7%94%B5%E4%BB%B7/3739134?fr=aladdin

[5] Notice of the National Development and Reform Commission on matters related to the feed-in tariff policy for Photovoltaic power generation in 2020 (国家发展改革委关于 2020 年光伏发电上网电价政策有关事项的通知): http://www.china-nengyuan.com/news/154111.html

[6] 火、水、风、光、核电的发电成本与上网电价

Power generation costs and feed-in tariffs for fire, water, wind, light, and nuclear power: http://www.china-nengyuan.com/news/147761.html

[7] 我国现行可再生能源补贴政策及标杆上网电价

China's current renewable energy subsidy policy and benchmark feed-in tariff: http://www.china-nengyuan.com/news/120495.html

[8] Zeng, M., et al., Overall review of renewable energy tariff policy in China: Evolution, implementation, problems and countermeasures. Renewable & Sustainable Energy Reviews, 2013. 25: p. 260-271.

[9] Y.X. He, M.Z. Zhu, W. Xiong, T. Zhang, X.L. Ge, Electricity transmission tariffs for large-scale wind power consumption in western Gansu province. China Renewable and Sustainable Energy Reviews, 16 (2012), pp. 4543-4550.

[10] Renewables energy additional actual income versus theoretical income? (可再生能源附加实际收入与理论收入“打架”无解?) : http://www.china-nengyuan.com/news/131806.html

[11] Thinking and prospect: Problems of the "14th five-year plan" electricity Price Mechanism (思考

前瞻：“十四五”电价机制问题) : http://guangfu.bjx.com.cn/news/20200515/1072529.shtml

[12] By the end of 2016, China's renewable energy subsidy gap had exceeded 70 billion RMB (截至 2016 年底我国可再生能源补贴缺口已超 700 亿元)：http://www.cspplaza.com/article-9748-1.html

[13] H.Y. Zhou, Research on feed-in tariffs for renewable energy. Jiangsu: Southeast University, 2013. (周红勇.可再生能源上网电价的研究[D].江苏:东南大学,2013.) DOI:10.7666/d.Y2511733.

[14] Foreign media: Is feed-in tariff for renewable energy out of date? (外媒：可再生能源的上网电价政策过时了吗?) : http://news.bjx.com.cn/html/20170210/807668.shtml

[15] Du, Y.M. and K. Takeuchi, Does a small difference make a difference? Impact of feed-in tariff on renewable power generation in China. Energy Economics, 2020. 87.

[16] B.Q. Lin, Z.J. Jiang, J. Lin, The analysis and design of China's residential electricity tariff subsidies. Financial Research Journal, 11 (2009), pp. 48-58

BBChina

Master Program on Bio-Based Circular Economy

Course of Renewable Energy Technologies

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

Students: Xuemin Lu Tongji University (Group leader)
Zhiqi Wang Tongji University
Yijun Yang Tongji University
Wei Wang Tongji University

Co-funded by the Erasmus+ Programme of the European Union

The Project "Master Program on Bio-Based Circular Economy: From Fields to Bioenergy, Biofuel and Bioproducts in China" (BBChina) is co-funded by the ERASMUS+ Programme of the European Union.

Agreement number - 2017-2984/001-001 - Project reference number - 586083-EPP-1-2017-1-IT-EPPKA2-CBHE-JP

Table of Contents

Background

The importance of renewable energy generation:

- The development and utilization of renewable energy has become an **international development trend.**
- Chinese excessive consumption of fossil energy has caused **ecological and environmental problems.**
- China is committed to a high proportion of **renewable energy development** path.

Background

At present, thermal power accounts for more than 66 percent of China's electricity from all types of energy sources.

The proportion of renewable energy represented by hydropower, wind power and photovoltaic power generation is about 26% and that of nuclear power is close to 4%.

