Research on Financing of Green Bonds Issued by Power Industry

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Abstract. The power industry in China is accelerating the pace of transition to green and low-carbon industry. Among the many factors restricting its green transformation, funding constraints are particularly prominent. On the one hand, the financing channels are too single for the reasons that the construction of power projects has long been relied on the government grants and bank loans. On the other hand, the term of power investment project is too long while the term of borrowings is too short, leading to the term mismatch. Green bonds have the characteristics of long maturity, low cost and quick review, which can alleviate the difficulties in the financing of the power industry. Therefore, it can be a good choice for power companies to use green bonds as an innovative financing tool to ease funding pressure. This paper takes the largest green energy company in China, Three Gorges Group, as an example, analyzing the financing behavior of issuing green bonds in the aspects of issue motivation and benefits. Based on the case, the paper draws conclusions that green bonds financing can be a proper use of green policies and it has obvious financing cost advantages. Finally, this paper contributes suggestions from the perspective of investors, enterprises and government to promote the healthy development of green bonds.

1. Introduction

In recent years, green finance has been fully developed in China as a new field of reform and innovation. As an important innovative product of green finance, green bonds are also developing rapidly. Driven by a series of government measures, issuers and intermediaries have actively participated in the green bond market, contributing to the continuous green bond product innovation and expansion in just a few years. The power industry in China is accelerating the pace of transition to green and low-carbon industry. Among the many factors restricting its green transformation, funding constraints are particularly prominent. The emergence of green bonds has broadened corporate financing channels, not only providing low-cost funding for corporate green projects, but also alleviating the pressure of mismatched funding maturities. Therefore, the transformation of the power industry needs the support of innovative financial products, and the emergence of green bonds provides a way for it to get out of the financial dilemma.

2. Development status of green bonds

2.1. Concept of green bonds

Currently, the definition of green bonds in the world is basically similar. The Organization for Economic Cooperation and Development (OECD) believes that green bonds are issued by governments, financial institutions, and companies to promote low-carbon economy or finance projects with fixed income. The People's Bank of China believes that green bonds are securities that
are issued in accordance with legal procedures and pay principal and interest in accordance with the agreement, including green corporate bonds, green financial bonds, etc., to raise funds to promote the development of green industries, green projects or green economic activities [1]

2.2. Development process in China
In 2007, the European Investment Bank issued the world's first green bond, marking the official opening of the international green bond market. Compared with the international market, the domestic green bond market has a late start, but has developed rapidly. From 2015 to the present, its development process can be roughly divided into three different stages: 2015-2017, the standard and regulatory system establishment stage. The regulatory authorities quickly established China's green bond certification standards and market supervision framework within a short period of two years, laying a solid foundation for the development of China's green bond market. From 2018 to 2020, the scale of the market will grow and supporting policies will be gradually improved. In 2018 and 2019, domestic green bond issuance reached 220.9 billion yuan and 295.6 billion yuan, respectively, with an increase of 6.5% and 33.8%. After 2021, a new era of development under the "dual carbon" goal. As of May 2021, domestic green bond issuance reached 170.4 billion yuan, significantly higher than the same period in 2019 and 2020. It is foreseeable that under the promotion of the "dual carbon" policy, China's green bond market will usher in a situation of rapid growth.

2.3. Scale of green bonds
In 2016, green finance was listed as an important issue by the G20 under the initiative of the Chinese government. During that year, the scale of green bond issuance in China has exploded, becoming the world's first. In 2017, affected by the downturn in my country's bond market, although the number of green bonds is still increasing, the overall development speed has slowed down. From 2018 to 2019, the number and scale of domestic labeled green bond issuance continued to grow steadily. By the end of 2019, the number of domestic labeled green bond issuance has reached 285.59 billion yuan. In 2020, there is a slight decline. Affected by Covid-19, the overall economy has slowed down. However, under the guidance of the "wide credit" monetary policy and a series of financial relief policies, the net financing of the domestic bond market in the first quarter was significantly higher than the same period in 2019. With the advancement of the resumption of work and production, the credit risk brought by the epidemic was gradually released in the second half of the year, leading to a slowdown in the issuance of new bonds, and the issuance of green bonds was also affected to a certain extent [1]

![Figure1. China's green label bond issuance from 2016 to 2020](image)

3. Case Introduction

3.1. Introduction of the power industry in China
The traditional power industry is dominated by coal power, and it has long assumed basic roles in the power system such as safe and stable power supply, emergency peak shaving, and centralized heating.
However, the coal power utilization in China have been declining year after year, and the coal power industry is continuously losing money due to the slowdown in power demand, rising coal prices, and expanding market trading power. And the development of coal power is accompanied by over-exploitation of petroleum and coal and massive production of greenhouse gases, as well as the resulting excessive consumption of resources and environmental degradation.

