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1 **How government subsidies promote the growth of entrepreneurial companies in clean**
2 **energy industry: An empirical study in China**

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How government subsidies promote the growth of entrepreneurial companies in clean energy industry: An empirical study in China

Abstract Under the context that entrepreneurial risk in clean energy industry has become increasingly complex, government subsidies are helpful to guide and promote the entrepreneurial companies' survival and development. This paper explored the roles of government subsidies, more specifically, in forms of government subsidies beforehand and government subsidies afterwards on the relationship between R&D and entrepreneurial companies' growth, particularly in the clean energy industry. To delve deeper into the roles, this paper analysed data from the 2013 and 2014 annual reports of 58 listed companies in clean energy industries in China. By using a moderating effect model, this paper derived following conclusions: (1) R&D investment does not have a lag effect on entrepreneurial companies' growth; (2) Government subsidies beforehand has negative moderating effects on the relationship between R&D investment and entrepreneurial companies' growth; (3) Government subsidies afterwards has positive moderating effects on the relationship between R&D investment and entrepreneurial companies' growth. This paper helped to understand the difference between the functions of government subsidies beforehand and government subsidies afterwards. To some extent, the results can revise prior studies about the function of government subsidies to influence the relationship between R&D and entrepreneurial companies' growth. The results will also be helpful for the government to evaluate the performance of government subsidies and design appropriate subsidies strategies.

Keywords: government subsidies; research and development (R&D); entrepreneurial companies; clean energy industry

32 1. Introduction

33 Subsidies are regarded as an important economic intervention tool to solve the problems of
 34 market failure. It should be noted that they generate great influence on companies' R&D
 35 activities (GÖRg and Strobl, 2007), export competitiveness (Desai and Hines, 2008),
 36 production efficiency (Azzimonti et al., 2008), etc. For entrepreneurial companies,
 37 government subsidies are important funding sources, which help them to overcome the
 38 constraint of capital shortage (Claro, 2006).

39 Many scholars have demonstrated the relationship between government support for
 40 entrepreneurial companies' R&D spending and entrepreneurial companies' growth from all
 41 angles. Clean energy is a rising industry that has been rising rapidly. In the early stage of
 42 development, there were a series of problems, such as market failure and technology
 43 spillover, which needed government subsidies to intervene. The government should take
 44 effective incentive mechanisms, such as subsidies beforehand and subsidies afterwards, to
 45 guide clean energy start-ups to increase technological innovation (Batlle, 2011). Soratana et
 46 al. (2014) researched Chinese companies and found that there was a significant positive
 47 correlation between government subsidies and new energy enterprises' performance.
 48 Impeded by the market entry barriers, it is not easy for entrepreneurial companies to open
 49 the new market and achieve relatively high market share (Jing et al., 2013; Shao et al., 2014).
 50 It is possible for the entrepreneurial companies to achieve funding that they need from bank
 51 loans and venture investment. However, it is much easier for them to obtain the
 52 government subsidies, which help to reduce asset-liability ratio greatly (Hsu et al., 2009).
 53 When the entrepreneurial companies have received the subsidies, it means that their legal
 54 status has been approved by the government, which in turn helped them to achieve more
 55 resources (Söderblom et al., 2015). It is essential for the entrepreneurs to handle the
 56 relationship with the related departments if they want to achieve the subsidies, and in this
 57 process their social network shall be expanded and the growth of their companies shall be
 58 benefited (Lahr and Mina, 2016). In addition, government subsidies motivated
 59 entrepreneurial companies to increase their investment in R&D and help to increase R&D
 60 efficiency (Meuleman and De Maeseneire, 2012; Zhang and Wang, 2017). Other scholars,
 61 like Wang et al. (2013) also found that government subsidies can increase entrepreneurial
 62 companies' current yield.

63 According to the time sequence of government subsidies and companies' R&D, government
 64 subsidies can be divided into two parts: government subsidies beforehand (GSB) and
 65 government subsidies afterwards (GSA) (Hud and Hussinger, 2015). The results of some
 66 previous in-depth studies aimed at the influence of government support on the relationship
 67 between R&D and entrepreneurial companies' growth (ECG). For example, Yu et al. (2016)
 68 found that both GSB and GSA have positive effects on the companies' R&D activities, and in
 69 general, GSB are more influential in promoting companies' R&D activities comparing with

GSA. GSB decreased entrepreneurial companies' financial risk and show government's positive attitude to these companies (Lee et al., 2014). Some researchers found that GSA are more effective than GSB as GSA represent government's approval of entrepreneurial companies' R&D activities (Czarnitzki and Kraft, 2004). The empirical research on the value of government subsidies to the listed companies in China has proved government subsidies' direct influence (Zeng et al., 2013). However, government subsidies exert different influences on different companies and different companies' behaviours. For example, Almus and Czarnitzki (2003) found that government subsidies generated great influence on companies' R&D activities (GÖRg and Strobl, 2007), while GÖRg and Strobl (2007) found government subsidies influenced companies' sustainable profit growing ability. Moreover, Girma et al. (2009) found that government subsidies enhanced companies' competitiveness and Claro (2006) found that they decreased the constraint of limited capital. The negative effects of government subsidies also should not be neglected. Government subsidies probably lead to overproduction and efficiency loss, hindering companies' sustainable development. Lee et al. (2014) found that government subsidies increased entrepreneurial companies' initial investment cost required as they spend the money on the acquisition of the subsidies.

