

Pioneering Energy Efficiency Through Green Financing in Guangdong: Project Partnership with Multilateral Bank



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Abstract Green development has become the national strategy of China, and green credit is an important source of incentive for green development. The Guangdong Energy Efficiency Power Project (EEPP) is the first pilot project of this kind based on a partnership between the Chinese government and the Asian Development Bank, which is considered to be successful, in terms of both operations and environmental effects. Based on the analysis of this EEPP case, this study provides a set of relevant experiences for the development of green credit and green financing that can be potentially extended nationwide referencing on the Guangdong model for the sustainable development in China.

Keywords Green credit · Efficiency power plant · Energy-saving and emission reduction · Revolving fund

1 Introduction

Green finance is a phenomenon that combines the world of finance and business with environmentally friendly behaviour. Green finance is an arena for many participants, including individual and business consumers, producers, investors and financial lenders [1].

In recent years, China has adopted market-based means, such as green finance, as important means of improving the environment and strives to create a green credit policy system to support the development of a green economy, circular economy and low-carbon economy. Significant results have been achieved in promoting economic restructuring and industrial structural transformation and upgrading.

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According to statistics of the China Banking Regulatory Commission (CBRC), the green credit of 21 major banks and financial institutions of China reached 8.22 trillion Yuan by the end of June 2017. According to the Chinese green credit statistics system, green credit consists of two parts: one part supports manufacturing terminals of three strategic emerging industries, such as energy conservation, environmental protection and new energy vehicles; the other part supports projects and services of energy conservation and environmental protection, and this portion of loans is expected to save 215 million tons of standard coal annually and to reduce carbon dioxide emissions by 491 million tons annually.

As a means of green credit, the Guangdong Energy Efficiency Power Plant (EEPP) project is the first pilot project between the Chinese government and the Asian Development Bank (ADB) in the field of energy conservation, and it also known as the project of the ADB loan to promote energy conservation and emission reduction. To promote the national energy conservation and emission reduction efforts, the Chinese government began to discuss with ADB how to build the first EEPP project in China at the beginning of the 11th Five-Year Plan. In view of the important role of the Guangdong Province in China's economic development and energy consumption, and due to the pioneering spirit of being the first, Chinese government authorities and ADB agreed to consider Guangdong Province as a pilot province of the EEPP in March 2006. It was anticipated that Guangdong would explore financing and management models for energy conservation projects that can be replicated in other provinces and regions in order to promote energy conservation and emission reduction efforts throughout the country.

The context of the EEPP is to use ADB loans to carry out energy-saving and emission reduction efforts. The project, guaranteed by the Chinese government and using ADB's \$100 million loan and supporting domestic funds, continues to support energy conservation and emission reduction projects in Guangdong Province on a rolling basis between 2009 and 2026. The project execution centre shall transfer the loan to each subproject implementing unit after the loan is exchanged into RMB.

Energy-saving efforts in Guangdong Province play an important role in the effectiveness of energy-saving efforts in China because Guangdong Province accounts for approximately one-tenth of the country's energy consumption. In short, the successful promotion of the EEPP has played an important role in promoting energy conservation and emission reduction in Guangdong Province and in the whole country.

2 Literature Review

2.1 Definition of Green Finance

Today, the term green finance appears in many studies. However, there is no universal definition of green finance. Höhne et al. [2] argue that green finance is a broad term that can refer to financial investments flowing into sustainable development projects

and initiatives, environmental products and policies that encourage the development of a more sustainable economy. Zadek et al. [3] argue that green finance is often used interchangeably with green investment. However, in practice, green finance is a wider lens including more than investments, as defined by Bloomberg New Energy Finance and others. Lindenberg [4] suggests that green finance comprises financing of green investments, financing of public green policies and a green financial system. Volz et al. [5] argue that green finance comprises all forms of investment or lending that take into account environmental impact and enhance environmental sustainability.

In general, most studies agree that green finance is a kind of financial product or service for sustainable development projects and environmentally responsible investments [6]. Green finance is indeed a broad term that includes all forms of investment or lending related to sustainable development projects.

Green credit is frequently used in China and refers to the actual green finance product and service offered by banks in China, such as loans related to environmental protection, emission reduction and energy conservation projects. If green finance is considered as a solution to environmental problems and resource management [7, 8], then green credit is the actual bridge that connects the environmental industries with the financial institutions [9].

2.2 Factors Affecting Green Finance

The promotion of green credit as a quasi-regular tool is not new. Many nations, including developing countries, such as India and Brazil, use this tool to promote environmentally beneficial financing at subsidized rates, often using public financial agencies as conduits [10].

While capital cost is largely influenced by the macroeconomic environment and fixed costs are stable, the ability to minimize bad debt can be managed to increase the profit of a bank. Typically, this strategy requires the lenders to monitor a borrower's capital stock, earnings, liquidity, etc. Those factors are often recognized as counterparty credit risks that influence the borrower's ability to repay the loan (i.e. the default risk of a borrower) [11–13]. Recently, environmental risk is recognized as one of the most important factors that can influence credit risk.

As suggested by Thompson and Cowton [14], the consideration of environmental issues is mainly motivated by the concern of risk management. In addition, some scholars find a correlation between sustainability performance and credit risks of borrowers [15, 16]

There is increasing pressure being placed on firms from a number of different sources, such as governmental regulation, community participation and market demand, to engage firms in environmental initiatives. These factors play different roles at various developmental periods. Government regulation was initially the major pressure. However, community participation and market demand have become increasingly important [17].