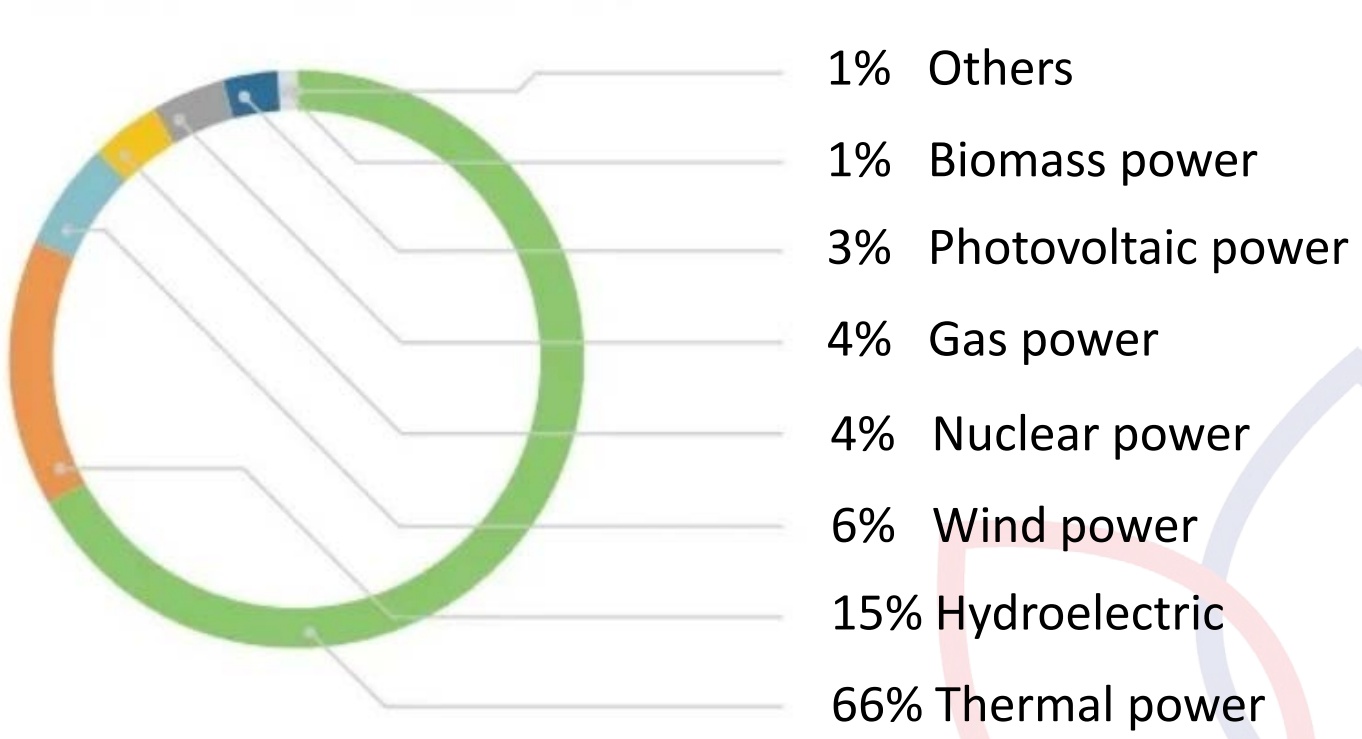


Fig.1 The proportion of electricity generated from all kinds of energy sources in 2018

Feed-in Tariff

What is the feed-in tariff ?

The feed-in tariff refers to the metering price at the point where the power generation enterprise is connected to the main grid when the power grid purchases the power and electricity generated by the power generation enterprise.

Feed-in Tariff

There are **three ways to form feed-in tariff**:
individual cost pricing, standard cost pricing and competition forming.