From the above analysis, at present there was no unified conclusion about how the GSB and GSA affected the relationship between R&D input and output of entrepreneurial enterprises (Dever, 2010). The research on GSB and GSA for entrepreneurial enterprises mainly discussed its impact on the economic performance of enterprises (Girma et al., 2007), and did not focus on the development and growth of venture enterprises. At the same time, the unique attributes of the clean energy field were ignored. There was little research analyses the impact of GSB and GSA on the enterprises in the clean energy industry.

In this study, the theory of externality was used as the theoretical connotation. The existence of externality breaks the marginal condition for the optimal allocation of resources and makes the allocation of resources deviate from the Pareto optimal state. The clean energy related knowledge leaks or spillovers in the process of R&D innovation in the development and innovation of clean energy enterprises leads to lower private returns, which increase the risk of R&D investment and independent innovation activities (Clarysse et al, 2009). The government participates in the innovative research and development activities of clean energy enterprises in the form of GSB and GSA, which can effectively solve the problem of no optimal allocation of resources caused by the inconsistency of marginal social income and private income.

In this study, the influence mechanism of government subsidies on the relationship between entrepreneurial companies' R&D investment and growth were studied through analysing the moderating effects of GSB and GSA. The article is constructed as follows. In section 2, the theoretical framework will be set up. In section 3, different hypotheses are developed from

the literature. In section 4, the samples, variables and research methods are discussed afterwards. In section 5, the empirical analysis is described and finally the conclusions and implications on management are discussed in section 6.

2. Theoretical background

Generally speaking, entrepreneurial companies rely on the government subsidies to lower cost and deal with risks especially under the condition of weak institutional contexts in emerging market economies (Du and Mickiewicz, 2016). On the other hand, the current market lacked enough incentives to encourage clean technology innovation, so clean energy enterprises must rely on government support (Acemoglu D et al, 2012). The government has designed different subsidy policies to adapt to the specific nature of the enterprise to support the development of the clean technology industry (Simón Moya, 2015). Therefore, more government subsidies (including GSB and GSA) means the entrepreneurial companies get more benefits from the participations in politics (Feng et al., 2015), which can reduce the innovation cost of clean technology and promote entrepreneurial companies' development.

2.1 Government subsidies beforehand

GSB referred to the subsidies that government provide economic support to the companies before the beginning of companies' R&D activities through financial allocation (Wang and Zhang, 2016). It should be mentioned that GSB always have clear goals, which meant that when the government appropriated the subsidies to the companies in advance, it stipulated specifically where these subsidies are going, and how the money is being used. The companies that received these subsidies should utilize the money according to the government rules and regulations. With the promotion of clean energy industry in the world, government subsidies have become a common phenomenon, which include different ways. There were differences in the use of government subsidies among different growth enterprises. The main goal of GSB was to help entrepreneurial companies to solve the financing problems in the early stage of R&D, and the amount of the subsidies is not influenced by the R&D results or the marketing of R&D results (Du and Mickiewicz, 2016).

Compared with GSA, GSB were more direct. They aimed at reducing R&D risk and R&D expenditure. GSB were commonly used by the governments of the members of Organization for Economic Cooperation and Development (OECD), and the amount of the subsidies occupied more than 1% of the GDP, which increased at a very high speed (Soratana et al., 2014). Because of the characteristics of high investment, long period and uncertainty of income of clean technology, clean energy companies' R&D was often accompanied by high risks, and GSB can reduce companies' R&D expenditure and help them to avoid the market failure of technology innovation. As a result, GSB can greatly improve the success rate of

companies' R&D (Dai and Cheng, 2015). Similar as the opinion of Dai and Cheng (2015), Bronzini and Piselli (2016) also found that GSB can lower the barriers for the entrepreneurs to start new companies and motivate the companies with the marketing potential to carry out more R&D activities. Through empirical research of more than 800 high-tech companies in Beijing, Hu and Hu (2001) found that the amount of GSB is positively related to the companies' R&D investment.

GSB and companies' R&D activities were complementary to each other. To be specific, GSB helped to reduce the risk of technological innovation in clean energy enterprises and provide more adequate financial support for internal R&D activities, thereby positively influenced the output of companies' R&D activities, and the increase of companies' R&D investment attracted more subsidies by attracting the government's attention (Meuleman and De Maeseneire, 2012; Wu et al., 2016). Moreover, through the research of different industries, Zhang et al. (2014) found that GSB were more influential in light industries than in heavy industries. Therefore, it is reasonable and scientific to say that the increase in the amount of GSB was conducive to companies' R&D activities.

2.2 Government subsidies afterwards

Different with GSB, GSA referred to the supporting policy that government reimbursed certain money to the companies when the projects achieved anticipated achievement or after the projects have been finished. Normally, the main form of GSA was tax reduction. It encouraged enterprises to use renewable energy, indirectly helped enterprises to reduce R&D expenditure, and encouraged enterprises to participate in R&D activities through tax reduction and other policy subsidies (Janssens and Zaccour, 2014). In addition to tax cuts, the government adopted the way of subsidy for later liquidation, such as new energy vehicles, in the field of partial clean energy to improve the access threshold of clean energy sector, aimed to improve the access threshold of clean energy industry, to avoid excessive reliance on subsidy policies and "cheat subsidy" action (Zhang X and Zhang C, 2015). Comparing to the GSB, GSA are much more flexible. Companies' R&D scale and methods are not influenced by government intervention. As a result, GSA assured the independence of companies' R&D which was operated under the condition of marketization mechanism (Antonelli and Crespi, 2013).