The degree of participation in green finance is truly management's decision. According to Koch et al. [18], decision-making from a bank's perspective involves managing: (1) bank performance, (2) securities and interest rate risks, (3) liquidity and capital, (4) loans and credit and (5) investments, globalization and technology.

This article will analyse the factors affecting green finance by examining a case of green credit in Guangdong Province, China, namely, the EEPP.

3 Operations of the EEPP

3.1 Defining an EEPP

An efficiency power plan is a virtual power plant composed of specific measures in demand-side management that enables savings in electricity resources by adopting an investment on a package of energy-saving plans and energy efficiency projects. The reduced demand for electricity is treated as the amount of electricity provided by a "virtual power plant", and the international energy industry has implemented similar demand-side management of electricity. The ability to implement power demand-side management and dispatch the resources of the demand side is perceived as EEPP by the international energy community.

3.2 Introduction of the EEPP

In recent years, China has produced a series of green policies, including green tax, green procurement, and green policies that are relevant to the financial sector, namely green credit, insurance and security policies. Of the three, the green credit policy is the most advanced, with three agencies (the Ministry of Environmental Protection, the Peoples' Bank of China and the China Banking Regulatory Commission) sharing the responsibility for implementation [19].

As a means of green credit, the development of EEPP is an important measure to develop green credit and practise green development in China. The concept of EEPP was proposed in the opening year of China's 11th Five-Year Plan; it conforms to the requirements of energy-saving situations and will span the 12th Five-Year Plan and the 13th Five-Year Plan. The main goal of the project is to encourage the main body of energy conservation to carry out energy-saving and emission reduction activities and to support the development of energy-saving service companies. The project is consistent with the medium- and long-term energy conservation plans of Guangdong Province, the 12th Five-Year Plan for energy saving and longer-term development planning. The project will be one of the important examples of energy-saving efforts in Guangdong Province for a long time to come.

3.3 Organizational Structure and Function

The implementation, evaluation and supervision of EEPP are relatively independent, and the fund management is relatively separate from project management. The organizational management structure of the project is shown in Fig. 1, and the figure shows a clear division of labour among the departments and their respective duties.

The project coordination group is responsible for guiding the overall operation of the project, researching and formulating the project policy and reviewing the loan of the subproject. The project coordination team is composed of members from the Economic and Information Commission of Guangdong Province (EICGP), Guangdong Provincial Development and Reform Commission (GPDRC), Department of Finance of Guangdong Province (DOFGP) and State-owned Assets Supervision and Administration Commission of Guangdong Province (SASACGP). Among these members, the EICGP is the lead unit of the project and is responsible for the daily management and coordination of the project coordination group; the GPDRC is responsible for examining and approving the feasibility study report of the project, reviewing the application report of the project funds and reporting to the approval of the national Development and Reform Commission; the DOFGP is the representative unit of project creditor’s rights and liabilities, responsible for withdrawing funds from ADB, managing special accounts for the project, signing trust contracts with trust financial service institutions and monitoring the operation of loan funds; the

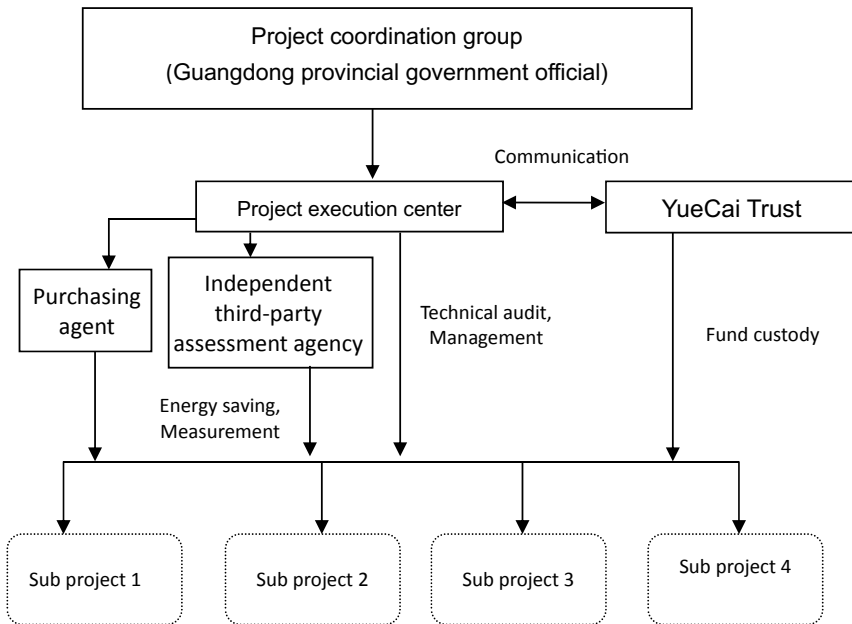


Fig. 1 Project organization management architecture. Source GEEPP [20]

SASACGP is responsible for project organization of the state-owned enterprises of the Guangdong Province.

The project execution centre (in the Energy-Saving Center of Guangdong Province) is in charge of project recruitment and concrete management. The specific work of this centre includes subproject collection, project overall monitoring and day-to-day project management, technical review and evaluation of subprojects, entrusting the third-party evaluation organization to evaluate the subprojects, submitting reports to the project coordination group and ADB according to regulations, etc.

