

THE EFFECTIVENESS OF THE POLICIES ON
RENEWABLE ELECTRICITY IN CHINA

By

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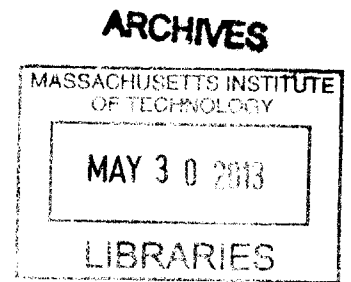
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The Effectiveness of the Policies on Renewable Electricity in China

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ABSTRACT

After the legislation of the Renewable Energy Law, China's government established a series of policies to promote renewable energy source electricity (RES-e) from 2005-2012. The effectiveness of the policies varies depending on different perspectives of different stakeholders. Explaining this phenomenon, this research comprises interviews of industry experts, references to previous studies, case studies and data exploration.

The renewable policies of China focused more on supply side than demand side. Indeed, China built up its capacity in manufacture of renewable energy equipment and in generation of RES-e under its policies over a short period of time. However, the lack of the involvement of consumer incentives hindered the further growth of RES-e industry. The renewable policies indicate the institutional shortcomings of China's government on designing economic growth policies.

This study concludes that policies are more effective to the sustainable development of an industry when set on the demand side than on the supply side. China's government needs to shift its focus on fast short-term growth of supply to long-term growth of local demand.

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1 Background: history and growth

China has been one of the fastest growing economies in the past twenty years. In 2012, the GDP of China reached \$8.36 trillion. (Brazil, Russia, India, China, South Africa) The total energy consumption of China also reached the equivalent of 3.62 billion tons of coal (National Bureau of Statistics of China), surpassing that of US and becoming the largest energy consumer in the world. As a rising economy in the world, China has become more and more serious about reducing carbon emission. A series of government regulations and economic incentives have taken place in the past decade to promote renewable energy. However, the consumption of non-hydro RES-e (mainly wind, solar and biomass power) has not increased as fast as the installed capacity of RES-e generation. The objective of this article is to study the effectiveness and influence of the renewable energy policy-set in China, analyze the reaction and motivation of stakeholders in the RES-e industry under the policy-set, and predict the future of RES-e consumption in China.

1.1 Phenomenon

In the year 2005, the National People's Congress (NPC) of China passed the Renewable Energy Law. Subsequently, to fulfill the growth of renewable energy, a series of administrative measures, instructions and development targets have been stipulated by different government departments, including National Development and Reform Commission (NDRC), Ministry of Finance (MOF), Ministry of Science and Technology (MOST), etc. A combination of policies, such as renewable portfolio standard (RPS), Feed-In Tariff (FIT), tendering and subsidies, has been implemented and tested within the renewable energy industry in China. The influence of these policies is significant. For instance, the newly installed capacity of wind power grew over 100% annually in four consecutive years, from 2006 to 2009. However, although the installed capacity of non-hydro RES-e was 7.51% of total electricity capacity in 2012, the non-hydro electricity generation was only 2.30% of total electricity generation. There were administrative limitations as well as technical limitations behind this phenomenon.

At the same time, manufacture of wind turbine and solar PV panel also grew exponentially during this period. Fast growth of the industry stimulated the economy and lowered cost. However, overproduction also caused waste and anti-dumping accusations in the US and European market.

1.2 Growth of RES-e

In 2005, the portion of RES-e was still negligible among overall electricity volume. The installed capacity of RES-e contributed 0.66% of overall installed generation capacity. At the same time, the electricity generation of RES-e accounted for only 0.47% of overall electricity generation. Thermal power dominated the electricity supply. Power plants, fueled by coal, gas and oil power, accounted for 75% of overall generation capacity and 80.4% total electricity generation. The fast growth of RES-e only took place after the legislation of the Renewable Energy Law.

1.2.1 Capacity

As shown in Table 1, from 2005 to 2012, the installed capacity of non-hydropower RES-e had grown quickly. The newly installed capacity had maintained a compound annual growth rate of 61.3% from 2005 to 2012. The cumulative installed capacity reached 86GW and was 7.51% of the total installed capacity.

Within the non-hydropower RES-e, wind power played an important role in China and contributed around 90% of the total installed RES-e capacity. From 2006 to 2009, installed capacity of wind power doubled every year.

The growth of solar happened relatively later. The technology focus was mainly on photovoltaic panel. The exponential growth of solar power took place in 2009. In 2011, the newly installed solar power capacity almost tripled the installed capacity in 2010. And the exponential growth rate continues.

Table 1 Installed capacity from 2005 to 2012 by technology, unit: MW, source: GlobalData, author's calculation

Technology	2005	2006	2007	2008	2009	2010	2011	2012
Biomass	2,021	2,086	2,443	2,743	2,880	3,087	3,308	3,556
Geothermal	28	24	24	24	24	24	24	24
Hydro	117,388	128,570	145,260	171,500	196,800	213,400	230,510	245,513
Nuclear	6,587	7,572	8,463	8,438	8,438	10,065	11,816	13,816
Solar PV	68	80	100	145	373	893	3,500	7,000
Solar Thermal	0	0	0	0	0	0	0	14
Coal	362,436	453,520	519,452	559,777	604,898	653,250	706,670	740,350
Gas	9,702	14,141	17,965	21,277	25,080	29,354	32,650	35,375
Oil	11,993	16,161	18,658	20,265	22,072	24,026	26,140	25,399
Wind	1,267	2,603	5,770	12,002	25,805	44,733	62,364	75,564
Total	511,489	624,757	718,134	796,172	886,371	978,832	1,076,983	1,146,610
Subtotal RES	3,384	4,793	8,337	14,914	29,083	48,737	69,197	86,158
Subtotal Thermal	384,130	483,822	556,074	601,320	652,050	706,630	765,460	801,124
% of RES	0.66%	0.77%	1.16%	1.87%	3.28%	4.98%	6.43%	7.51%
% of Fossil	75.10%	77.44%	77.43%	75.53%	73.56%	72.19%	71.07%	69.87%

1.2.2 Generation

As shown in Table 2, electricity generated from RES-e grew at a CAGR of 38.7% from 2005 to 2012. The growth rate was much higher than the CAGR of total electricity generated, which was 10.7% during the same period. However, compared with the growth rate of installed RES-e capacity, the growth rate of the electricity generated was much smaller.