In November 2015, China proposed that "Adhere to green development, advance the energy revolution, accelerate energy technology innovation, and build a clean, low-carbon, safe and efficient modern energy system. Increase the proportion of non-fossil energy sources and accelerate the development of wind, solar, biomass, and water Energy, geothermal energy, safe and efficient development of nuclear power". In the context of economic development and environmental protection, the power industry's transition to green and low-carbon has become a general trend.

3.2. Introduction of Three Gorges Group

As the world's largest hydropower development and operation company, China Three Gorges Group Co., Ltd. was established in 1993. It is a wholly state-owned enterprise with hydropower as its main business. It is responsible for the development, construction and operation of six giant hydropower stations, including Gezhouba, Three Gorges, Xiluodu, Xiangjiaba, Wudongde, and Baihetan on the mainstream of the Yangtze River, as well as the expansion of other new energy businesses such as wind power and solar energy. China Three Gorges Group is the leader of China's hydropower industry chain "going out" and the leader of innovative development of new energy such as offshore wind power. The Three Gorges Project, with huge social and economic benefits and an important national strategic position, has become a model of the world's hydropower industry. The Three Gorges Group is China's largest clean energy company. Its clean energy development is highly in line with the country's policy guidance and meets the requirements of the power industry's energy structure adjustment and green transformation.

4. Analysis of corporate financing by issuing green bonds

4.1. Motivation for issuing green bonds

4.1.1. Seize market opportunities and enjoy policy benefits. The Green Finance Professional Committee issued the "Green Bond Support Project Catalog" in 2015, which clarified the six major application areas of green financial bonds. Then the National Development and Reform Commission issued the "Green Bond Issuance Guidelines" in 2016. While relevant regulations have been made on the use, the review conditions for corporate bond issuance have been relaxed to encourage companies to issue green bonds for financing. And encourage local governments to encourage the development of green bonds through subsidies and bond discounts. In the same year, both the Shanghai Stock Exchange and the Shenzhen Stock Exchange set up green channels to improve the efficiency of pre-review of green bond listings. This kind of policy opportunity mainly comes from three aspects: relaxation of access conditions for bond issuers, acceleration of bond approval and policy incentives. This enables companies to raise funds through green bonds, firstly, they are not restricted by bond issuance indicators, and the financing proportion can be relaxed to 80% of the total project investment. Secondly, they can enjoy the green channel in terms of approval procedures to simplify the review process and shorten the review time. Third, you can enjoy financial incentives in terms of local policies, such as interest discounts, tax deductions and so on. The Three Gorges Group also seized the opportunity of green bond development. In addition, hydropower and wind power projects have obvious environmental effects and are green projects that meet the requirements of the catalog. Therefore, the Three Gorges Group’s green bond financing has natural advantages.

4.1.2 Satisfy low-cost funding needs. Since 2015, the Three Gorges Group has started construction of various hydropower and wind power projects, entering the peak period of project construction and the peak period of capital demand. While internal financing cannot meet the needs of project construction,
and the cost of bank loans is high, green bonds are actually a means taken by the Three Gorges Group to solve funding pressures and meet low-cost funding needs.

4.1.3 Alleviate the problem of project funding mismatch. The construction cycle of power projects does not match the maturity of bank loans. The “short-term borrowing and long-term investment” leads to the problem of maturity mismatch of the power project. The advantage of green bonds for power companies is mainly reflected in long-term financing. The construction period of Wudongde Hydropower Station and Baihetan Hydropower Station, the three Gorges Group’s main fundraising projects, is expected to be 6 years, while the three Gorges Group’s green bond issuance is mostly mid-to-long term, including 3-year, 5-year and 10-year periods. The issuance scale is 20 billion, 30 billion and 6 billion, respectively, with the scale accounting for 35.71%, 53.57% and 10.71%. It can be seen that the scale and proportion of the five-year green bonds of the Three Gorges Group are the largest, which is very close to the construction period of the main fundraising projects, which can effectively alleviate the problem of mismatched project funds.

4.2 Benefits of issuing green bonds

4.2.1 Economic benefit. The economic benefit of green bond issuance is manifested in a lower coupon rate. Since the Three Gorges Group has not issued ordinary corporate bonds, it is impossible to make comparisons. Therefore, comparable bonds are selected to analyze their financing cost advantages. In order to avoid the interference of maturity, debt rating, issuance time, issuance scale and other factors on the analysis results, when selecting comparable bonds, the bond maturity is set to be the same as the maturity of the Three Gorges bonds, the debt rating is AAA, and the value date is Set a total of 3 months before and after the month of issuance of the Three Gorges Green Bonds, and finally perform weighted average processing on the coupon rates of comparable corporate bonds.