The Guangdong YueCai Trust Co., Ltd. (GYCT) is the trust financial service institution. Entrusted by the Department of Finance of Guangdong Province, the GYCT is responsible for subproject unit financial capacity assessment, issuance and recovery management of subloans, portfolio management of subloans, mortgage or guarantee management of subloans, trust account management, submission of project financial reports on a regular basis, delivery of real-time information on the project and identification and reporting of problems in a timely manner.

Entrusted by the project execution centre, the third-party evaluation organization is responsible for the pre-project evaluation (estimation of energy savings, project implementation monitoring, etc.) and the post-retrofit evaluation (inspection and acceptance of the project, determination of the actual energy savings, follow-up tracking, etc.).

3.4 Subproject Introduction of the EPPP

Jointly promoted by the EICGP, GPDRC, DOFGP and SASACGP, the EPPP developed an overall operational framework for batch implementation, that is, the \$100 million of total loans from the ADB was implemented in batches. At present, three batches of the first phase of the project have been completed, and \$100 million of green loans have been used and repaid. The project has entered the second phase, that is, the batch of revolving use of loan funds. The subprojects for each batch are as follows.

3.4.1 The First Batch of the Project

The overall planning for Guangdong EPPP and its first batch of development were approved by the state council of China on 1 April 2008, and passed the resolution of the board of directors of ADB on 4 June 2008. The first batch (see Table 1) used \$35 million in ADB loans, or 238 million Yuan (the agreed exchange rate is \$1 for 6.8 Yuan), each for a loan period of three years. The ADB loans accounted for 68.1% of the total investment in subprojects, and all subprojects were completed in 2013. In the first batch, Guangzhou Zhiguang Electric Co., Ltd. and Guangdong Shaogang Songshan Co., Ltd. are the only large companies, and the remaining six companies are energy-saving service companies or small companies. Of the eight subprojects in

Table 1 First batch of the Guangdong EEPP

Subproject enterprise (borrower)	Content	Total investment (1000 Yuan)	ADB loan (1000 Yuan)	ADB loans account for total investment (%)
1	Promotion of high-voltage inverter	94,000	67,007	71.3
2	Building intelligent energy-saving reconstruction	25,000	20,000	80.0
3	Promotion of high efficiency and energy-saving transformer	12,500	10,000	80.0
4	Steam recovery and utilization/energy-saving retrofit of industrial boiler	12,500	10,000	80.0
5	Optimization monitoring and management system for transformer	51,600	20,000	38.8
6	Recovery and utilization of waste heat of flue gas in ring cooler	87,600	70,080	80.0
7	Promotion of reactive power compensation device	3741	2993	80.0
8	Promotion of the high efficiency and energy-saving transformer	62,500	37,920	60.7
Total		349,441	238,000	68.1

Source GEEPP [20]

the first batch, four are for the promotion and application of new equipment and new technologies, and four are for the upgrading of existing equipment and technologies.

3.4.2 The Second Batch of the Project

The fund application report of the second batch of the project was approved by the National Development and Reform Commission in November 2009. The second batch (see Table 1) used \$22.06 million in ADB loans, or 150 million Yuan (the agreed exchange rate is \$1 for 6.8 Yuan), each for a loan period of three years. The ADB loans accounted for 36.1% of the total investment in subprojects, and all subprojects were completed in 2014. In the second batch, Guangdong Real Faith Lighting Technology

Table 2 The second batch of the Guangdong EEP

Subproject enterprise (borrower)	Content	Total investment (1000 Yuan)	ADB loan (1000 Yuan)	ADB loans account for total investment (%)
1	Promotion of solar photovoltaic power generation system	68,000	35,000	51.5
2	Promotion of energy-saving transformer	30,000	10,000	33.3
3	Promotion of regenerative high efficiency and energy-saving aluminium melting furnace	40,000	20,000	50.0
4	Digital substation transformation and distribution monitoring management system	127,800	20,000	15.6
5	Promotion of LED street lamp	100,000	50,000	50.0
6	Promotion of energy-saving automatic plastic moulding machine	50,000	15,000	30.0
Total		415,800	150,000	36.1

Source GEEPP [20]

Co., Ltd. and Borche Machinery Co., Ltd. are the only large companies, and the remaining four companies are energy-saving service companies or small companies. Of the six subprojects in the second batch, five were for the promotion and application of new equipment and new technologies, and one was for the upgrading of existing equipment and technologies (Table 2).

3.4.3 The Third Batch of the Project

The third batch (see Table 3) used the rest of the ADB loans, that is, \$42.94 million or 292 million Yuan (the agreed exchange rate is \$1 for 6.8 Yuan), each for a loan period of three to five years. The ADB loans accounted for 44.5% of the total investment in subprojects, and all subprojects were completed in 2015. In the third batch, Guangdong Shaogang Songshan Co., Ltd. and Borche Machinery co., Ltd. are the only large companies, and the remaining four companies are energy-saving service companies or small companies. Moreover, this is the second time that these two large companies have participated in the Guangdong Energy Efficiency Power Plant project, which reflects the enthusiasm of participating in the project and demonstrates the appeal of the project. Of the six subprojects in the third batch, four were for the promotion and application of new equipment and new technologies, and four were for the upgrading of existing equipment and technologies.