Table 2 Electricity generation from 2005 to 2012 by technology, unit: GWh, source: GlobalData, author's calculation

Technology	2005	2006	2007	2008	2009	2010	2011	2012
Biomass	10,161	10,490	12,285	13,791	14,481	15,521	16,635	17,879

Geothermal	96	96	178	178	180	180	180	180
Hydro	393,047	431,428	429,957	522,423	548,955	686,307	662,600	778,200
Nuclear	50,331	51,800	59,290	65,324	65,713	70,962	87,400	94,983
Solar PV	67	79	99	143	368	881	3,451	6,961
Solar Thermal	0	0	0	0	0	0	0	38
Coal	1,946,545	2,297,431	2,647,141	2,710,470	2,914,263	3,325,563	3,776,211	3,918,013
Gas	12,320	25,757	40,284	45,697	61,456	70,130	79,633	83,577
Oil	59,136	50,912	33,275	23,134	16,482	18,808	21,356	41,287
Wind	1,356	2,785	6,175	12,843	27,617	50,100	70,600	90,420
Total	2,473,058	2,870,777	3,228,683	3,394,001	3,649,515	4,238,451	4,718,066	5,031,538
Subtotal RES	11,680	13,449	18,736	26,954	42,646	66,682	90,866	115,478
Subtotal Thermal	2,018,000	2,374,100	2,720,700	2,779,300	2,992,200	3,414,500	3,877,200	4,042,877
% of RES	0.47%	0.47%	0.58%	0.79%	1.17%	1.57%	1.93%	2.30%
% of Fossil	81.60%	82.70%	84.27%	81.89%	81.99%	80.56%	82.18%	80.35%

A performance measurement of power plant is the Equivalent Full-Load Hours (EFLH). If the total electricity generated of a given plant in a given year is divided by the installed capacity of that plant, the result is the EFLH of that plant that year.

$$\text{EFLH} = \text{Total electricity generated} / \text{Installed capacity (1)}$$

The intermittency of RES-e and the limitation of the power grid both limit the EFLH of RES-e. The intermittency of RES-e is the technical factor. The performance of wind or solar power plant depends on weather condition. Without strong wind or sunshine, wind or solar plant cannot produce at full capacity. Second, the generation of RES-e is also limited by the capacity and preference of the power grid company. Chapter 5 will discuss about it in detail.

1.3 Stakeholders in this industry

The electricity sector is highly regulated in China. Although institutional reform has taken place during the past ten years, the transmission, distribution and retail of the power sector is still monopolized by the state power grid company (SPGC). The generation is separated from the grid company and still consists mostly of state owned enterprises (SOEs). The national development and reform commission (NDRC), sets the electricity price. Further, the state electricity regulatory commission (SERC), the regulator, did not act as influential as it supposed to be.

Under a centralized government structure, the development of renewable energy is mainly driven by the central government, especially the NDRC, which plays the role of key regulator. In the industry pipeline, the stakeholders include manufacturers, developers or generators, power grid company and power consumers. At the same time, local governments also have an important role within their jurisdictions respectively. This paper will take different perspectives of stakeholders to evaluate the effectiveness of the policy-set.

2 Regulatory framework

In 2005, the renewable energy law established the regulatory framework of renewable energy in China. As shown in Appendix 1, Chinese government established a series of policies and regulations in the renewable energy sector to plan and support the development of renewable energy.

From 2005 to 2012, the government implemented a combination of tendering, renewable portfolio standard and feed-in tariffs to find the most reasonable and practical RES-e price. At the same time, several government departments provided subsidies and special funds to support the development of the renewable energy industry. However, the organizational structure of the regulators and the different interests of the central government and local governments created barriers during the process.

2.1 Electricity price

There are two main policy models to determine the electricity price of RES-e in the world. One is the feed-in tariff (FIT) and the other is the renewable portfolio standard (RPS). Regulators in China tested both of the two models in the RES-e industry.

FIT

Within the FIT mechanism, the regulator sets a fixed price for RES-e and guarantees the price for a period long enough to remunerate the investment of developers with a reasonable profit. At the same time, power grid companies have the obligation to purchase RES-e. RES-e also has priority to access the power grid.

As the price of RES-e is fixed and the profit of renewable energy investment is protected, investors have fewer risks under the FIT policy model. The FIT model also requires a powerful regulator to implement the system. So countries characterized with a more regulated and centralized power sector use the FIT

model more. For example, in Europe, Germany, the Netherlands and Spain take FIT as their RES-e pricing model.

The payment process of RES-e in China was special. Rather than paying the premium of RES-e directly during purchase, the power grid company only paid the conventional electricity price on generation, and collected a renewable energy surcharge on electricity consumption. After the collection, the power grid company paid the premium to generators annually. The renewable energy surcharge was only CNY 0.001/kWh from 2006, raised to CNY 0.004/kWh in 2009 and raised again to CNY 0.008/kWh in 2011. The shortcomings of this model are discussed in detail in Chapter 4.

RPS

The RPS policy model is a quota system. The regulator allocates a fixed quantity or share of RES-e to the electricity suppliers or generators. RES-e generators will get tradable certificates for RES-e production, and the price of such certificates will be determined by market demand.

Under an RPS policy model, either the price of RES-e or the certified emission reduction credits (CERs) fluctuates more. Investors could gain a bigger profit during high demand and also could lose money during low demand. A feature of RPS model is that it requires more market mechanism, and consequently countries with a more liberalized power sector usually implement the RPS model. The UK, Sweden and Italy are examples of countries implementing the RPS model.

In 2005, China implemented a modified RPS model accompanied by a tendering process to stimulate investment in RES-e. The RPS model in China was different from that in Europe. Rather than requiring an RES-e generation quota, the Chinese RPS required an RES-e installed capacity quota. This was also canceled during the modification of the renewable energy law in 2009, as FIT took its place.

This mechanism motivated the developers, because of their state-owned nature. The bidding electricity prices were as low as CNY 0.43/kWh during the first period. (Xu, Yifan) The main reason behind this phenomenon was that the SOEs did not have as much economic pressure to make money on RES-e as they had administrative pressure to meet the required RES-e portfolio. However, this process gave the regulator an opportunity to create a market and understand the cost of RES-e. Manufacturers, developers and power grid companies all got experience during this process.

As the total capacity of RES-e increased, especially wind power, the profitability of RES-e became more important for developers. NDRC, as the regulator, also understood the cost structure of RES-e better from the concession tendering over time and wanted to create a sustainable market. The regulatory framework gradually turned into a FIT model.

In 2009, “NDRC announced FITs for four categories of onshore wind power projects. The tariffs ranged from CNY0.51/kWh, CNY0.54/kWh, CNY0.58/kWh and CNY0.61/kWh with the best wind resource regions getting the lowest tariff.” (All FITs quoted from GlobalData) These FITs provided economic incentive to developers to keep invest in wind power plant. At the same time, FITs of solar and biomass were also established as below:

“Solar projects approved before July 1, 2011 and completed before December 31, 2011 will receive \$0.18/kWh (CNY1.15/kWh), excluding solar thermal.

“Solar projects approved after July 1, 2011 but not completed by December 31, 2011 will receive \$0.16/kWh (CNY1/kWh).”

“In 2010, the National Development and Reform Commission announced a new national FIT for biomass power of CNY0.75/kWh, equivalent to \$0.11/kWh.” (GlobalData)

The evolution from an RPS mechanism to a FIT mechanism helped the regulator to get a reasonable price for RES-e and continuously provide incentives for developers to invest in RES-e.

2.2 Tax relief, Subsidies and funds

Tax relief, subsidies and special funds (TSFs) were also contributing to the growth of the RES-e sector in China. The TSFs were mostly designed to support local manufacturers and developers of renewable energy projects.

Taxes

Tax policies supporting renewable energy projects involved two taxes: corporate income tax (CIT) and value-added tax (VAT).