The main research results regarding the relationship between GSA and companies' R&D activities can be listed as follows. GSA motivated the companies to be involved in the R&D activities, but the influence of GSA differed greatly in different countries and different areas (Kleer, 2010). Through empirical research of 17 different countries, Alexander and Organ (2015) found that government subsidies in certain degree motivated the whole society to start new businesses. Moreover, it should be mentioned that GSA have different effects on different entrepreneurial companies. They exerted great influence on the high-tech

companies, like biological medicine companies, high-end equipment manufacturing companies etc. (Clausen, 2009).

2.3 The growth of Entrepreneurial companies

According to the opinion of Global Entrepreneurship Monitor (GEM), those companies which have been established for more than 42 months but still have the consciousness of innovation, competition and growth belong to entrepreneurial companies. With the government's increasing support for the clean energy venture, the number of enterprises entering the clean energy industry was growing (Malen and Marcus, 2017). The nature of entrepreneurial companies' growth involved in the expansion of companies' scale, the maturity of companies' management system, the stability of the organizational structure, and the market scale of companies' products (Meutia and Ismail, 2012). Reijonen et al. (2015) pointed out that the indicators measuring entrepreneurial companies' growth included the level of total assets, the level of net assets, the return on total assets, the return on the net assets, and the growth rate of net cash flow. To be specific, the level of total assets and the level of net assets reflected entrepreneurial companies' scale, and the return on total assets, the return on the net assets, and the growth rate of net cash flow reflected entrepreneurial companies' prospects.

Researchers' opinions regarding to the development stage of entrepreneurial companies were different. According to the changes of the managing mode of R&D activities, Soininen et al. (2012) divided the development stage into four parts, which were, self-execution stage, supervision and control stage, organizational management stage, and departmentalization coordination. To be specific, it meant that entrepreneurs directly controlled the R&D activities in the initial stage, while at the final stage, the R&D activities were mainly influenced by the cooperation among companies' internal departments, reflecting the expansion of companies' market scale and the maturity of the management system. Wang et al. (2011) held different opinions of how the development stage of entrepreneurial are divided. They divided the entrepreneurial companies' development into the incubation stage, infancy stage, go-go stage, and adolescent stage according to the characteristics of entrepreneurial companies, moreover, they specifically pointed out that after the adolescent stage, the companies were no longer entrepreneurial companies (Wang et al., 2011). Particularly, the core tasks for each stage were very different.

Bontempi and Prodi (2009) thought that the development process of entrepreneurial companies was mainly distributed into two stages: strategy replication stage and strategy innovation stage. In the strategy replication stage, the entrepreneurial companies' lack of the marketing experience, so required them to learn, analyse and replicate competitors' strategies to avoid the unknown risks. In the strategy innovation stage, entrepreneurial

companies have already obtained certain achievements and experiences, so in this stage, they endeavour to achieve the sustainable development by utilizing the new strategies.

3. Hypotheses

It is no doubt that companies that continue to conduct R&D activities were more likely to innovate their knowledge and skills (Colombo et al., 2009), investment in R&D helped companies to expand their business and increase their market competitiveness (Coad and Rao, 2008; Artz et al., 2010). However, it did not mean absolutely high performance and high sales revenue. Researchers have already revealed that the effects of investment in R&D on the growth of entrepreneurial companies differed greatly within different industries. Diaz Arias and van Beers (2013) found that the investment in the R&D of renewable energy resources has negative effects on the research and patent application of renewable energy technologies, especially the technologies related to solar energy and wind energy. They thought that the investment in R&D had negative effects on companies' performance rather than positive effects, and the enterprise life for those companies engaged in research and development or companies start in the development was usually short. R&D investment in high-risk projects may not improve their key financial performance indicators. Only when the enterprise R&D activities achieved a breakthrough, it will improve the business performance (Brinckmann et al., 2011). Beason and Weinstein (1996) directly pointed out that investment in R&D decreased companies' growth speed and brought scale descending effects. The more investment in R&D by companies, the higher uncertainty the companies were confronted with. For entrepreneurial companies, they were often short of money. Therefore, if they invest too much in the R&D, the business risks will be increased tremendously (Nitsch, 2009), echoing the opinion of Dzhumashev et al. (2016). He put forward that entrepreneurial companies which pay too much attention on R&D faced higher financial risks compared with those show less concern on R&D. Due to scale disadvantages, increasing R&D investment will have a greater pressure on the entrepreneurial companies. They may not directly use R&D investment to improve business situation but try to promote business growth in a simple and quick way (Berrone et al., 2014). Eveleens (2010) divided R&D into three different kinds, which were, basic research, strategic basic research, and experimental development. Basic research barely shown any value in application, strategic basic research and experimental development both had relatively long development period and consumed a lot of money. Therefore, the high investment in R&D in certain condition just hindered entrepreneurial companies' growth. Especially for clean energy enterprises as the main body and direct beneficiaries of clean technology, although the development of clean energy enterprises needed technical support, the protection of related patents and intellectual property rights was weak. Investment in R&D cannot bring the entrepreneurial companies with high sales in short terms. Investment in R&D will inject the entrepreneurial

companies with technological innovation vitality and help them to increase the sales period (Yang and Lin, 2008; Coad and Rao, 2008). As a result, the following hypothesis can be derived:

H1: R&D investment has a lag effect on entrepreneurial companies' growth.