Table 3 Third batch of the Guangdong EEPP

Subproject enterprise (borrower)	Content	Total investment (1000 Yuan)	ADB loan (1000 Yuan)	ADB loans account for total investment (%)
1	Promotion of steam recycling technology	94,813	64,000	67.5
2	Promotion of insulated thin-walled copper busbar	45,000	30,000	66.7
3	Energy-saving transformation of air conditioner	323,100	100,000	58.8
4	Promotion of high-power frequency conversion speed regulation system	75,000	50,000	66.7
5	Promotion of energy-saving automatic plastic moulding machine	102,000	37,000	36.3
6	Promotion of LED street lamp	16,000	11,000	68.75
Total		655,913	292,000	44.5

Source GEEPP [20]

3.4.4 The Batch of Revolving Fund of the Project

The first three batches were completed by 2015, and the ADB loan of US \$100 million was used once; then, the project entered the batch of revolving fund (see Table 4). The batch began in August 2010 with the first subproject to repay the first principal amount and will continue until the end of the project in 2026. The number of subjects of the batch reached 22 by 31 October 2017, and rolling use of loans in Guangdong Province can promote more energy-saving and emission reduction projects. This batch was Guangzhou Zhiguang Energy-Saving Company's and others' second time participating in the project, Borche Machinery Co., Ltd.'s third time participating in the project and Zhuhai Industrial Green Building Technology Company's and others' fourth time participating in the project. The multiple participation of enterprises fully reflects the appeal of the EEPP to enterprises and the promotion of energy saving and emission reduction in Guangdong. The batch of revolving fund had used more than \$100 million by 31 October 2017, meaning the ADB loans had been recycled twice. This observation reflects the project operation mechanism of recycling and continuously promoting energy-saving and emission reduction work in Guangdong.

4 Results and Findings

Different from traditional financial projects, the project of the Guangdong EEPP has distinct green financial characteristics from its origin of operations. The details are as follows:

4.1 *The Purpose of the Project as Green Development*

As a green finance project, the purpose of green development is to distinguish the EEPP from the traditional financial project. The main purpose of traditional financial projects is profit, while green financial projects are green environmental protection; there is an essential difference between the two goals. The three main application conditions of the EEPP are: a full mortgage guarantee, content of the project that conforms to requirements and measurement of energy savings. From the application conditions, we can see that the EEPP is a typical green project that aims to save energy and reduce emissions.

The technical scope and environmental protection requirements of the EEPP reflect green environmental protection. The EEPP has expanded the concept of the energy efficiency, aimed not only at saving electricity but also to the broad sense of energy conservation through the adoption of various energy efficiency and new energy development technologies to achieve the purpose of energy saving and emission reduction. The technical scope includes the optimal control of motor and motor drive systems and electric power transmission and distribution, such as transformer

Table 4 Revolving fund of the Guangdong EEPF

Subproject enterprise (borrower)	Content	Total investment (1000 Yuan)	ADB loan (1000 Yuan)	ADB loans account for total investment (%)
1	Promotion of energy-saving micro motor	50,000	30,000	60.0
2	Promotion of frequency conversion speed regulation system	45,000	30,000	66.7
3	Promotion of energy-saving transformer	20,000	12,000	60.0
4	Promotion of energy-saving industrial boiler	15,000	10,000	66.7
5	Construction of solar photovoltaic power station	28,818	15,000	52.1
6	Transformation of environmental degradation product line	27,350	20,000	73.1
7	Promotion of energy-saving dyeing equipment	50,000	20,000	40.0
8	Guangdong Yuedian Hongfa Hydropower Project	147,920	60,000	40.6
9	Construction of solar photovoltaic system and application of new energy in Guangdong province	244,000	60,000	24.6
10	Renovation of high efficiency LED lamps	66,240	40,000	60.4

(continued)

Table 4 (continued)

Subproject enterprise (borrower)	Content	Total investment (1000 Yuan)	ADB loan (1000 Yuan)	ADB loans account for total investment (%)
11	Renovation of intelligent control of central air conditioner	15,460	10,000	64.7
12	Renovation of high efficiency LED lamps	77,050	50,000	64.9
13	Guangdong Yuedian Dianbai wind power project	487,500	50,000	10.3
14	Energy-saving project of building system	227,086	20,000	8.8
15	Promotion of energy-saving injection moulding machine	30,000	20,000	66.7
16	Energy-saving technology and equipment for ceramic powder	28,164	15,000	53.3
17	Technical transformation project of recycled plastics	150,000	95,000	63.3
18	Promotion of solar photovoltaic power generation	74,814	50,000	66.8
19	Construction of solar photovoltaic power generation system and development of new energy	350,000	60,000	17.1

(continued)

Table 4 (continued)

Subproject enterprise (borrower)	Content	Total investment (1000 Yuan)	ADB loan (1000 Yuan)	ADB loans account for total investment (%)
20	Promotion of energy-saving distribution transformer	43,000	30,000	69.8
21	Promotion of solar photovoltaic power generation	50,400	35,000	69.4
22	Promotion of energy-saving injection moulding Intelligent equipment	40,000	19,000	47.5
Total		2,267,802	751,000	33.1

Source GEEPP [20]

and reactive power compensation, green lighting, heating, ventilation and air conditioning (HVAC) systems and other energy system optimization, air compression system and pump system energy saving, industrial waste energy recovery and utilization, industrial boilers and heat and power co-supply, etc. The three main environmental restrictions of the EEPP are as follows: not involving any land expropriation or involuntary immigration or causing any adverse effects on local residents; not being located in any particular environmentally protected area; and being in compliance with the national and provincial social and environmental protection-related laws and regulations design and implementation. From the technical scope and environmental protection requirements of the EEPP, it can be seen that the project content of the EEPP also aims to save energy and reduce emissions, which embodies the concept of green development.