CIT was exempted or deducted in several ways. First, qualified advanced and new technology enterprises enjoyed a reduced CIT rate of 15%, while the normal CIT rate in China is 25%. Second, CDM funds and enterprises operating CDM projects could enjoy CIT exemption for “carbon emissions reductions (CER) proceeds that are shared by the government” (KPMG). The exemption was 100% in the first three years and 50% in the following three years. Third, enterprises also enjoyed CIT deductions from investments in renewable energy equipment and R&D. Such deduction could also be amortized over the next five years after the investment happened.

VAT was refunded to companies in a more direct way. Fifty percent of VAT was refunded on the sale of wind power to the generators, and a “100 percent refund of VAT [was] paid on the sale of biodiesel oil generated by the utilization of abandoned-animal fat and vegetable oil”. (KPMG)

Subsidies and funds

Various subsidies and funds were provided to manufacturers and generators from different departments of the government. Manufacturers were given subsidies to promote advanced and new technology projects. From 2008-2010, the Ministry of Finance (MOF) provided subsidies of CNY 600/kW for qualified wind turbine manufacturers for their 50 sets of machines (Xu, Yifan).

2.3 Administrative policies

Unlike economic incentives, administrative policies directly mandated stakeholders to behave according to the growth targets of renewable energy set by the regulators.

From 2003-2010, NDRC took measures to protect and promote local production of wind turbines. During that period, all the wind power concession projects required that at least 50-70% of the components should be produced in China. (Silva, and Klagge)

In 2010, industry experts reported to the state council that the wind turbine industry was facing overcapacity. The government filed documents to limit the incremental capacity of wind turbine production. On the developers' side, all wind farms over 50MW were required to get approval by NDRC.

Meanwhile, the Renewable Energy Law required the power grid companies to purchase all the RES-e and share the incremental cost among their electricity customers.

3 Manufacture

The manufacture of renewable energy equipment scaled up very fast in the past several years. In terms of production capacity, China is leading the world in wind turbine and solar photovoltaic production. Both economic incentives and administrative policies have been leveraged to motivate manufacturers in this sector. At the same time, market drivers were different between wind turbine and solar PV manufacturers in China. Wind turbine manufacturers were driven mainly by the local wind power market, while solar PV manufacturers were mostly focusing on the international solar power market.

The growth of the manufacturing sector has lowered the cost of renewable energy and increased its competitiveness. However, both wind and solar manufacturers in China now face issues of overproduction. The international market has also made antidumping accusations, which threatens the sustainability of renewable energy manufacturing in China, especially in the solar PV industry.

3.1 Related policies

Supply side

Tax relief: Qualified manufacturers of wind turbine and solar PV could enjoy the VAT and CIT tax relief mentioned in Chapter 2; Subsidies and funds: Leading manufacturers of wind turbine could get subsidies from MOF. Several special funds were set aside for advanced and new technology research in both wind power and solar power manufacturing.

Demand side

Renewable portfolio standard: The RPS required the power developers with more than 5GW-installed capacity to have a portion of their electricity supply from RES-e. So the big developers had to expand their RES-e to meet the standard. Concession project: The government organized several rounds of concession projects, first in wind power and then also in solar power, to encourage RES-e.

3.2 Growth of renewable energy manufacture

3.2.1 Wind

Wind power manufacturing developed in three stages. In the first stage, wind turbine manufacturing was motivated by government policies. In 2005 and 2006, the demand for wind turbines grew rapidly after the implementation of renewable policies. All the state-owned developers were looking for wind turbines at that time. The first group of local manufacturers, mainly having an SOE background, devoted themselves to this industry. Shortly after their purchase of technology from European industry leaders, local manufacturers ramped up production quickly and took advantage of the 70% localization provision.

In the second stage, attracted by the economic incentives and driven by local government, manufacturers kept increasing their production capacity and establishing branches in regions with abundant wind resources. In 2010, there were more than 80 wind turbine manufacturers in China. The leading manufacturers claimed to have the core technology and used localized key components to drive down cost. During this period, the price of on-shore wind turbines dropped from CNY 6000/kW to less than CNY 4000/kW.

In the third stage, under the accusation of international market, government cancelled almost all the subsidies and the 70% localization provision in wind turbine industry. However, the low cost competitiveness of local manufacturers was already established in the local market. The Chinese manufacturers also started to seek overseas market to utilize their production capacity, although quality issues limited their capability in the international market. Meanwhile, after the second period of intense competition, competitors in this market could hardly make profit. The top two manufacturers, Sinovel and Goldwind, both faced shrinking profit and tense cash flow.

The influences of government policies on wind turbine manufacturers were significant. The manufacturing industry of wind turbine is close to a competitive market. With all the economic

incentives, tax relief, subsidies and funds, new entrants kept entering this market and drove the profit to zero. At the same time, under the protecting 70%-localization provision, local manufacturers took advantage of the policy and avoided competition from international competitors on technology and quality. It is obvious that policies in wind power manufacture effectively expanded the production of wind turbine as well as drove down the cost. The low cost of equipment contributed to the fast growth of installed capacity. However, the problem of over production also created waste. Especially, driven by local governments, lots of manufacturers built localized branches that were less than economically effective.

3.2.2 Solar

Solar was not considered as the first choice of renewable energy source by China's government. First, the cost of solar power has always been higher than that of wind power. Second, the energy intensity of solar is lower than wind. Solar power requires a huge area to build up capacity. (Gao) Before 2005, solar power was mainly used to electrify rural areas with no access to the power grid. (Liu, Wang, Zhang, and Xue) After the establishment of Renewable Energy Law, Solar power was still not economically competitive with wind power in China. However, benefiting from economic encouragement from the government, the solar power market grew fast in Europe, especially in Germany, Italy and France. Different from wind turbine manufacturers, solar PV manufacturers in China were mainly driven by private capital.

In 2005, Suntech, the biggest solar PV manufacturer in China, was privatized and listed in NYSE as the first private owned Chinese company listed in NYSE in history. According to Forbes magazine, the founder of Suntech became one of the richest people in China with "a personal net worth of USD 2.9 billion and ranked 396th among the world's billionaires in 2008." (He) Local government also supported Suntech, which was the excellent economic growth provider and tax contributor.

Observing the success of Suntech, new entrants entered into this market at a fantastic speed. According to Xinhua News Agency, “more than 100 cities in China had build solar PV industrial park. In Zhejiang province along, there were more than 205 companies doing solar power business.” At the same time, markets leaders also kept expanding their business. In 2011, Suntech was the biggest manufacture of solar panel in the world. Starting from 2007, China has been the biggest solar PV manufacturing country in the world for six consecutive years. The production in China took 40% of the market share around the world in 2009. (Liu, Wang, Zhang, and Xue)

However, as solar power was less economically competitive than wind power and more difficult to build up huge capacity, domestic market for solar panel was limited. More than 90% of the Chinese production was exported to international market, mainly to Europe. The negative influence of the international market after the financial crisis in 2008 was magnified by the antidumping and countervailing accusation from the US in 2011. The department of commerce (DOC) determined in 2012 that “Chinese producers/exporters have sold solar cells in the United States at dumping margins ranging from 18.32% to 249.96%.” (Department of Commerce, United States) The antidumping and countervailing investigation from EU is still ongoing, and consequently the solar PV industry in China has fallen into winter after that.