One price for one plant

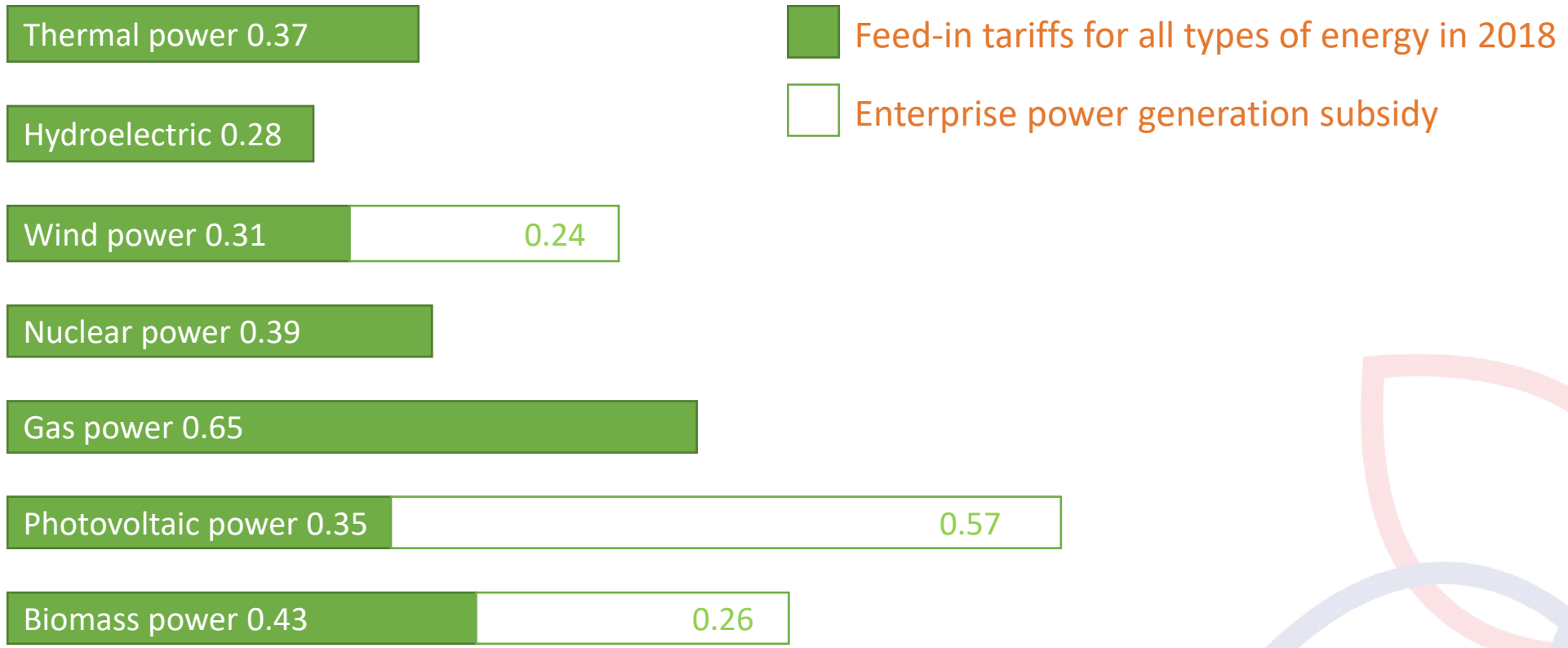
Benchmark electricity price

Competition in the market

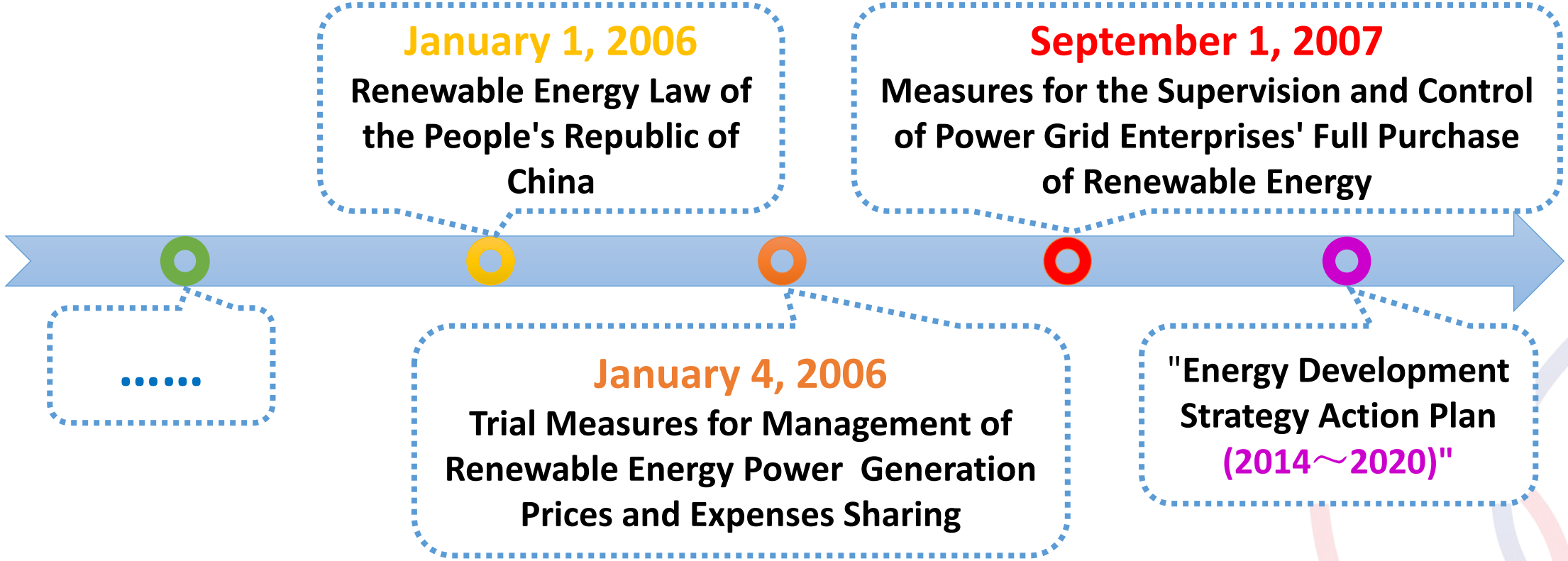
Feed-in Tariff

Feed-in tariff for all types of energy in 2018

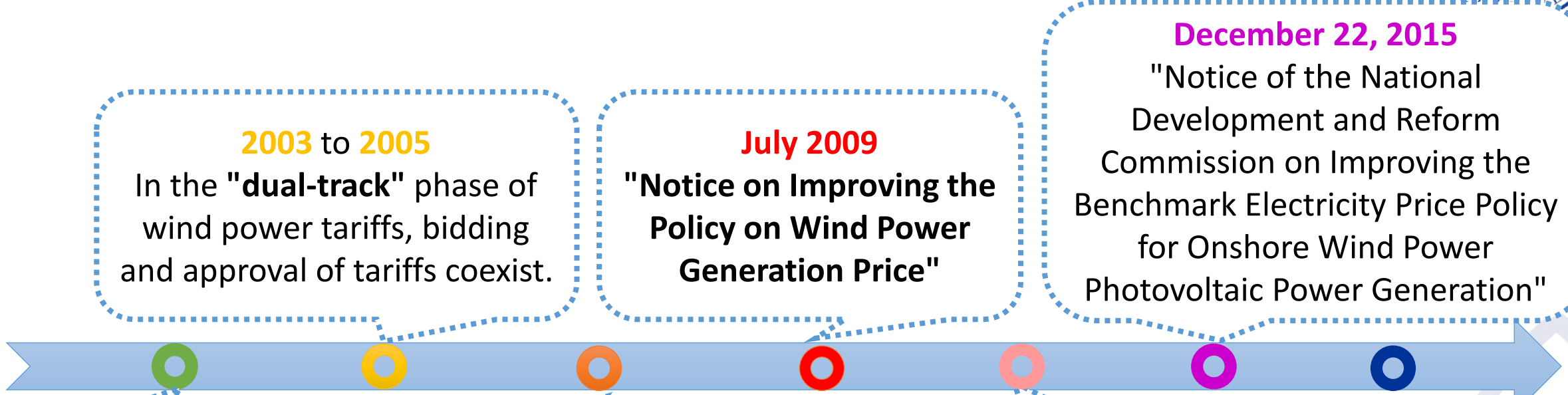
（No tax）¥/kW·h



Feed-in Tariff in China Policy



Feed-in-tariff of Wind Power



2003 to 2005
In the **"dual-track"** phase of wind power tariffs, bidding and approval of tariffs coexist.

July 2009
"Notice on Improving the Policy on Wind Power Generation Price"

December 22, 2015
"Notice of the National Development and Reform Commission on Improving the Benchmark Electricity Price Policy for Onshore Wind Power Photovoltaic Power Generation"

2003
“Notice on the preliminary work of the construction of large-scale wind farms nationwide”

January 1, 2006
“The feed-in-tariff of wind power projects is subject to government guidance”

June 2014
"Notice on Offshore Wind Power Tariff Policy"

May 21, 2019
"Circular of the National Development and Reform Commission on Improving the Policy of Wind Power Grid Prices"