4.2 Achieving Green Development

As a green financial project, promoting the harmonious development of the economy and environment and embodying the concept of green development are the essential characteristics of the Guangdong Energy Efficiency Power Plant project, which is different from those of traditional financial projects.

4.2.1 Reducing Energy Consumption in Guangdong Province

The energy-saving capacity already achieved by the project far exceeds the requirements of the project. During the pre-evaluation phase of the project, the project team signed a financing framework agreement with ADB to confirm the project energy-saving requirements (see Table 5). After the implementation of the project, the project team commissioned a third-party evaluation organization to evaluate the energy savings of completed projects according to Environmental Policy (2002 edition), Environmental Assessment Guidelines (2003 edition) and the domestic requirements of Methods and Parameters of Economic Evaluation of Construction Projects (third edition). By the end of 31 October 2017, the annual energy-saving capacity of the completed projects exceeded the ADB requirements (see Table 5). If we assume that the EEPP works 330 days a year and 24 h a day and use the 2016 national average industrial electricity price (0.7 Yuan per hour), then the EEPP could save end-users \$355 million a year on electricity. Since the ADB loan can be recycled at least three times in the Guangdong Province within 15 years, the energy-saving benefit will be doubled, and the remarkable energy-saving benefit will promote the decrease of energy consumption in Guangdong. Thus, the project will bring good economic benefits.

The successful operation of the EEPP has greatly promoted the development of Guangdong's green economy. The EEPP was proposed at the beginning of the 11th Five-Year Plan, which conforms to the requirements of the current energy-saving situation and will span the 12th and 13th Five-Year Plans. The project is consistent with the energy conservation plan of Guangdong Province in the medium and long term in alignment with the energy-saving plan of the 12th Five-Year Plan and its long-term development direction. The EEPP will still be one of the important examples of energy conservation work in Guangdong Province for a long time to come. In the face of the difficult task of energy saving and consumption reduction, Guangdong Province has completed the energy-saving targets of the 11th Five-Year

Table 5 Energy-saving details of the EEPP

	Energy-saving requirements	Actual energy saving (by 31 October 2017)	Meet the requirements or not
Annual reduction in coal consumption (tce)	175,813	503,941	✓
Annual reduction in electricity consumption (MWh)	532,767	1,527,093	✓
Equal to EEPP (MW)	107	305	✓
Annual electricity savings for end-users (million dollars)	42.6	355	✓

Source GEPPP [20]

Plan and the 12th Five-Year Plan with the efforts of all parties concerned, and the energy consumption level is in the leading position in the country. The EEPP plays a significant role.

4.2.2 Economic Benefits Through the EEPP

First, industrial and residential electricity prices are not the same. Second, industrial electricity is different from peak value, average value and lowest value, and there is a ladder price for residential electricity. Finally, electricity prices are different in all regions of the country and in Guangdong. To simplify the calculation, this paper selects the average value of the national industrial electricity price in 2016, which is approximately 0.7 Yuan/KWh.

It is assumed that the depreciation period of the fixed assets is 10 years. According to the sixtieth provision of the Enterprise Income Tax Law of the People’s Republic of China (2011 edition), the minimum age of depreciation for fixed assets of machinery, machinery and other production equipment is 10 years, so this paper sets the fixed assets depreciation life as 10 years.

The interest rate is chosen as the one-year deposit rate of the central bank in 2017. Because the fixed asset depreciation life is set to 10 years, we need to convert the project income into the current value of the current year. The interest rate used to calculate the present value is chosen as the one-year deposit interest rate of the central bank in 2017, that is 1.5%.

Then, the formula for calculating the total return on investment is:

$$\text{Total return} = \sum_{i=1}^{10} \left(\text{Annual electricity savings} \times \text{Electricity price} \div (1 + 1.5\%)^{i-1} \right) \quad (1)$$

Second, we must calculate the total cost of the investment. Total project investment includes self-financing and ADB loans; enterprise self-financing does not calculate interest. Based on the actual cost of using the ADB loan, assume that the interest on the ADB loan is 2%. Then, the formula for calculating the total cost of investment is:

$$\text{Total investment cost} = \text{Enterprises own capital} + \text{ADB loan} \times (1 + 2\%) \quad (2)$$

Finally, we must compare the total return of investment and the total cost of investment. Based on formula (1) and formula (2), the investment returns of the first three batches of EEPP can be calculated (see Table 6). As seen from the table, 18 of the first three batches of 20 subprojects are profitable, with a profit rate of 90, and only two subprojects generate losses, with a loss rate of 10. The first three batches of 20 subprojects are profitable as a whole, and the proportion of income investment is 4.0; the EEPP has achieved good economic benefits.

Table 6 Investment returns of the first three batches

Batch	Subproject enterprise (borrower)	Total return (1000 Yuan)	Total cost (1000 Yuan)	Return/Cost	Profitable or not
1	1	445,233	95,340	4.7	✓
	2	82,527	25,400	3.2	✓
	3	15,706	12,700	1.2	✓
	4	43,940	12,700	3.5	✓
	5	144,532	52,000	2.8	✓
	6	830,643	89,002	9.3	✓
	7	413,074	3801	108.7	✓
	8	83,471	63,258	1.3	✓
2	1	20,299	68,700	0.3	×
	2	40,854	30,200	1.4	✓
	3	95,068	40,400	2.4	✓
	4	261,485	128,200	2.0	✓
	5	44,392	101,000	0.4	×
	6	110,571	50,300	2.2	✓
3	1	479,319	96,093	5.0	✓
	2	106,941	45,600	2.3	✓
	3	2,067,296	325,100	6.4	✓
	4	165,857	76,000	2.2	✓
	5	223,354	102,740	2.2	✓
	6	18,058	16,220	1.1	✓
Total		5,692,621	1,434,754	4.0	✓

Source GEPPP [20]

4.2.3 The EEPP Achieved Synergistic Reduction of Greenhouse Gas, Air Pollution and Suspended Particulates and Promoted the Development of a Green Environment

Facing the grim situation of air pollution, suspended particulate pollution and international tendency of independent greenhouse gas emission reduction, “cooperative control” of greenhouse gases, air pollution and suspended particulate has become the key policy choice for the world, especially developing countries that are in a period of industrialization, to address domestic pollution prevention and the greenhouse gas emission reduction obligations of international control.