Taking "G16 Three Gorges 2" as an example, it was issued in August 2016, so ordinary corporate bonds from July to September 2016 will be selected, with a bond rating of AAA and an ordinary corporate bond with a 10-year issuance period. A total of 8 comparable bonds were found, and their issuance rates were weighted averaged to obtain the interest rates of comparable bonds. It is calculated that the average issuance rate of comparable bonds of "G16 Three Gorges 2" is 3.46%, which is 7bp higher than the issuance rate of "G16 Three Gorges 2" of 3.39%.

The formula is as follows:

\[ R = \frac{\sum_{i=1}^{n} S_i R_i}{\sum_{i=1}^{n} S_i} \]

\( R \) is the average issuance rate of comparable corporate bonds, \( n \) is the number of comparable corporate bonds, \( S_i \) is the issuance scale, and \( R_i \) is the coupon rate at the time of issuance.

Among the 11 green corporate bonds of the Three Gorges Group, “G16 Three Gorges 1” did not find a comparable bond under these conditions and was not considered. The coupon rates of the other 10 green bonds are significantly lower than the average issuance rate of comparable bonds, and the cost advantage is between 7 and 134 bp. Comparing the financing cost advantages of green bonds with different bond maturities, the three-year term is the largest, the 5-year term is the second, and the 10-year term has the smallest financing cost advantage. This shows that the green corporate bonds of the Three Gorges Group have obvious advantages compared with ordinary corporate bonds in the market.

The specific data is shown in Table 1
Table 1 Coupon rate saving by issuing green bonds

| Bond name         | Rating | Bond issuance scale (100 million) | Bond maturity (year) | Coupon rate (%) | Number of comparable bonds | Comparable bonds coupon rate | Bp |
|-------------------|--------|-----------------------------------|----------------------|-----------------|---------------------------|-----------------------------|----|
| G16 Three Gorges1 | AAA    | 35                                | 3                    | 2.92            | 0                         |                             |    |
| G16 Three Gorges2 | AAA    | 25                                | 10                   | 3.39            | 8                         | 3.46                        | 7  |
| G17 Three Gorges1 | AAA    | 35                                | 3                    | 4.56            | 50                        | 5.34                        | 78 |
| G17 Three Gorges2 | AAA    | 20                                | 3                    | 4.68            | 21                        | 5.63                        | 95 |
| G18 Three Gorges1 | AAA    | 25                                | 3                    | 4              | 98                        | 5.34                        | 134|
| G18 Three Gorges2 | AAA    | 10                                | 5                    | 4.2            | 84                        | 4.74                        | 54 |
| G18 Three Gorges3 | AAA    | 40                                | 3                    | 4.08            | 110                       | 5.3                         | 122|
| G19 Three Gorges1 | AAA    | 25                                | 5                    | 3.73            | 54                        | 4.32                        | 59 |
| G19 Three Gorges2 | AAA    | 5                                 | 10                   | 4.4            | 6                         | 4.74                        | 34 |
| G19 Three Gorges3 | AAA    | 5                                 | 3                    | 3.38            | 95                        | 4.04                        | 66 |
| G19 Three Gorges4 | AAA    | 30                                | 10                   | 4.3            | 11                        | 4.42                        | 12 |

4.2.2 Environmental benefits. Three Gorges Group's green bonds include hydropower projects and wind power projects. Wind power is the use of wind energy to generate electricity, and hydropower is the use of hydropower to generate electricity. Both use renewable and clean energy to generate electricity, and no pollutants are generated during the power generation process. Other power generation methods consume energy and produce pollution, such as coal-fired power generation and waste-to-energy generation. It can be seen that the environmental benefits of wind power projects and hydropower projects are mainly reflected in reducing the consumption of non-renewable energy and reducing pollutant emissions. When the green projects under construction of the Three Gorges Group are put into production, they will bring considerable environmental benefits. These environmental benefits can be specifically measured by the amount of standard coal saved, CO2 emission reduction, SO2 emission reduction, NOX emission reduction, and soot emission reduction. Specific energy saving and emission reduction benefits are shown in the following Table.