Feed-in-tariff of Wind Power

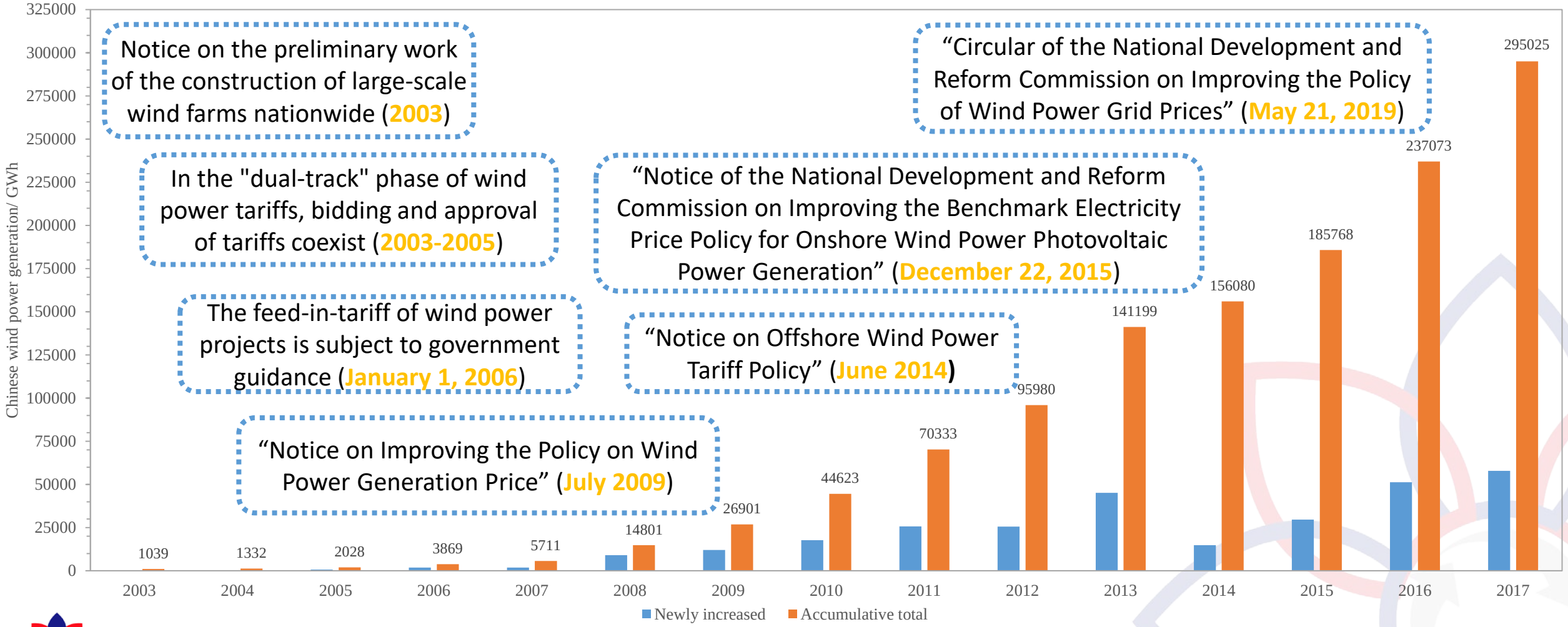


Fig.2 Chinese wind power generation in 2003-2017

Feed-in tariff of Photovoltaic

In 2008, the Feed-in-tariff of Photovoltaic was 4 RMB/kWh.
In 2009, the price was 1.09 RMB/kWh
In 2010, the price was 0.72-0.99 RMB/kWh.

Since 2016, the benchmark electricity price of photovoltaic power generation will be adjusted once a year.

2019
"Notice on the Policy of On-grid Electricity Price for Solar Thermal Power Generation"

January 1, 2006

July 2011
"Notice on Improving the Policy of Solar PV Power Generation Price"

April 28, 2019
"Notice of the National Development and Reform Commission on Issues Regarding the Improvement of the Photovoltaic Power Generation Pricing Mechanism"

2020
"Notice on Relevant Matters Regarding the Photovoltaic Power Generation Tariff Policy in 2020"

BBChina

Feed-in-tariff of Nuclear Power

From **2004** to **2006**, the domestic electricity price was 0.414 RMB/kWh
After **2007**, the domestic electricity price was 0.42 RMB/kWh.

July 2013
"Notice on Relevant Issues Concerning the Improvement of the Nuclear Power Net Price Mechanism"

March 21, 2019
"Notice on Trial Implementation of Feed-in-tariff for the First Batch of Three Generation Nuclear Power Projects"

Since **2003**, prices have been between 6-6.6 cents/kWh.