Air pollution, greenhouse gases and suspended particulate emissions, mainly caused by burning fossil fuels, have the same root synchronization. The EEPP not

Table 7 Comparison of reduction capability of the EEPP

	Project reduction requirements	Actual emission (by the end of 31 October 2017)	Complete or not
Suspended particulate (ton/year)	1785	5345	✓
Sulphur dioxide (ton/year)	4795	13,744	✓
Nitrogen oxide (ton/year)	1066	3054	✓
Carbon dioxide (ton/year)	415,560	1,191,133	✓

Source GEPPP [20]

only promotes the development of new equipment and new technology and transformation of the old but also facilitates the reduction of greenhouse gases, air pollution and suspended particulate at the same time.

The project's capacity to reduce emissions is far beyond the requirements of the project. The EEPP requires not only the content of the project to meet the requirements of the energy efficiency power plant but also the amount of emission reduction accountable. In the evaluation stage, the project team and the ADB signed a "financing framework agreement", confirming the project energy requirements (see Table 5). After the implementation of the project, the project team entrusted a third party to quantitatively evaluate the project based on the "environmental policy" (2002 edition) and "Environmental Assessment Guide" (2003 edition), combined with requirements for emission reduction projects of the domestic Chinese "construction project economic evaluation methods and parameters" (third edition). By the end of 31 October 2017, the annual emission reduction capacity of the completed project exceeded the ADB requirements (see Table 7) and achieved a good effect on the improvement of the environment. Because ADB loans can be recycled in Guangdong at least three times within 15 years, the benefits and environmental will be doubled.

The EEPP has successfully created a synergistic reduction of greenhouse gases, air pollution and suspended particulates, which is good for environmental pollution control and land surface temperature control, and has strongly promoted the green development of Guangdong. The EEPP aims to reduce greenhouse gas emissions and carbon emissions by 2030 and to promote the Chinese peak and peak ahead of Guangdong Province; the Guangdong Energy Efficiency Power Plant project also aims to reduce air pollution and suspended particulate matter and to promote the air pollution control and environmental management in Guangdong.

To summarize, the EEPP has promoted the coordinated development of the economy and environment and embodies the concept of green development.

4.3 Alignment with Public Policy Orientation

As a green financial project, the policy orientation to the service entity economy is the third characteristic of the EEPP that differs from traditional finance. Profit is the main purpose of traditional financial; funds may flow to the real economy as well as to a fictitious economy, which is different from green finance. The report of the 19th National Congress of CPC noted that finance is the core of modern economy; we must deepen the reform of the financial system, enhance the ability of financial services in the real economy, improve the proportion of direct financing and promote the healthy development of a multi-level capital market. The EPP is an important experience and reform of green finance development. All 42 items (by the end of 31 October 2017, including the first batch of three projects and recycling projects) are concerned with upgrading and popularizing the application of new technology and equipment, the funds all flow to the real economy, and the loan amount is 1 billion 431 million Yuan, which accounts for 39% of the total investment.

4.4 Promoting Industrial Upgrading

As a green financial project, the clear use of funds is the fourth characteristic of the EPP. While a traditional financial project has no clear direction of investment, encouraging and guiding the development of the main energy-saving project and supporting the development of energy service companies are the main goals of the development of the EEPP. The use of funds has a clear property of green finance and support of industrial development. There are 20 projects in the first batch, including 7 original equipment and technology and upgrading projects and 13 new equipment and technology promotion and application projects, such as a high efficiency, energy-saving transformer and aluminium melting furnace.

The popularization and application of these new devices and new technologies not only save energy and reduce emissions but also improve the production efficiency of enterprises and upgrade the industry. Additionally, the application of a solar photovoltaic power generation system not only achieved energy savings and emission reductions but also completely changed the production and industrial structure of the electric power enterprises. The replacement of thermal power and hydropower has obvious characteristics of upgrading the industry and industrial chain.

The upgrading of the original equipment and the original technology has also promoted the upgrading of the industry. There are seven equipment and technology upgrade projects of the EEPP, such as steam recycling and recovery and the utilization of flue gas waste heat. These projects can save energy and reduce emission reductions, as well as cope with waste and turn it into an advantage, which will increase product value and profits and upgrade the industry.

4.5 *Social Benefits*

The project brought good social benefits to the participating enterprises. First, the enterprise had to adapt to the global green trend in response to national policies of energy-saving and reduction of emissions in the development of new energy. Participating in energy efficiency projects will reduce the level of enterprise energy consumption and environmental pollution, assume more social responsibility and improve the enterprise's reputation. These practices will not only enhance the company's public image but also increase the opportunities for the enterprise to receive more government fiscal support, incentives and subsidies of programme applications. Second, the participating enterprises became familiar with the loan procedures and operation practices of international financial organizations, such as ADB, through the process of this programme, which improved the management level of the enterprises. Finally, enterprises will improve their credit and further broaden financing channels to attract more support of domestic financial institutions through participation and completion of the government in cooperation with ADB, which is especially important for small and medium enterprises.