Aware of the risk of an industrial failure, central government started a series of project to increase domestic market. The process to promote solar power was similar to that of wind power, as the government was quite familiar with the process already. In 2009, government organized the tendering of the pilot solar project in Gansu, and got a relatively lower price at CNY 1.09/kW. (Liu, Wang, Zhang, and Xue) At the same time, the price of the main components, solar panel, kept decreasing. In 2011, NDRC set the FIT for solar power at CNY 1/kW. The government also started to promote distributed solar power generation, which was a more common form than large-scale power plant in Germany.

The policies from the government seemed to come a bit late. In 2011, the solar power market in China took 8% of the world market (Xu, Honghua), while the production in China took more than 50%. In early 2013, Suntech was forced into Chinese bankruptcy proceeding after defaulted on a USD 541 million US bond payment.

3.3 Effectiveness analysis

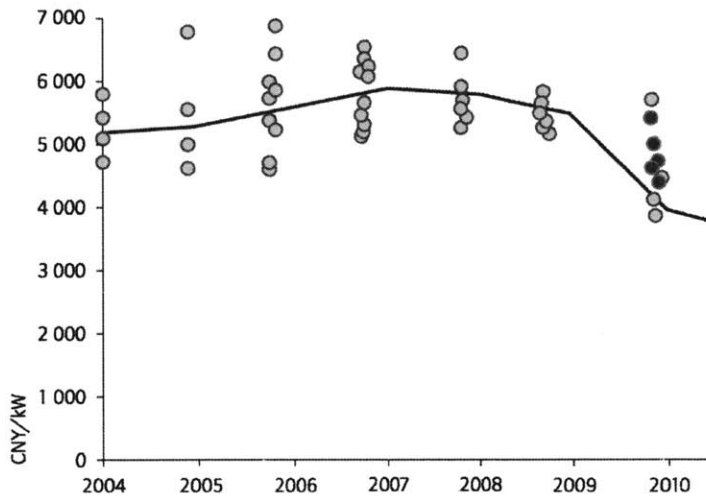
The economic incentives and the administrative policies were more than effective in the manufacture sector of wind power and solar power. There were similarities and differences between wind and solar, in terms of policy effectiveness.

First, the two manufacturing industries had different market focus. Due to government policy support, the wind power development started earlier and grew faster. China has become the world's No. 1 both in wind turbine production and wind power installed capacity. As most of the production was for domestic market, wind power manufacturers enjoyed a more stable and less risky market.

Second, influenced by government policy, the capital sources of wind and solar manufacture were also different. To shown support for government policy, more SOEs would invest in wind turbine manufacture. At the same time, solar PV manufacturers were mostly driven by the high profit margin from oversea markets in 2005 and funded more by private investors.

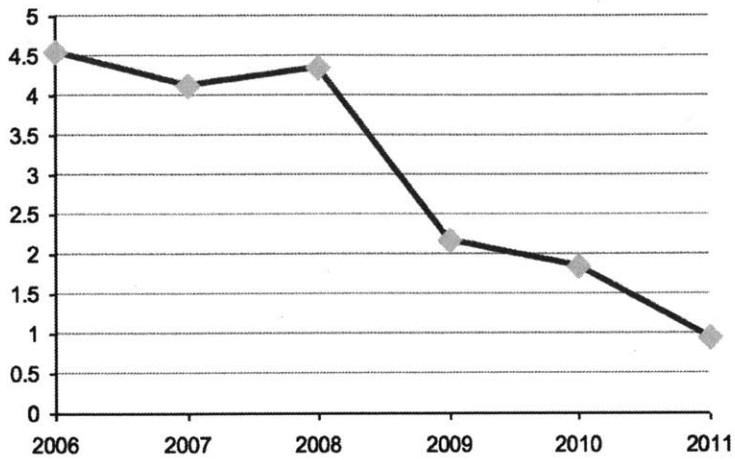
However, both oversupply and trade frictions took place in wind and solar manufacture. Oversupply was reasonable during the rapid growth period of a new industry. Although both wind and solar in China faced trade friction from international market, the two industries were affected differently due to different market position.

Figure 1 Chinese wind turbine price, Source: IEA, Notes: yellow circles represent turbines with smaller capacity and red circles represent those are 2.5MW or larger



Another important similarity was that fierce price competition both took place in these two markets. This was also reasonable according to economic principle, which tells us that only zero economic profit could stop more market entrants. Price competition greatly lowered the cost of RES-e and supported the further expansion of renewable energy. As showed in figure 1 & 2, the price of wind turbine and solar PV both dropped a lot in the time period discussed. However, low profit margin also limited the investment in R&D activities and the focus on product quality, which in the long run would harm the industry, especially in the competitive global market.

Figure 2 Chinese PV module price, source: Reconsidering the Economics of Photovoltaic Power



In conclusion, the manufacture side of RES-e was a competitive market influenced by government policy. Wind turbine manufacture benefited from local protection, tax relief and subsidies, and also enjoyed a fast growing local market under government policy. Although economic incentives on the manufacture side also benefited solar PV manufacturer, the lack of domestic demand finally harmed the industry more. The different policy support on the demand side determined the different scenario of wind and solar manufacture in China.

4 Generation

The development on the generation side has been growing fast, especially on installed capacity. From a mechanism of tendering with a renewable power standard (RPS) to that of feed-in tariff, policy makers successfully motivate power developers to produce RES-e.

Most of the power plants in China are owned by state owned enterprises (SOEs). Due to a liberalized coal market and a regulator-set electricity price, most of the power plants claim losing money under the current given electricity price. However, under the feed-in tariff policy, RES-e developers are promised to recover their investment with a reasonable profit by investing in wind, solar and biomass. Government also implements taxation measures to increase profitability of RES-e plant. At the same time, the clean development mechanism (CDM) could also provide income for generators.

Meanwhile, the administrative policies of RPS also help motivate developers. According to the Renewable Energy Law enacted in 2006, generators were required to generate a percentage of non-hydropower RES-e in their energy source portfolio. The percentage required is 3% by 2010 and 8% by 2020. The character of SOEs makes the administrative policies especially effective and drives the developers to invest in RES-e. Further more, regulators also required the state power grid company (SPGC) purchase all RES-e and facilitate grid connection.

4.1 Related policies

Supply side

FITs made the investment in RES-e profitable. Profitability was the effective economic incentive on the supply side. CDM also made profitability more possible for developers by trading certified emission reduction credits (CERs). However, additionality is the basic requirement for CDM project scrutiny. Projects, which could make money with out CERs, could not pass CDM assessment. The price of CERs also depended on market demand. "The price hit a high of \$26 in July 2008, and then fell to around \$10

in February 2009 in response". (Gillenwater, and Seres) The concession tendering was one of the most effective measures from the NDRC to directly promote RES-e. Up to the 2012, five rounds of wind power bundled tendering were organized with a total 2.6GW capacity of wind power projects. (Xu, Yifan)

Demand side

Required purchase of the RES-e was stipulated in the Renewable Energy Law, which required the power grid company to purchase all the generated RES-e. Required purchase theoretically protects supply by creating an infinite demand. However, the mandatory purchase provision was also modified to guaranteed purchase in the modification of renewable energy law in 2009, as the generation of RES-e in lots of places overweight the absorption capability of the power grid. Government also urged the power grid company to provide grid connection support to RES-e, as most of the RES-e plants were build in remote regions where grid connection was weak.