Government often used subsidies to make up the market failure and improved its economic intervention capabilities (Schwartz and Clements, 1999). The clean energy field has the characteristics of high risk and long recovery period, and once the research was successful, it has great positive externality and high income. According to the externality theory, for industries with positive externalities, the government should restore the incentive function of the market through subsidies, so that the supply of positive externalities of clean energy enterprises could reach the best level of society (Yin and Lin, 2010). The development and promotion of related technologies in the field of clean energy mainly depend on government subsidy intervention. Under the joint efforts of the government and enterprises, clean energy related technology, economic and political knowledge can be better integrated and deployed, promoting the development of enterprises and the technological progress of the industry (Ardito et al., 2014). For example, government provided advance subsidies to influence companies' R&D behaviours (GÖRg and Strobl, 2007). Japan Ministry of International Trade and Industry offered cheap money to targeted industries to motivate R&D activities for entrepreneurial companies to promote the development of entrepreneurial companies (Parker, 2008). Desai and Hines (2008) thought that investment in R&D helped companies to achieve high revenues and assured sustainable development for them. However, the R&D of entrepreneurial companies in the growth stage was restricted by funds and was very hard to predict, as it has no clear goals. As a result, R&D risk of entrepreneurial companies was comparatively higher (Coad et al., 2016). Almus and Czarnitzki (2003) also found that GSB can effectively promote R&D. For example, in some specific industries or areas, GSB can protect the companies that without high revenues by lowering their R&D expenditure (Lee, et al. 2014). The government subsidized the knowledge acquisition costs of the entrepreneurial companies, which could help them carry out R&D activities easier and make knowledge of schools and other social research institutions more convenient to transfer to entrepreneurial companies. This can promote the transformation of knowledge and the development of entrepreneurial companies (Felzensztein et al., 2013; Shao et al., 2017). Moreover, GSB motivated entrepreneurial companies R&D enthusiasm (Bronzini and Piselli, 2016). Generally speaking, R&D investment of companies in the mature stage have more stable effects as R&D investment of entrepreneurial companies had no specific goals. Therefore, it is reasonable to assume that the development of entrepreneurial companies was closely related with GSB. GSB not only helped to reduce entrepreneurial companies' R&D expenditure, but also helped them to find the right R&D direction. Based on the analysis above, following hypothesis can be derived.

H2: GSB have positive moderating effects on the relationship between R&D investment and entrepreneurial companies' growth.

GSA referred to the supporting method that government departments appropriated certain proportional reimbursement when the projects achieved anticipated achievement or after the projects have been finished. In recent years, the clean energy industry has begun to take shape with the government's increasing efforts to cultivate the clean energy market. A higher demand was put forward for the research strength and independent research and development level of entrepreneurial enterprises. GSA can effectively stimulate the entrepreneurial enterprises in clean energy industry to improve R&D capability (Zhang H, et al, 2014). To encourage innovation and product development of entrepreneurial companies, some governments will take related measures to reduce R&D costs (Wise & Miles, 2003), such as tax deduction, which can help entrepreneurial companies to reduce their financial stress before the end of the fiscal year and help companies achieve their next year's strategic goals (Patzelt and Shepherd, 2009). Zhang et al. (2003) put forward that GSA were often more effective than GSB in promoting companies' sustainable development. Koga (2005) suggested that government subsidies were not available for all the companies. Influenced by national policies and R&D motivation, it is possible that government gave the advance subsidies to the projects without good prospect (Lerner, 1999).

As a result, compared to GSB, GSA were more reasonable as the government gives out the reimbursements based on the practical R&D effects. On the one hand, GSA promoted the companies to fully utilize the internal R&D resources and to enhance their internal cooperation. On the other hand, they helped to enhance the companies' relationship with external organizations (universities, research institutions, etc.), so it is reasonable to assume that the companies can have a relatively higher success rate. Therefore, the following hypothesis can be developed.

H3: GSA have positive moderating effects on the relationship between R&D investment and entrepreneurial companies' growth.

Fig.1 summarizes the 3 hypotheses above in this study.

Fig. 1. The hypotheses models presented in this study

327

328 **4. Data and Methods**

329 To further study the influence of government subsidies on the relationship between
 330 entrepreneurial companies' own R&D investment and their growth, it is necessary to get the
 331 data about GSB, GSA, R&D and entrepreneurial companies' growth, to build up the proposed
 332 logistic framework.

333 **4.1 Data**

334 As shown in Table 1, during 2007 to 2013, the pumped storage energy of China's
 335 hydropower industries has grown from 130 million KW to 270 million KW with an average
 336 annual growth rate of 17.9%. It is estimated that by 2020, the scale of the pumped storage
 337 energy will reach 300 million KW. The annual output of solar cells of China's solar
 338 photovoltaic industries has increased from 1200 MW to 18073 MW, with a tremendous
 339 average annual growth rate of 234.3%. The estimated electric output for solar energy is
 340 21600 MW for the year 2020. The installed capacity of wind power industries in China has
 341 grown from 6050 MW to 91500 MW for the same period, and its average annual growth
 342 rate is 235.3%. It is estimated that by 2020 its capacity will be up to 120000 MW. The power-
 343 generating scale of China's biomass power generation has increased from 2200 MW to 9600
 344 MW, with an annual growth rate of 56.1%. It is predicted that its scale will reach 22000 MW
 345 by 2020. The output of Bio-solid fuel in China has grown from 550000 tons to 5.1 million
 346 tons, and its average annual growth rate is 137.9%. By 2020, it is estimated that its output
 347 will increase to 50 million tons.

348 In addition, according to the forecast report of CCID (China Center for Information Industry
 349 Development) Consulting Company Limited by 2020, the scale of Chinese biogas industry will
 350 reach 440 cubic meters; the scale of the fuel ethanol industry will reach 12.7 billion litres;
 351 the scale of the biodiesel industry will reach 2.4 billion litre; the scale of the geothermal
 352 industry will reach 1200 tonne of coal equivalent (TCE); the scale of the tidal power industry
 353 will reach 100 MW; and the scale of the nuclear power industry will reach 44968 MW.