The project has good social benefits for the local people. This project takes the mode of multi batch cycle lending, and each subproject unit is located in ten cities in Guangdong Province. So, the implementation of the project brings a positive change to the location of the project, such as the LED street extension and building intelligent node transformation programme, which benefit the local people. The projects improved the ecological environment and promoted ecological consciousness and the local people's awareness of energy conservation and the environment. Local people's ecological behaviour will be encouraged through the implementation of the project, which lays a solid foundation for the ecological development of these areas into a virtuous cycle.

The project has achieved great economic and social benefits and has been highly affirmed and praised by the Chinese government and the ADB. In 2011, the ADB, in its official publication of the "energy efficiency intervention practice report", noted that the EEPP is the only project that made significant progress of all the ADB loan projects and the only project that measured and certified energy efficiency during its implementation. In 2013, the first batch of the project was awarded "highly satisfied project" among all completed projects, and the second batch of projects obtained the "2012 best performance Loan Project" award among all under-construction projects, which are the only energy efficiency projects to receive the privilege in the implementation of the Chinese ADB project, and the third batch of the projects won "the 2014 best performance award loan project".

4.6 Development of a Green Finance Industry Chain

The green financial industry chain includes financial capital, a project execution centre, funds and financial managing institutions, independent third-party evaluation of enterprise, energy service companies and project target enterprises (see Fig. 1). The success of the Guangdong EEPP as a green financial operation sets an example to promote the development of the green finance industry chain, and specific examples of performance are as follows:

4.6.1 Development of Energy-Saving Service Industry

The energy services industry is the supporting industry for enterprises and projects to provide services in energy savings and emission reductions with contract energy management. Generally, this industry provides a diagnosis and financing and transformation services for energy savings of energy-using units to obtain reasonable profits and investment recovery through energy conservation benefits sharing. Therefore, this industry is the starting point to achieve the goal of energy saving and emission reduction for the energy industry, but it is not well developed due to various reasons.

Most of the domestic energy-saving service companies are unable to provide a full mortgage guarantee because of light assets, which create difficulty in obtaining the support of green credit. Through financial innovation and other measures, the Guangdong EEPP projects support a number of energy service companies with new energy-saving technology in a new field with high credit. Six of 20 projects in the first three batches are projects of energy services companies; they received 220 million Yuan of the ADB loan, accounting for 32.4% of the total loans. Through the process of supporting these energy service companies in terms of low-carbon technology and energy savings, the Guangdong EEPP projects promote the development of the energy services market and energy service companies and therefore the overall development of the green financial industry.

4.6.2 Development of Third-Party Evaluation Institutions

Without the third party of authority, evaluation institution is an important factor to restrict the development of green financial projects. At present, audit institutions of energy saving are mainly constructed by energy service companies, accounting firms, industry associations and research institutions. Lacking third-party assessment agencies with a strong professional credibility, energy service companies and energy units will have differences in energy saving and efficiency calculations in the process of project operation. An energy-using company will also be intentionally default in green financial projects, affecting the completion of the whole green financial project. According to a survey of green financial default projects, 38.89% exist because of energy-saving effects, 94.44% of which are caused by the unacceptable measurement

standards and methods used by the energy service company; 74.14% of the banks that operated with green financial projects admit the lack of an evaluation system, which restricted the credibility of enterprise financing.

From 2009 to 2026, Guangdong EEPP projects supported the green credit project with a loan of one hundred million Yuan from the ADB and participated with third-party evaluation agencies in each project. The Guangdong EEPP supports and promotes the development of a third evaluation party to promote the development of the green financial industry.

4.6.3 Green Development of Small- and Medium-Sized Enterprises or the Guangdong Model of Green Finance

The Guangdong EEPP project not only pays attention to large energy consumption but also focuses on the green development of small- and medium-sized enterprises and creates the Guangdong model of green finance. The Guangdong EEPP project has both large electric companies, such as Shaogang and Zhiguang, and a large number of small- and medium-sized enterprises and energy service companies. There are four projects that listed companies in the first three batches of 20 projects, and two projects are with large companies. There are 14 projects that belong to small- and medium-sized enterprises and energy service companies, and the loans from ADB are 366 million Yuan, accounting for 53.8% of the total loans, which fully demonstrates support for small- and medium-sized enterprises and energy service companies.

Small- and medium-sized enterprises were keys to promoting Chinese economic reform for approximately the past thirty years, which made great contributions to economic development in China. As the pioneer of Chinese reform, the number of small- and medium-sized enterprises of Guangdong Province in 2009 reached 813.4 thousand, becoming the pivotal position and social economic development in Guangdong's reform and ranking second place in China. Therefore, the goal of the Guangdong EEPP is to innovatively activate small- and medium-sized enterprises, which is a breakthrough as compared to the traditional international financial loans.