Table 2 Energy saving and emission reduction benefits generated by the project

| Project                        | Annual standard coal savings (Ten thousand tons) | Annual CO2 emission reduction (Ten thousand tons) | Annual SO2 emission reduction (Ten thousand tons) | Annual NOX emission reduction (Ten thousand tons) | Annual smoke reduction (Ten thousand tons) |
|-------------------------------|-------------------------------------------------|--------------------------------------------------|--------------------------------------------------|-------------------------------------------------|------------------------------------------|
| Dafeng Wind Power Station     | 38.34                                           | 66.36                                             | 0.34                                              | 0.3                                             | 2.22                                     |
| Zhuanghe Wind Power Station   | 32.25                                           | 55.82                                             | 0.28                                              | 0.25                                            | 1.87                                     |
| Xihuodu Wind Power Station    | 2070                                            | 4606                                              | 2.17                                              | 2.17                                            | 0.65                                     |
| Wudongde Wind Power Station   | 1400.4                                          | 3116                                              | 1.47                                              | 1.47                                            | 0.44                                     |
| Xiangjiaba Wind Power Station | 1098                                            | 2443                                              | 1.15                                              | 1.15                                            | 0.35                                     |
| Baihetan Wind Power Station   | 1929.49                                         | 4953                                              | 56.02                                             | 14.86                                           | 0                                        |

4.2.3. Reputation benefit. The explosive development of green bond market in China has also enabled the issuance of green bonds to gain more exposure. From the perspective of media promotion, green bonds are often marked with slogans such as "first domestic order" and "largest scale" to attract market attention. For example, in 2015, China General Nuclear Power's wind power additional carbon-income medium-term notes were rated as "the first overseas carbon bond". In 2016, Goldwind Technology's green medium-term notes was rated as "the first domestic green perpetual bond", and the
State Grid Energy Conservation Green Medium-term Notes in 2017 Was rated as "the first green bond in the field of biomass power generation" and so on.

By issuing green bonds, companies can not only gain public opinion support, but also signal to investors that they are actively fulfilling their social responsibilities, thereby enhancing corporate reputation and attracting investors[4]. According to the reputation theory, a good reputation has an incentive effect, which can enhance the competitiveness of an enterprise and help it create value. After the Three Gorges Group launched its green corporate bonds in 2016, its green bonds have performed exceptionally well. Its green corporate bonds are regarded as "the largest domestic green corporate bonds", and the euro green bonds are regarded as "China's first green bonds certified by the climate bond standard", and were rated as "2017" by the internationally renowned financial media "The Asset" "Best Green Bond of the Year", green exchangeable bonds are regarded as "the first domestic green exchangeable bonds." The successful launch of these green bonds has brought a certain degree of media exposure to the Three Gorges Group, and also sent a positive signal to the market that the Three Gorges Group has been deeply engaged in environmentally beneficial power projects for a long time, and has established a green and clean corporate image for the Three Gorges Group.

5. Conclusion and Suggestions
In order to meet the large-scale long-term funds required for the construction of wind power stations and large hydropower stations, the Three Gorges Group has issued multiple green bonds, which has made great contributions to the prosperity of my country's green bond market and the development of green industries. In order to enable other companies to make use of their strengths and avoid weaknesses, and the future development of green bonds can be more healthy and regulated, this article proposes the following recommendations from the perspectives of investors, enterprises, and supervisors.

5.1 Investors
Investors need to be cautious when investing in green bonds. The series of green bonds issued by the Three Gorges Group can be enthusiastically sought after by international and domestic investors for that it benefits from both the policy advantages and its own efforts, but it does not mean that there is no risk for investors to invest in green bonds. Green bonds are considered to be relatively safe investment tools due to their policy support and high credit ratings. Although green bonds have environmental benefits, they are essentially debt financing tools, it contains various risks in nature. Investors cannot blindly invest in the green bond market based on policy support and their own sense of social responsibility. Investors should be more cautious when making investment decisions.

5.2 Companies
Green bonds provide companies with a new low-cost financing idea, while the strict requirements for the use and management of funds in green bonds have brought the cost of capital use to enterprises. Companies must do what they can when considering the issuance of green bonds. The long construction period and large investment of green projects make capital planning more difficult. In addition, companies should make more efforts to standardize and improve information disclosure, and disclose detailed information about the progress of green projects, the use of funds, and environmental benefits.

5.3 Supervisors
The government should promote the establishment of a unified scientific environmental benefit assessment method and environmental disclosure indicator system from the policy level, standardize and strengthen the disclosure of environmental benefits, and enhance the transparency of bonds.[5] Efforts to cultivate the society's awareness of green investment and financing, so that more enterprises and investors can participate in it. We can reduce financing costs through interest discounts and tax cuts to encourage companies to issue green bonds for financing; through news reports, awards of outstanding green bonds, etc., we can cultivate the nation's green investment and financing awareness.
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