354 **Table 1. The development status of main clean energies in China (2007-2013)**

Type	Unit	The annual capacity							
		2007	2008	2009	2010	2011	2012	2013	2020
Hydropower (pumped storage)	Hundred Million KW	1.3	1.5	1.8	2.1	2.3	2.4	2.7	3.0
Solar	MW	1200	2126	3460	5660	9848	15067	18073	21600

photovoltaic (annual output of solar cells)									
Wind power (installed wind capacity)	MW	6050	13240	26270	40720	61080	78520	91500	120000
Biomass power generation (power- generating scale)	MW	2200	3150	4300	5500	6700	8000	9600	22000
Bio-solid fuel (Output)	Ten Thousand Tons	55	95	145	210	295	365	510	5000

There were totally 66 listed companies that belong to clean energy industries in 2014 in China. To empirically test the hypotheses, this study used data from the 2013 and 2014 annual reports of the total 66 companies. The basic information of these samples is shown in Appendix. According to the main products, the firms can be subdivided into 10 categories, and 16 firms belong to solar energy industry, which occupies the highest proportion. Most of these entrepreneurial firms have relatively long development history and relatively big size as can be seen from the table 1 that 86.4% of the firms have more than 10 years development history and 62.1% of the firms have more than 2000 employees (as shown in Table 2).

Table 2. Basic information of 66 listed companies in China's clean energy industry

Classification	Sub-classification	Number	Percentage
Industrial Classification	Wind power	7	10.6%
	Nuclear power	6	9.1%
	Photovoltaic power	7	10.6%
	Solar energy	16	24.2%
	Hydrogen	3	4.5%
	Lithium battery	2	3.0%
	Biological energy	8	12.1%
	Tidal energy	1	1.5%
	Geothermal energy	11	16.7%
	Hydropower	5	7.6%
Age	1-5	3	4.5%

	6-10	6	9.1%
	11-20	29	43.9%
	21-30	24	36.4%
	> 30	4	6.1%
Size	<500	4	6.1%
	500-2000	21	31.8%
	2001-5000	22	33.3%
	5001-10000	12	18.2%
	> 10000	7	10.6%
Total		66	100%

It should be noted that in this study, the data of variables came from the annual reports of 66 companies in China's clean energy industry in 2013 and 2014, all the 66 listed entrepreneurial companies in clean energy industry had received GSB and GSA, while in which there were 8 companies that did not report the data about R&D invest in their annual report. Therefore, this study deleted these 8 companies from samples.

4.2 Variables definitions and operationalization

In this study, dependent variable is defined as entrepreneurial companies' growth (ECG), independent variable refers to R&D investment, and moderating variables include GSB and GSA. In addition to these, the study also considered some control variables. They are as follows.

4.2.1 Entrepreneurial companies' growth (ECG)

Companies' growth can be measured by multiple indexes, and companies of different types and in different development periods present different growth characteristics (McKelvie and Wiklund, 2010). The entrepreneurial companies' growth embodied in launching competitive products and service (Naldi and Davidsson, 2014; Shao et al., 2016), and the increasing of products' sale and employees' number (Coad, et al., 2016). It should be noted that companies' growth should be measured by one index that specifically indicating their development (Davidsson et al., 2010). In the samples, these companies' business covered some other industries in addition to clean energy industry. Therefore, to measure entrepreneurial companies' growth more directly, this study defines the income of main business (namely the business about clean energy) as entrepreneurial companies' growth (Tibor et al., 2015).

4.2.2 R&D investment (R&D)

The R&D investment involved in the whole process of products innovation, including the initial systematic planning and scale production in the later stage (Honoré et al., 2015). Companies' R&D investment, accompanied by high uncertainty and high risk, needed comparatively long time to generate its influence. As a result, R&D investment was often considered as the organizational searching behaviour (O'Brien and David, 2014). The aim of the R&D investment was to provide innovative solution schemes and produce new knowledge and technologies (Lee, et al., 2014). The process of R&D investment was quite complicated, including the creation and dissemination of new knowledge, the application of new technologies (Wang, 2010) etc. Based on the analysis above, companies' R&D activities can be defined as the organizational searching behaviours aiming at solving the practical problems and nurturing the core competitiveness (Lewellyn and Bao, 2015). It should be mentioned that R&D included basic research, applied research, and experimental development. In this study, the variables to measure clean manufacturing entrepreneurial companies' R&D investment included $R\&D_t$ and $R\&D_{t-1}$, in which $R\&D_t$ was used to measure the present clean manufacturing R&D investment and $R\&D_{t-1}$ was used to measure the clean manufacturing R&D investment in previous year, namely the lag effect of R&D investment.

4.2.3 GSB and GSA

Government subsidies were very important tools for signal transmission (Kleer, 2010; Lerner, 1999). Through direction guiding, they increased firms' possibilities of achieving external funding (Meuleman and De Maeseneire, 2012; Feldman and Kelley, 2006), accelerating commercialization and promoting entrepreneurial companies' growth. Through sharing the risk and cost of R&D with firms, they enhanced firms' motivation and confidence in R&D, promoting effective development of entrepreneurial companies (Huang et al., 2008). According to the order of subsidies been distributed, government subsidies can be divided into two different forms: GSB and GSA. At present, their accurate definitions have not been given by scholars yet. In this study, GSB referred to supporting method that government decided the subsidies amount beforehand and appropriated the subsidies as soon as the projects started. GSA refer to the supporting method that government departments appropriate certain proportional reimbursement when the projects achieve anticipated achievement or after the projects have been finished. As government subsidies influence entrepreneurial companies' growth and R&D, it is logical to say the two moderating variables i.e. GSB and GSA have certain influences on entrepreneurial companies' growth and R&D. In terms of data selection, this study used the company annual report to distinguish between GSB and GSA in accounting standards. The accounting standards considered that GSB should be included in deferred income, and GSA should be included in the current profit and loss. Therefore, in actual data calculation, GSB, GSA and R&D did not have the problem of repeated computation and collinearity.