In **2009**, the electricity price method of the operating period was adopted.

October 9, 2013
The national benchmark electricity price for nuclear power was finally approved at 0.43 RMB per kWh.

Feed-in-tariff of Biomass

Since **2007**, a temporary electricity price subsidy of RMB 0.1 per kWh has been granted to the straw direct combustion project.

November 2011

The **"Interim Measures for the Administration of the Collection and Use of Renewable Energy Development Fund"** is charged at **4%/kWh**.

December 2012

"Renewable Energy Price Additional Accounting Regulations" raises the standard to **1.5 cents/kWh**

July 2010

"The Notice of the National Development and Reform Commission on Improving the Agricultural and Forestry Biomass Power Generation Price Policy" uniformly implements the benchmark on-grid electricity price of **0.75 RMB/kWh.**

March 2012

"Interim Measures for the Administration of Additional Subsidy Funds for Renewable Energy Electricity Prices" is charged at **8%/kWh.**

January 2016

Renewable energy tariff has been increased to **1.9 cents/kWh**, and it is still used today.

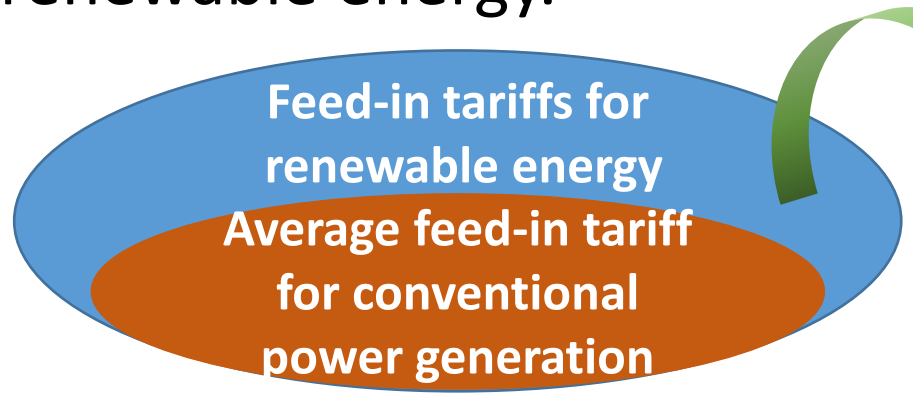
Weaknesses of feed-in-tariff in China

- The fixed feed-in tariffs for renewable energy in the past did not match the development of power generation technologies.

- Unified feed-in tariff is contrary to the distribution of resource in China.

Weaknesses of feed-in-tariff in China

- There is a big gap in the additional subsidies of electricity price for renewable energy.



Attached to the sale price of electricity:
0.019 RMB/kWh from 2016/01/01
(except agriculture and household electricity use)

By the end of 2016, this subsidy fund gap has reached about 70 billion RMB .

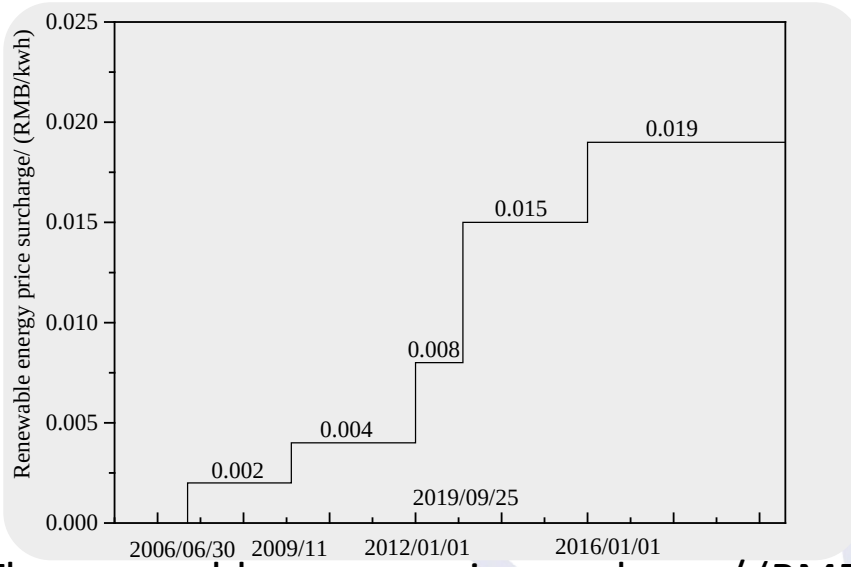


Fig. 3 The renewable energy price surcharge/ (RMB/kWh)

Strength of feed-in-tariff in China

- Push the rapid development of the renewable energy power generation technology in the past ten years.
- Renewable energy electricity generation has reached the world‘s leading level (Chinese wind power generation has overtook the US to become the world’s No.1 in 2016).
- The feed-in tariff is changing from fixed to market competition, which can regulate the relationship between electricity power supply and demand.