4.2 Growth of RES-e generation

4.2.1 Wind power

As discussed in Chapter 1, wind power was the main RES-e source in China during the period from 2005-2012. In 2011 China has become the biggest wind power market for both newly installed capacity and total installed capacity. Three reasons, energy intensity, economic competitiveness and profitability, contributed to the fast growth of wind power generation in China. (Gao)

Frist, he energy intensity of wind power is relatively high comparing with solar and the other renewable energy. The government could plan several 10GW class wind power projects in wind source affluent regions. The developers, mainly SOEs, were also willing to build up RES-e capacity in short time to meet the RPS requirement. Not surprisingly, wind power grew fast because of its nature.

Meanwhile, the price of wind power electricity has always been much lower than solar power or biomass. In 2010, the FITs for wind, solar and biomass are respectively CNY 0.51-0.61/kWh, CNY 1/kWh and CNY 0.75/kWh. (GlobalData)

Third, the profitability of wind plants changed in two stages. In the first stage, wind power electricity price was determined by tendering result. In this stage, most of the bidding price could be as low as CNY 0.4365/kWh. The projects were hardly profitable under these prices. However, benefiting from CDM support, those projects could still somehow sustain and break even. At the same time, the competition from the wind turbine manufacturers took place fast and fiercely. Wind turbine took 60% of the total investment in wind farms. And the price of wind turbine decreased by more than 30% from 2006 to 2009. The developers benefited from the price competition of wind turbine manufacturers, the advanced techniques in construction and the taxes relief from government policies. In the second stage, after the establishment of the FITs wind farms were in general profitable without generation limitation from the grid.

However, the power grid company had limited capacity to fully absorb wind power, as it kept growing. At the same time, technology maturity and economic feasibility also challenged the further development of off-shore wind power in China. The problems from the power grid companies became more serious as the capacity of wind power increased. First, grid connection could not be promised in some remote areas. Areas with abundant wind resource usually were not electricity load center. Since the local consumption of electricity was low, the power grid there was also built at low capacity and limited distribution capability. Second, in some areas with abundant wind resource and limited grid capacity, the installed capacity of wind farms had surpassed the demand of the grid. During windy seasons when all the wind farms could operate on full capacity, the grid had to limit their production to protect its security. Third, wind power was not stable due to its nature of intermittency. However, the

power sector requires the supply of electricity to match the demand. Backup electricity plant, usually gas power plant or hydropower plant, has to be ready to operate during low-wind or non-wind periods. As it is not economically feasible to build back up electricity plant only for wind power, the power grid companies had to limit the production of RES-e due to electricity security consideration. The issues and solutions of the power grid company would be discussed in Chapter 5 in detail.

Wind power developers had also started offshore wind development under the support of NDRC. The pilot project in Shanghai Donghai Bridge has been operating since 2010. And the first round offshore concession projects tendering also took place in 2011, getting electricity prices from CNY 0.6235/kWh to 0.737 /kWh. The maturity of manufacturers and construction companies under such low price and huge scale is still questionable.

4.2.2 Solar

The development of solar power was in general later than wind power. Due to the nature of solar power, some special policies and solar schemes were implemented to support both large-scale solar power plant and distributed solar power utilization.

In 2009, a series of events about solar power took place. "The first large-scale grid-connected solar PV power project was commissioned." (Liu, Wang, Zhang, and Xue) The project is located in GanSu province with a capacity of 10MW. However, different from wind power, distributed solar power is a more feasible form to utilize solar energy. In 2009, government initiated the Golden Sun Program to support both grid connected and off-grid PV power generation, and the BIPV Subsidy Program to support distributed building integrated PV projects.

The real exponential growth of solar power took place in 2011. At the end 2011, total installed capacity of solar power reached 3.5GW with a newly installed capacity of 2.7GW in that year. (Xu, Yifan) The lowered cost of solar components realized the large-scale development of solar power. Government planned large-scale solar power plant mainly drove the fast growth. Lowered cost, tax relief and subsidies also made the investment in solar power more attractive.

However, the nature of intermittency also limited the performance of solar power. Distributed solar power utilization seems to be a solution to mitigate the impact of intermittency of solar. It has been proved to be a successful mode in Germany. Up to now, although the government intends to promote distributed solar power, power developers lack experience and incentive to invest in the small-scale generation. The realization of distributed solar power relies on the involvement of electricity consumers. Chapter 6 would discuss the involvement of consumers in developing distributed solar power in detail.

4.3 Effectiveness

The effectiveness of policies on RES-e generation was significant. First, most of the power developers in China are SOEs. For SOEs, administrative targets are as important or even more important than economic incentives. The initiative of RES-e was closer to a planned economy in the generation side. The NDRC has developed and become experienced in a process from concession projects tendering, to feed-in tariffs. This process was especially effective in wind power sector. Second, the policies of tax relief and subsidies to the generators increased the profitability of the power plants directly. After a short period of low profit or loss, the FITs promised the generators a better internal return rate (IRR) than conventional power plant. Third, the cost of renewable energy equipment kept driven down by intensive competition. A lowered cost also resulted in a better profitability to the generators.

There are two important barriers limiting the further development of RES-e generation. One comes from the limitation of the power grid; the other is caused by insufficient renewable energy fund. The

bottleneck of connection and absorption from the power grid could not be solved by current policies. The implications of current policies to the power grid will be discussed in detail in Chapter 5.

The insufficiency of renewable energy fund is caused by a fixed RES-e surcharge and a fast growing RES-e generation. Although the RES-e surcharge was raised from CNY 0.001/kWh to 0.008/kWh, there is still a gap of CNY 10-20 billion to pay the premium of RES-e. The gap could be as big as 50% of the total RES-e premium. (Xu, Yifan) Although generators are mostly profitable on book, the delayed payment intensifies their cash flow, which influences their payment to the equipment suppliers.

5 Transmission, distribution and retail

In China, the transmission, distribution and retail of the power sector is actually monopolized by the state power grid company (SPGC), which has become a colossal conglomerate in power sector.

The whole body of regulation and policies does not provide much incentive to SPGC. The FIT mechanism gives RES-e a premium to conventional electricity. Regulator requires SPGC to purchase all the RES-e. Although the shared cost mechanism namely allows SPGC to share the cost among all its consumers. The electricity-selling price is actually set by the NDRC. The SPGC is a price taker and does not have economic incentive to purchase RES-e.

Meanwhile, the intermittency of wind and solar makes RES-e technically unwelcomed by the grid company. As the planning of power supply is based on the power demand in a given region, the power supply system need to prepare backup capacity to backup RES-e when the production of wind power and solar power decreases due to weather conditions.

5.1 Related policies

Supply side

Under the FIT mechanism, the power grid was required to purchase all the RES-e and provide connection support.