The Guangdong EEPP is a positive innovation in policy research, mechanism design and project management based on the actual situation of Guangdong. The EEPP supports small and medium enterprises to become main energy-saving and emission reduction parties that strongly promote Guangdong's energy-saving emission reduction efforts and achieve good economic and social benefits. Distinctive characteristics of energy saving and emission reduction in the project provide a good demonstration in the implementation of ADB in other provinces and a reproducible, trustworthy and successful experience for construction of efficiency power plant projects in other domestic provinces and the international community. The successful implementation of the project marks a breakthrough in the cooperation between the Chinese government and ADB in the field of energy saving and emission reduction. This project fully demonstrates that the Guangdong mode of SMEs is the model of energy saving and emission reduction and is fully consistent with China's national conditions.

5 Conclusions

Through the case study of the EEPP, we find that policy support is necessary in the early stage of green financial development.

As a green financial project, requiring policy support in the early stage of development is the sixth characteristic of the EEPP. The non-profit nature of green financial has an obvious disadvantage in market competition, especially in situations with bound budgets and weak public consciousness of green development compared with traditional financial; therefore, the development of green finance requires not only development of public awareness of environment protection but also the engagement of government support in development. The policy support of the EEPP includes mortgage innovation, energy reward, low financing costs, long loan period, government bared loans, external risk and project operation costs, so these policies provided by the EEPP are the main differentiations from the traditional financial project.

5.1 *Mortgage Guarantee Innovation*

Through the innovation of mortgage guarantee, the EEPP provides the necessary policy support to the development of green finance. Because the EEPP is national sovereign guaranteed, it should be strictly risk controlled and fully secured. Constrained by funding strength, the majority of small- and medium-sized enterprises and energy service companies will find it difficult to achieve full collateral requirements, while the energy conservation centre has collateral innovation, such as land guarantee, group guarantee, bank guarantee, pledge of accounts receivable (such as SPDB), executives of credit guarantee, executives real estate guarantee, joint guarantee (such as Guangdong 50 million loans, signed by third-party guarantees, a finance company fall back of repayment after 3 years), third-party guarantee and accounts receivable guarantee, to help the application of the EEPP for some small- and medium-sized enterprises and energy service companies.

5.2 *Energy-Saving Reward Funds*

The energy-saving incentive fund is another policy support provided by the EEPP for the development of green finance. Guangdong Province issued the “Guangdong Province to promote energy-saving emission reduction of ADB loan (EPP pilot) project management manual” to reward the subproject borrower who achieved energy savings and debt service on time. Generally, project companies receive incentive funds, such as 15 projects in the first 20 projects of three batches, and there were only five remaining projects with no reward funds for failing to complete the energy-saving targets or execution.

The reward funds are derived from the project surplus. Seventy per cent of project earnings are used to reward the project unit, and project earnings include loan interest, financial income and other income after deducting the project operation cost; the difference in loan interest comes from the differences between the interest rate of project group obtained loans from the ADB's (the first and second batch of loans' interest is LIBOR up 0.2%, the third is up to 0.3%. The average interest rate of the projects is approximately 1%) and the interest rate project offered to project enterprises (interest rate of 6 months' commercial loans issued by the people's Bank of China falls 10%); financial income is derived from a portion of funds that has not been loaned out by the fund custodian (Guangdong finance trust) in managed funds during the financial implementation.

5.3 Low-Cost Financing

The low cost of financing is the third necessary policy support provided by the EEPP to the development of green finance. The nominal interest rate project provided to subproject enterprises is 10% lower than the commercial loans interest rate provided by People's Bank of China, and the top three batches' project loan rate is only approximately 3% because of tax preferential policies (the implementation period is from 2009 to 2015 and adjusted according to the central bank interest rate); considering the energy reward, the real interest rate of the enterprises involved in the project is very low, generally less than 2%. For example, the interest is 3.8 million with a 67 million loan and 3.2 million reward for the final return of the project for the Guangdong power group. Therefore, the actual interest from the ADB loan is less than 1%, and some are even as low as 0.5%, far below commercial lending rates, which greatly reduce the cost of corporate financing and strongly support the development of green financial projects.

5.4 Long-Term Loans

Arrangement of long-term loans is the fourth necessary policy support provided by the EEPP for the development of green finance. Generally, the operation cycle of green financial projects is longer, which becomes an important feature and key factor that limits the development of green finance and differs from traditional financial projects. Funds are required in the pre-period of contract and investment in green finance projects, which will be used for purchasing equipment and construction, while loans for traditional financial projects will be offered after the first payment during the project operation. Green finance investment funds for projects cannot be effectively satisfied because of the mismatch of time, which often leads to the abortion of the project. The funds of the EEPP lend early with a period of 3–5 years, as well as a grace period; a three-year loan has a one-year grace period and the

ability to pay the principal in four stages in the last two years with monthly interest; a five-year loan has a two-year grace period and a schedule to pay back the principal twice a year. The longer loan period and relaxed repayment arrangement reduce the financial pressure of the enterprises, thus bringing about economic benefits to the participating enterprises while facilitating successful operations of the project.

5.5 Government Undertaking the Risk

The government takes the external risk and operation cost of loans as the fifth necessary policy support for the development of green finance in the EEPF. The direct support of the government is also an important feature of the green financial project, which is different from traditional financial projects. The EEPF loans are in US dollars, while loans to participating enterprises in the project group are in RMB, whereas interest risk and exchange rate risk are borne by government alone but not by the enterprises. At the same time, the government set up a project coordination group responsible for the overall operation of the project and guidance of the formulation of project policy. The project execution centre is managed by the project coordination group. The Guangdong finance trust and third independent party organization are responsible for the project operation and commission. Without the project cost, including the operation costs and service charges of hiring intermediate financial services institutions, the third-party evaluation agency cost borne by the government can be reduced.

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