Suggests

1 Encourage battery energy storage to improve consumption capacity

2 Improve the renewable energy feed-in-tariff policy

- For solar photovoltaic power generation, policy makers need to improve attractive pricing policies and adjust prices at any time according to changes in power generation costs.
- For biomass power generation, the price of different types of biomass should be determined according to the principle of encouraging biomass power generation when biomass power generation.

3 Establish subsidized renewable energy installed ceilings

4 Enhance inter-provincial interconnection of the regional power grid

References

1. 可再生能源发展“十三五”规划，2016. The 13th five-year plan for renewable energy development in 2016.
2. 中国可再生能源展望，2017. China's Renewable Energy Outlook in 2017.
3. 仲苏亮.稳步推进中国可再生能源平价上网的必要性及相关政策建议[J].中外能源,2019,24(05):15-20. S.L. Zhong, The necessity and relevant policy Suggestions of steadily promoting the affordable access to Renewable energy in China. The Chinese and foreign energy, 2019, 24(05): p.15-20.
4. 上网电价_百度百科 Feed-in tariff _ Baidu Baike: https://baike.baidu.com/item/%E4%B8%8A%E7%BD%91%E7%94%B5%E4%BB%B7/3739134?fr=Aladdin
5. 国家发展改革委关于2020年光伏发电上网电价政策有关事项的通知 Notice of the National Development and Reform Commission on matters related to the feed-in tariff policy for Photovoltaic power generation in 2020: http://www.china-nengRMB.com/news/154111.html
6. 火、水、风、光、核电的发电成本与上网电价 Power generation costs and feed-in tariffs for fire, water, wind, light, and nuclear power: http://www.china-nengRMB.com/news/147761.html
7. 我国现行可再生能源补贴政策及标杆上网电价 Chinese current renewable energy subsidy policy and benchmark feed-in tariff: http://www.china-nengRMB.com/news/120495.html
8. Du, Y.M. and K. Takeuchi, Does a small difference make a difference? Impact of feed-in tariff on renewable power generation in China. Energy Economics, 2020. 87.

References

9. Zeng, M., et al., Overall review of renewable energy tariff policy in China: Evolution, implementation, problems and countermeasures. Renewable & Sustainable Energy Reviews, 2013. 25: p. 260-271.
10. Y.X. He, M.Z. Zhu, W. Xiong, T. Zhang, X.L. Ge, Electricity transmission tariffs for large-scale wind power consumption in western Gansu province. China Renewable and Sustainable Energy Reviews, 16 (2012), p. 4543-4550.
11. B.Q. Lin, Z.J. Jiang, J. Lin, The analysis and design of China's residential electricity tariff subsidies. Financial Research Journal, 11 (2009), p. 48-58
12. 【深度报告】中国上网电价机制现状及其问题(涉及火电、水电、风电、核电等)[In-depth report] The status quo and problems of China's on-grid electricity price mechanism (involving thermal power, hydropower, wind power, nuclear power, etc.): http://news.bjx.com.cn/html/20160602/738832-8.shtml
13. 外媒：可再生能源的上网电价政策过时了吗？Foreign media: Is the on-grid tariff policy for renewable energy outdated?: http://news.bjx.com.cn/html/20170210/807668.shtml
14. 周红勇.可再生能源上网电价的研究[D].江苏:东南大学,2013. DOI:10.7666/d.Y2511733. H.Y. Zhou, Research on grid-connected electricity price of renewable energy, Jiangsu,Southeast University.
15. 思考前瞻：“十四五”电价机制问题Thinking forward: "14th Five-Year" electricity price mechanism: http://guangfu.bjx.com.cn/news/20200515/1072529.shtml

Thanks for listening!

Question & Answer