Demand side

On the demand side, the FIT mechanism was combined with a shared cost mechanism. All the users should share the premium cost of RES-e. In practice, government let the power grid company collect a surcharge of CNY 0.001/kWh. The surcharge was tax-free (GlobalData) and was raised to CNY 0.004/kWh in 2009 and to CNY 0.008/kWh in 2011 due to the fast increase of RES-e. (IEA, Energy Research Institute

of China) The surcharge was put into renewable energy fund to subsidize further development of renewable energy.

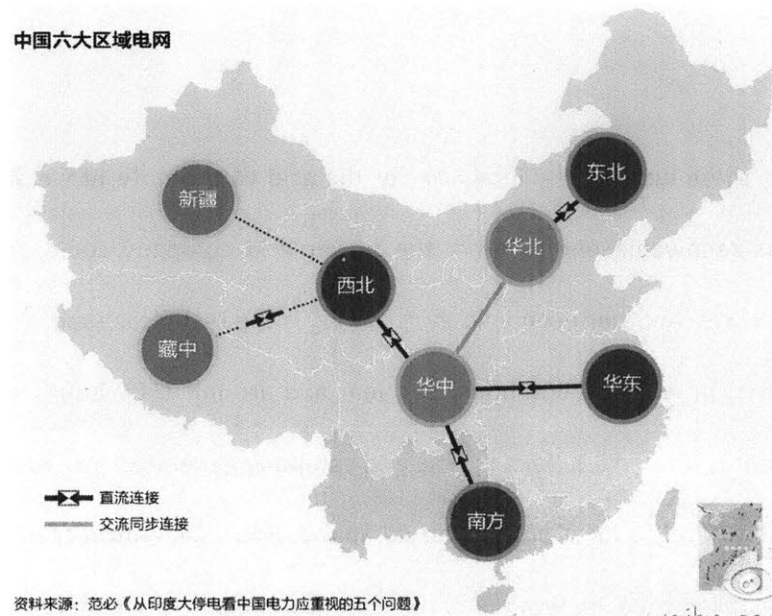
5.2 Reaction of the grid

Other than administrative requirement, there was no real incentive for the grid to promote RES-e. As the entire surcharge would be used as renewable energy fund, the power grid company could get nothing from the purchase and sales of RES-e. Another economic shortcoming is the technical issue. The compounded full operation hours (CFOHs) of wind is 2000 hours per year and around 1500 hours for solar PV. That of conventional power plant is around 5000 hours. The grid company generated profits by charging a transmission fee. At the micro level, a local power grid company didn't have incentive to support more RES-e, because if more installed capacity was taken by RES-e, total electricity generation would decrease and less transmission income could be generated.

Second, to provide connection support to the RES-e generation, the power grid companies also need to leave capacity on the grid for RES-e generators that were usually much smaller than conventional generators. These RES-e plants made the design and construction of power grid more complex. (Gao) Providing connection support to RES-e might even increase the cost of grid.

At the same time, distributed RES-e or off-grid RES-e took potential market from the power grid company. The more RES-e generate by distributed generator, such as building integrated PV or private solar panel, the less those consumers would consume electricity from the grid. Although the government required the power grid company to provide connection to those distributed RES-e generation, the monopoly status of the grid company in China determined that it had no motivation to really promote RES-e. That is also the same for stand-alone or off-grid RES-e generation.

Figure 3 The layout of SGCC and CSPG, source: Mr. Fan Bi's blog, note: the power grid of the grey area in southern China is controlled by CSPG, the rest area is controlled by SGCC



The behavior of the grid company came from its monopoly market position. Previously, the entire power sector was integrated in one institution in China, the ministry of electric power. After the State Grid Corporation of China (SGCC) was established, government required the separation of generation from the SGCC and established five big state owned power developer. However, all the rest parts of power sector, transmission, distribution and retail, were still monopolized by the SGCC and the China South Power Grid (CSPG), which monopolize part of the southern region.

Although the electricity price is set by NDRC, the SGCC still generates huge amount of profit from simply purchase and sales of electricity. Some experts criticized that the efficiency of the power grid was very low. (Xu, Yifan)

Intermittency was the biggest disadvantage of RES-e from wind and solar. Meanwhile, regions with abundant wind and solar source are usually not electricity load center. SGCC has planned a remote power transmission line of 750 kV, which is the highest level around the world, to solve the RES-e

transmission problem. However, some experts also worried that the high voltage line would be a too costly project and might be used more by conventional electricity source. (Xu, Yifan)

5.3 Effectiveness

Because of the nature of monopoly, the grid company, SGCC, lacked the incentives to promote RES-e. The government could only use administrative policy to require that the grid should connect to and purchase all RES-e. If the vertical monopoly is broken and the distribution and retail of the power sector could be liberalized, more market measures could be leveraged in promotion RES-e. The further development of RES-e really needs support from the grid side. Remote transmission and smart grid might be technical solutions for the grid. Market liberalization would provide the government more choices to promote RES-e.

6 Consumption

The consumption side of RES-e is not actually involved during the fast growth of renewable energy in China. There were some demonstration projects of consumer involved RES-e development. First, the green electricity scheme in Shanghai tried to motivate users to consume RES-e at a premium price. Second, some big developers integrated RES-e plant and electricity consuming factory and established self-sustained micro grid mode. Third, under the new policy of distributed solar PV, some household users also successfully connected private solar power generation to the power grid.

6.1 Shanghai green electricity scheme

Shanghai tried to implement a green electricity scheme to motivate voluntary purchase of RES-e. But the scheme ended up with no continuous RES-e subscribers. There are both economic and institutional barriers to improve, according to the analysis of the failure of the Shanghai case.

First, government needs to set up a mechanism to raise the awareness of RES-e in consumers, provide economic incentives as well as notable honor to RES-e users to fully utilize the contribution on the consumption side. Second, institutional reform or better organization is needed to utilize market measures in promoting RES-e schemes.

Introduction

Green electricity scheme is a market-based instrument (MBI) to form a market of RES-e, generate revenue from the premium sales and further develop RES-e based on the revenue. In 2005, Shanghai introduced the first green electricity market in China. (Mah, and Hills)

The purpose of the green electricity scheme was to build a market based on the willingness to pay for the RES-e at a premium price. Consumers were assumed to voluntarily purchase the RES-e. The theory of this mechanism is to leverage the willingness to pay from the consumers, generate revenue and

lighten the burden of government in supporting renewable energy development. At the same time, “the concept of the green electricity market is also a form of institutional changes.” (Mah, and Hills) Lots of countries, such as Germany, the Netherlands and UK, had implemented this mechanism, although it’s not considered as the mainstream.

Shanghai is one of the most developed cities in China. As residents of the economic center in the country, Shanghai citizens were also considered to have the higher awareness of environmental protection and energy conservation. As the 2010 world Expo was approaching, shanghai government also had the political incentive to realize its concept of “better city, better life”.