4.2.4 Control variables

Entrepreneurial companies in high-tech industry are accompanied by high profit and high risk during their growth period (Bertoni et al., 2015; Grilli and Murtinu, 2014). Jin et al (2016) found that compared with companies in the traditional industry, the growth of entrepreneurial companies in high-tech industry were constricted by many factors, which were always decided by their industrial classifications. In this paper, the selected 58 clean energy companies were all high-tech entrepreneurial companies and referred to different clean energy industries, including wind power industry, water and electricity industry, nuclear power industry and so on. Therefore, this study chose industrial classification (IC) as one of the control variables.

The growth of entrepreneurial companies with different ages presents different characteristics. During the start-up stage, entrepreneurial companies focused on building the system suitable for their development as they lacked the resources base and the financial channel (Khelil, 2016). During the mature stage, the entrepreneurial companies focused on modifying their management framework to meet the requirements of R&D activities (Khelil, 2016). During the decline stage, the main factors that influence the growth of entrepreneurial companies include the market potential of key technologies, and the risk of entering the capital market (Reijonen et al., 2015; Kautonen et al., 2015). Generally speaking, entrepreneurial companies with different ages differ greatly in core competitiveness, technological innovation ability, management system, property relations etc. (Bao and Peng, 2016; Shan et al., 2016), so the growth of these companies presented different characteristics. All in all, the age of entrepreneurial companies influences their growth. As a result, in this study, age is also treated as a control variable.

For entrepreneurial companies in high-tech industry, the size of the talent was one of the key factors influencing their growth (Laufs and Schwens, 2014; Puente et al., 2015). From the perspective of entrepreneurial companies' production cost, Trianni et al. (2016) pointed out that large size helped firms to reduce production cost and achieve organizational resources. Generally speaking, companies' size positively influences their R&D activities, which in turn speed up companies' development (Ahmedova, 2015). Through statistical analysis of companies in a number of countries, like America, Britain etc., Meath et al. (2016) found that large companies (the number of employees is more than 1000) consumed 80%-97% of total R&D investment. In summary, companies' size was one of the important factors that influenced entrepreneurial companies' growth. To be specific, the larger the companies are, the lower the cost of the R&D activities. Similar as the research done by Vaona and Pianta (2008), in this study, size is also treated as a control variable.

4.3 Methodology

Multi-regression models have been widely used to explore the statistical problems in society management (Yu et al., 2016). For example, Acaroğlu and Aydoğan (2012) applied the Multi-

regression models to analyse the factors that affect health-related quality of life in adult spinal deformity. Amiri et al. (2015) utilized the Multi-regression models to develop energy consumption indicators for commercial buildings. Multi-regression models were regarded as very powerful tools as they allowed the users to explore the effects of a changing variable on the dependent variable while holding other variables constant in certain degree (Smith and Smith, 2015). To be specific, the multi-regression models helped the researchers and the readers to deepen their understanding of the qualitative analysis, and helped them to reveal the dependence relationship among the variables based on which the researchers can find the internal relationships among the variables. The purpose of this research is to explore how GSB and GSA promote entrepreneurial companies' growth, so it is reasonable and scientifically correct to utilize the multi-regression models to carry out this research.

5. Results

Because the data of the GSB, BSA, R&D investment, and the main business income of the 59 entrepreneurial companies in clean energy industries was different orders of magnitude, and the data did not meet the normal distribution, so it is not suitable for direct regression analysis. In the actual data processing, all the variables were logarithmic processed. In addition, to avoid the existence of the common linear problem, the independent variable and adjustment variable have been processed centralization. Descriptive statistics for the control variables, dependent variables, moderating variables and independent variables in the models were reported in Table 3 (see appendix 1). In Table 3, the normal distribution was checked by the 1-Sample K-S command, and all variables of $P > 0.05$, which can be considered that variables are similar to the normal distribution and suitable for regression model analysis. It can be seen in Table 4, the ECG in 2014 was significantly related with size ($r=0.828$, $p<0.001$), R&D investment in 2012, 2013 and 2014 ($r=0.703$, $p<0.001$; $r=0.693$, $p<0.001$; $r=0.745$, $p<0.001$), GSB and GSA in 2014 ($r=0.621$, $p<0.001$; $r=0.684$, $p<0.001$).

To explore how GSB and GSA influenced the relationship between R&D investment and entrepreneurial companies' growth, this study constructed multi-regression models to verify the related hypotheses. This study adopted the widely applied 4 steps to test the moderating effects. The results of the hierarchical moderated regression analysis were presented in Table 4.

In model 1, the study only considered the control variables and found that ECG has highly positively relevance with the size ($\beta=0.824$, $p<0.001$).

In model 2, the study entered the independent variables. On the basis of eliminating the rate of market growth, this study found that the R&D investment in 2012 and R&D investment in 2013 were not significantly positive with entrepreneurial companies' growth in 2014 ($\beta=0.287$, $p>0.1$; $\beta=-0.150$, $p>0.1$), while the R&D investment in 2014 was

significantly positive with entrepreneurial companies' growth in 2014 ($\beta=0.273$, $p<0.05$). Therefore, H1 was not supported.

In model 3, the study included the moderator variables found that GSB and GSA in 2014 were unrelated to ECG ($\beta=0.109$, $p>0.1$; $\beta=0.033$, $p>0.1$).

In model 4, the study added the interaction of R&D expenditure with GSB and GSA in 2014. The regression results showed that the regression coefficients of the regulating variables GSB and GSA and the interaction items to ECG were all significant at the level of $P < 0.05$, which shown that GSB and GSA have a significant adjustment between R&D expenditure and ECG, and found the moderating effect of GSB on the relationships between R&D2014 and ECG was negatively significant ($\beta=-0.360$, $p<0.05$), H2 was not supported. In model 4, the study also found that the moderating effect of GSA on the relationships between R&D2014 and ECG was positively significant ($\beta=-0.444$, $p<0.01$), thus, H3 was supported.

The interaction plot was widely used to describe the moderating effects (Aiken and West, 1991), which was shown as Fig. 2. As to the interaction of R&D investment (R&D) with government subsidies beforehand (GSB), the results indicate that R&D was negatively related with entrepreneurial companies' growth (ECG) when GSB was one standard deviation above the mean, but positively related with ECG when GSB was one standard deviation below the mean.

With regard to the interaction of R&D with GSA, the results shown that R&D was positively related with ECG when GSA was one standard deviation above the mean, while negatively related with ECG when GSA was one standard deviation below the mean.

Fig.2. Moderating effects of GSB and GSA on the relationship between R&D and ECG

6. Discussion and Conclusions

The research focused on how entrepreneurial companies' R&D investment influences their growth, especially the moderating effects of GSB and GSA by taking the listed companies in clean energy industries as the samples. The findings shown that R&D investment did not have lag effect on entrepreneurial companies' growth, GSB have negatively positive moderating effects on the relationship between R&D investment and entrepreneurial companies' growth, and GSA have positive moderating effects on the relationship between R&D investment and entrepreneurial companies' growth.

6.1 Discussion

For H1 that the investment in R&D has a lag effect on entrepreneurial companies' growth has not been validated in this study, which is different from the opinions of Fitzpatrick (2008), Rosenberg (1990), Luintel and Khan (2011), Campbell (2012) et al. By using specific cases analysis, they found that the outputs of R&D have the time-lag effect. Specifically, Fitzpatrick (2008) found that the application of basic research in clinical practice normally required 10 to 30 years, sometimes even longer. A good example in sight was personalized cancer drug as it spent nearly 50 years from research to practical application (Yarden and Caldes, 2013). Through empirical research, Yun et al. (2008) found that there was a time lag of 4 years between the indexes of patent impact and rate of return on common stockholders' equity (ROE), and 5 years of time lag with earnings per share (EPS), and lag time in the

pharmaceutical area was even longer. Moreover, Campbell (2012) pointed out that there was a time lag between entrepreneurial enterprises' performance and their new process development (adopting IT and increasing the investment in IT). To be more specific, it spent 3 to 4 years to achieve maximum performance advantage of investment in IT on average. From the analysis above, this study found that the time-lag effect of the outputs of R&D was very common. While for the entrepreneurial companies in clean industry in China, the time-lag effect of investment in R&D was not so obvious. Firstly, entrepreneurial companies lacked the legitimacy in the eyes of resources providers and consumers (Zhang and White, 2016), so it is highly possible that they think the quality and market of the entrepreneurial companies' new products cannot be guaranteed. To satisfy the need for the return of investment (ROI) of shareholders, it is necessary for the R&D activities to produce the instant effects. Therefore, most R&D investment was involved in applied research or experiment research while not basic research, therefore the output of the R&D investment in clean energy industries are relatively direct and obvious. Secondly, the entrepreneurial companies in clean energy industries in China were very large and have rich experience in marketing and technology innovation. Therefore, they probably can absorb the extensive, detailed and structural marketing information (Fabienne and Eric, 2012), then utilize the outputs of R&D instantly. Thirdly, the length of lag-time of R&D activities was decided by the gap between research investment and academic achievement (Jaekyung et al., 2011), the relatedness between new products, new processes and R&D outputs, and lag effect between academic investment and industrial utilization of R&D achievement (Mansfield, 1991). In this research, a large number of R&D investments mainly focused on equipment innovation, which was near to the final market and easy to be industrialized. In addition to this, the gap and uncertainty of entrepreneurial companies' R&D activities in the clean energy industries in China can be reduced by government procurement. Therefore, the lag effect of R&D investment cannot be found in this research. According to this conclusion, it is suggested that the government participate in the process of R&D innovation in the form of subsidies (including GSA and GSB), increasing the R&D investment of entrepreneurial enterprises in the field of clean energy, enhancing enterprise innovation ability and enriching enterprise entrepreneurial resources (Oliviero, 2011). The development of clean energy was greatly encouraged by the formulation of appropriate GSA and GSB policies and the implementation. Subsidy investment can not only reduce the pressure of R&D and innovation of clean energy, but also send a positive signal to the market (Maryann and Maryellen, 2006), so that clean energy start-ups can get more investment channels to expand the scale of production.