Figure 4 Subscription Statistics of Shanghai Green Electricity Scheme, source: The Kadoorie Institute, HKU

Subscribers/ Year (by year end)	2005	2006	2007	2008	2009
(1) Household Subscribers					
Number of Subscribers	N.A.	6,842	7,258	7,258	None
Subscription Volume (million kWh)	N.A.	1.06	1.14	1.14	None
(2) Corporate Subscribers					
Number of Subscribers	N.A.	22	24	24	None
Subscription Volume (million kWh)	N.A.	14.76	17.4 2	17.4 2	None
Total Subscription Volume: (1)+(2) (million kWh)	N.A.	15.82	18.56	18.56	None

However, the performance of the scheme was not satisfying. As showed in Figure 4, most of the original subscribers were corporate users, mainly organized by the government. The involvement of household

users was limited. At the end of the first subscription period, which was 2008, no more users continued their subscription.

Several barriers limited the performance of this scheme. First, the awareness of consumers was not focused or raised by the scheme. The scheme was not well known among normal citizens, so potential demand from household consumers was not fully utilized.

Second, the scheme barely provided any incentives to subscribers. The initial plan was only to entitle subscribers a “green leaf” label, which demonstrated their contribution to green electricity. However, even this honorable incentive was not promoted much over media. In the later stage, government provided economic incentives as tax relief on RES-e and consumption priority during electricity shortage. The marketer, Shanghai municipal electric power company, failed to implement these measures.

Third, as the marketer, SMEPC lacked marketing experience. SMEPC is a branch company of SGCC. The nature of monopoly determined that SMEPC could not be a good marketer and has no incentive to promote the scheme effectively.

Last but not the least, Institutional inertia also slowed the decision making process of this scheme. As mentioned in the second point, measures of tax relief and usage priority came out late. Low efficiency of communications between different departments at the municipal government level delayed the decision making process. (Mah, and Hills)

6.2 Micro grid demonstration

The energy-intensive industries have incentive to build self-supply power plants as the electricity cost will be lower than purchasing from power grid. Several metallurgical factories located in wind abundant areas build some wind plant to supply RES-e. This is a successful mode to promote renewable energy. The energy-intensive industries should take bigger responsibility in reducing carbon emission. As lot of

these factories have self-supply power plant, they could nicely absorb a reasonable capacity of RES-e themselves. At the same time, the mode of self-supply avoids the barriers from the power grid company and saves the cost of transmission and distribution.

6.3 Household generation

In 2012, NDRC issued official documents to promote distributed solar PV projects. In the fourth quarter 2012, the SERC also issued documents to support distributed solar PV grid connection. As soon as the document was released, a Beijing householder installed a small solar PV project on the roof of his house, applied for power grid connection, and at the beginning of 2013, started generation and sales of RES-e to power grid.

This was an inspiring demonstration project. It is the first time a private householder selling electricity to power grid in this country. However, as the supportive policies had not been fully established, the householder could only sell his RES-e at the grid-purchase price of conventional electricity, which was CNY 0.4/kWh. Because of the low price, the project would take 18 years to break even. (Xi)

6.4 Effectiveness

The three cases of consumer involved RES-e promotion have shown the potential of RES-e on the consumers' side. The Shanghai Green Electricity Scheme was a government driven RES-e consumption promotion project, which ended up failed. The model of voluntarily purchase of RES-e seems not working without associated policy support. However, distributed RES-e seems to be an effective model, as the consumers themselves could be involved within the projects and share the benefits. Opportunities and probabilities on the consumption of RES-e will be discussed in detail in Chapter 9.

7 Role of local government

In China, central government is the policy maker while the local governments take the responsibility of implementation. However, due to the variety between different regions, the effectiveness of policy is different from place to place. The incentive for the local government should also be considered during policymaking process.

For most of the local governments, the biggest interest of renewable energy industry is its contribution to local economic growth and financial income. Local governments welcome RES-e while it could bring incremental growth and income with a small cost. This phenomenon is more obvious in developing areas as the contribution of renewable energy could take a big percentage to local growth and as the land cost is relatively lower. In developed regions such as Shanghai, most of the motivation for RES-e is from administration policy and willingness to mitigate environmental problems.

7.1 The influence of tax policy

Local governments always tend to prioritize their local interests over central government policy. Before 2009, local governments welcomed wind power plant more than after. The reason was in 2009, a tax policy was set to support generators. The provision was that for the generators, the cost of wind turbine is deductible in the VAT of electricity generation. Before this policy, local government could collect taxes right after the construction of wind power plant. After that, local government could not get any taxes from wind power plant for five to eight years. (Ministry of Finance, China) This policy was designed to support RES-e generation, but somehow harmed the incentive of local governments.

After that policy, more and more local governments urged wind power developers introduce manufacture into the region to support local economy in another way. As some of the key procedures were controlled at the local level, developers could only try their best to satisfy the requirement of local

government. Under such background, manufacturers built factories at a less than economic effective level.

7.2 Effectiveness

The implications of a policy could be more than the government intension. Taking the variety of different region into consideration, regulators at the central government level could not make over simplified or generalized policies. In the case of VAT policy, the unpredicted effect to the local government finally harmed the generators, the intended beneficiary of the policy.

8 Difficulties and shortcomings of the policy-set

8.1 The focus on the supply and overlook on the demand

At the very beginning of the policy-set, the policymakers chose installed capacity rather than RES-e consumption as the first criterion to evaluate the target of renewable energy development. Installed capacity is the production capacity of RES-e, while RES-e consumption is the final use of it. The criterion of installed capacity is easier to evaluate and reach. As long as there are enough equipment and investment, capacity could be built in a short period. This actually happened in RES-e in China. However, the installation of capacity is just the beginning rather than the end of the RES-e industry. The lower section of the industrial chain is the market of the upper section. The overlook on the end users, because of the difficulty to evaluate and control them, finally caused the problem of overproduction.

In the RES-e equipment market, both the suppliers and the consumers were motivated. Developers, as the equipment consumers, were motivated to invest in RES-e power plants by the administrative policy and promised profits under FIT. Manufacturers, as the suppliers, were motivated both by the fast growing demand and the supportive policies. While both the supply and demand sides were motivated, a new market of RES-e equipment was quickly established.

In the RES-e power market, the developers, as the suppliers, were motivated, while the buyers, the power grid companies, had not enough incentive to absorb RES-e. Other than the technical limitations, the lack of demand on the other side of the power grid determined the lack of willingness to purchase RES-e.

8.2 Organizational barriers

The decision making process of the policy-set in the central government is fragmented. The policies in the policy-set were set by different department of the government and sometimes could overlap with

each other. At the same time, different targets between central and local government effected the implementation of the policy-set.

The NDRC is in general considered to be the most influential department in planning economic growth of China. However, other departments of the central government are also involved in decision-making process. In renewable energy industry, the electricity price is decided by the NDRC; the special funds are decided by ministry of finance (MOF); R&D projects is decided by ministry of science and technology (MOST); and state electricity regulatory commission (SERC) is namely the regulator. "Decision-making is fragmented at the central government level." (Lou) The fragmented decision-making process also caused overlapping. For instance, while supporting local manufacturers of wind turbine, the NDRC set the 70% localization criterion while the MOF also set the supportive subsidy policy to manufacturers. The overlapping of supportive policies might over motivated manufacturers and cause the problem of overproduction.

The local government did not hold the same target as the central government did. Local governments both practice according to the administration of the central government and yield to their own economic growth target. Because of the inconsistency between their targets, the local government did not necessarily behave according to the intension of the policy-set. For instance, the policy to deduct VAT of the RES-e equipment from the VAT of RES-e power was designed to motivate developers. But when that policy harmed the income of the local governments. They pushed the developers harder to attract local manufacturer, which both increased burden of developers and caused overproduction.

The fragmentation at the central level and inconsistency between central and local level are the organizational barriers of RES-e development.

8.3 The monopoly of power grid

The monopoly of power grid eliminated competition in the transmission, distribution and retail section. Market measures were not available in these sections to support RES-e development. The size of SGCC is huge. In 2012, the company generated a profit of more than CNY 200 billion with a profit margin of less than 3%. Any of the national department alone could hardly influence SGCC much. (Xu, Yifan)

RES-e development was not attractive to SGCC. At a micro level, the connected capacity of RES-e would affect that of conventional electricity. As the generation of RES-e plant was in general less productive than conventional plant, the power grid would get less income by connecting more RES-e. At the macro level, the demand of distributed power plant or self-sustain micro grid would harm the influence and income of the power grid.

At the same time, the power grid company also mostly monopolizes power grid technologies. The barriers and solutions were all claimed and dominated by the power grid company.

The power grid company has been arguing high voltage remote transmission system as one of the solution of RES-e absorption. However, some industry experts also questioned that the SGCC might use the system more on conventional electricity transmission than on RES-e. There were examples that the grid company used RES-e to construct new transmission capacity but reject RES-e by technical excuses after construction. (Xu, Yifan)

9 Potential and opportunity

9.1 Funding of renewable energy

The funding of renewable energy is a critical problem. Under the current FIT model, all the consumers are supposed to share the cost of RES-e. However, the price of electric power was sensitive in China. To industry, a rise in electricity price might harm economic growth. To low income householders, an increase in electricity price might also cause social problems. If a nationwide increase of electricity price is not an option, two solutions could be considered to solve the funding problem. One is fiscal channel and the other is RPS model.

The fiscal channel solution is to support RES-e by the government fiscal budget. The income of the fiscal channel is taxation on electricity consumption or carbon emission. By doing that, government could collect taxes mostly from energy intensive industries, which should take more responsibility in emission reduction.

The real RPS model is different from the RPS model on installed capacity, which was used in China at the very beginning of the discussed time period. By requiring a quota of RES-e generation or consumption, RPS model would form a market of certified emission reduction credits (CERs). The RPS model would fund RES-e within the CERs market it created and sustain the ecosystem.

9.2 Liberalization of power sector

The separation of distribution and retail section of the power grid would help leverage market measures to support RES-e. Take the Shanghai Green Electricity Scheme for example. If the retail of RES-e was a free market, several retailers of RES-e could compete under a market framework. Each of them would have better motivation to promote RES-e for their own sake.

9.3 Distributed RES-e

Distributed RES-e is a good method to involve more consumers into the promotion of RES-e. As showed in the Beijing householder case, normal citizens as well as factories have willingness to participate in RES-e development if they are properly motivated. Self-sustained RES-e would be more appropriate to promote RES-e consumption.

One important consideration to promote self-sustained RES-e is the pricing. If the price of distributed RES-e were the same as FIT, generators would prefer to sell all of their production to the power grid as the FIT is even higher than the electricity price of normal users. More economic benefit could be captured if they sell the electricity rather than consume it. At the same time, the RES-e price for distributed RES-e should also be high enough to support a reasonable IRR.

A good consideration is to price the distributed RES-e at a lower price and subsidize on generation. Because the normal consumption price of electricity is higher than the sales price, more benefits will be captured if the generators use the RES-e themselves.

10 Conclusion

Under the renewable policies of China, the manufacturing of renewable power equipment and the generation of RES-e grew rapidly. However, the power grid company, the consumers lacked incentives to sustain a local demand of RES-e. When focused on the supply side, policies could build up capacity shortly but could not make an industry sustainable. This conclusion is found in the study of RES-e policies in China. This conclusion is also valid in the manufacturing industry of renewable power equipment. Wind turbine manufacturers survive better than solar PV manufacturers, because the policies motivated local wind farm developers, who created a stable local demand.

Focusing on GDP growth in the past decades, China's government tended to design its economic growth policies on the supply side to build up capacity quickly. However, as the economic scale of China becomes significant, international market could no longer absorb the entire capacity growth in China, especially during economic decline. Facing sustainability issues as in the RES-e industry, China's government should shift its new policies focus on the local demand side and increase its domestic consumption.

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12 Appendix

Appendix 1 Major renewable energy regulation timeline in China, source: GlobalData, REEEP

Year	Organization	Policy	Key Points
2005	National People's Congress (NPC)	Renewable Energy Law	The NPC passed the law in 2005 for its implementation in 2006.
	National Development and Reform Commission	Renewable energy industry development instruction list	The list details 88 renewable energy areas (including 35 PV areas) subject to support.
2006	National Development and Reform Commission	Provisional administrative measures on pricing and cost sharing for renewable energy power generation	The document covers how to calculate FITs for renewable energy and the FIT system.
	National Development and Reform Commission	Administrative provisions for renewable energy power generation	The document specifies the scope of management responsibility for the central and local governments, the scope of responsibility for central government organizations, and the responsibilities and obligations of electric power generation and transmission companies.
	Ministry of Finance	Provisional administrative measures on the Renewable Energy Development Fund	The document specifies the scope for support from the Renewable Energy Development Fund and explains the procedures for applications for financial support and their acceptance. It also clarifies financial support methods and the scope of their applications and specifies the responsibility for monitoring and reporting uses of the fund.
	Ministry of Finance and Ministry of Construction	Provisional administrative measures on the fund for renewable	The document specifies how local government regulatory organizations should consider applications for subsidies for projects to use renewable energy in buildings and how they should appropriate those subsidies.

		energy applications for buildings	
	Ministry of Finance and Ministry of Construction	Instructions on deliberation process of pilot projects for renewable energy applications for buildings	The document specifies how local government regulatory organizations should deliberate pilot projects. Approved projects will be announced annually.
2007	Ministry of Science and Technology, National Development and Reform Commission	Renewable energy and new energy international cooperation plan	The plan promotes international cooperation in research on renewable energy and new energy priorities.
	National Development and Reform Commission	Temporary Measures of Regulation on Renewable Energy Surcharge	The document provides for how electric power transmission companies should collect and use renewable energy surcharges.
	National Development and Reform Commission	Medium to Long-term Renewable Energy Development Plan	The plan sets renewable energy development goals for 2010 and 2020.
2008	National Development and Reform Commission	11th Five-Year Development Plan for Renewable Energy	Based on the Medium to Long-term Renewable Energy Development Plan, the document sets renewable energy development goals (including modified ones) for 2010 and provides for specific action plans.

2009	National People's Congress	Revision of the Renewable Energy Law	The revised law was passed on December 26, 2009.
2011	National People's Congress and National Development and Reform Commission	The Twelfth five-year plan	The plan incorporates specific deployment targets for renewable energy