For H2, contrary to the opinions of Meuleman and De Maeseneire (2012), Feldman and Kelley (2006), this study found that GSB have negative moderating effects on the relationship between R&D investment and entrepreneurial companies' growth. GSB shared the R&D failure risk with entrepreneurial companies, helping to partially alleviate the market

failure (Lee and Cin, 2010). However, it is highly possible that the GSB crowded out the companies' own R&D expenditure (Li, 2002). As a result, entrepreneurial companies' R&D activities will be influenced by the government greatly. At this time, it is not easy for the products and technologies originated from these R&D activities to meet the customers' need since the main guidelines for entrepreneurial companies' R&D should be the market and customers. Without the profitable products, the entrepreneurial companies cannot survive in the fierce market competition, let alone the rapid growth and development. Meanwhile, GSB can be regarded as important tools for signal transmission (Kleer, 2010; Lerner, 1999). When the amount of GSB for R&D was considerable high, entrepreneurial companies will spend much more energy and resources to develop and maintain the strong guanxi network with the government departments. It means that to a certain degree, the entrepreneurial companies will neglect to develop the weak guanxi networks with other stakeholders. These weak guanxi networks expanded entrepreneurial companies' access to diversified resources, excavate existing resources potentialities and enhance organizational management (Ahuja et al., 2009), which can promote entrepreneurial companies' growth greatly. In summary, the GSB for R&D reduced entrepreneurial companies' motivation to exploit the weak guanxi network, therefore impeding entrepreneurial companies' growth. Lastly, the more advance subsidies the government appropriates to the entrepreneurial companies, the more expensive the technologies and products shall be. Correspondingly, the initial costs for these renewable energy technologies and the related products will be relatively higher (Hirmer and Cruickshank, 2014). Most customers tend to put high priority on the initial cost (Reddy and Painuly, 2004), so it is not easy for them to spend a lot of money on these renewable energy technologies and the related products. Therefore, GSB have negative moderating effects on the relationship between R&D investment and entrepreneurial companies' growth. According to this conclusion, it is suggested that the government should reduce the proportion of GSA as much as possible by providing subsidies to enterprises. In general, there was a certain moral hazard in GSA, and it cannot play its due role in improving the R&D efforts of enterprises. Compared with the GSB, GSA was a kind of low efficiency policy. However, due to the fact that the definition of GSA was difficult to measure, GSA was still a common policy tool in practice. Especially for the R&D projects with strong credit capital constraints, GSA has a certain starting and guiding role (Hussinger, 2008). Therefore, it is suggested that GSA as a supplementary policy tool can reduce the negative impact of government subsidies on the growth of entrepreneurial enterprises, and promote more attention to clean energy related R&D and product innovation (Craig and Allen 2014).

Normally, the negative effect of GSB on clean energy companies' growth came from the following aspects. It is very possible for GSB to distort clean energy companies' growth investment and R&D activities, because the government enforced their oriented objectives and will focus on clean energy companies which go against those companies' development strategies (Haas et al., 2004). Large amount of GSB made the competition in clean energy

industry much fiercer, and engages many large state-owned enterprises enter the industry, while they did not master the key technology and process, even making high pollution and low output (Shen and Luo, 2015). Chen and Luo also pointed out that large amount of government subsidies has induced solar companies to expand production and resulted in the risk of solar companies' overcapacity. With regards to why GSB has negative effect on the relationship between clean energy companies' R&D investment and growth, it is referred to clean energy companies' ownership and industry types (Yu et al., 2016; Arias and Beers, 2013). The amount and ways of GSB should be adjusted according to the clean energy companies' ownership and industry types, while not the more, the better. The influence of GSB was also decided by the duration of subsidies. Generally speaking, the performance of clean energy companies which have been supported by GSB will be improved in the first year, but the subsequent performance will be decided by clean energy companies' ownership and political relationship (Zhang et al., 2016).

For H3, GSA have positive moderating effects on the relationship between R&D investment and entrepreneurial companies' growth, which is similar with the views of Levy and Terleckyj (1983), Lichtenberg (1984), Mansfield and Switzer (1985) and Katrak (1998), Ouyang and Lin (2014), U.S. DOE Energy Information Administration (2013), Silveira et al. (2013), Chang et al. (2013). The main characteristics of entrepreneurial companies were mainly embodied in four dimensions, namely proactiveness, innovativeness, aggressive competitiveness, and risk taking (Zehir et al., 2015). When the entrepreneurial companies first enter the market, it is quite difficult to achieve the key resources as they are not legitimated in the eyes of many resources providers (Zhang and White, 2016). Constrained by the limited resources, the new technologies and products originated from entrepreneurial companies were usually the improved techniques, systems and services. If the entrepreneurial companies obtained a large amount of GSA, this probably will make them believe in their products and technologies in the future. In summary, the GSA for entrepreneurial companies' R&D activities probably led entrepreneurial companies' strategic orientations, promoting their sustainable development. Moreover, the manufacturing process of the clean energy products often demands many processes and each process requires capital-intensive equipment (Ockwell et al., 2007). Many potential customers in the market for the clean energy technologies and related products have no or little knowledge and experience for the application of these technologies and related products (Flamos et al., 2008). Customers' poor access to the information of clean energy technologies and the related products was one of the most important barriers for these products to realize their market value (Luthra et al., 2015). From this point, GSA were helpful to bring the passion for innovation, exploit the potential market and enhance the confidence of customers.

As to the entrepreneurial companies in the clean energy industries, the positive function of government subsidies can also be realized. Prior studies have proved the GSA will alter the

development phase of clean energy companies (Costa-Campi et al., 2014) and Zhang et al. (2016) further proved that GSA have different effects on clean energy companies' R&D investment during different periods. GSA encouraged these entrepreneurial companies to broken through the threshold in certain growth period. Although Simpson and Clifton (2016) found that large amount of GSA was harmful to the enthusiasm of clean energy companies' original innovation and revolutionary product innovation, even some clean energy companies apply for GSA by means of rent seeking to compensate for their own investment on R&D activities (Darmani et al., 2016), such kind of R&D investment are not real innovative activities. Along with the policy about GSA in clean energy industries becomes increasingly regulatory and the supervisory process about GSA in clean energy industries becomes more and more strict, GSA will have normative function. According to this conclusion, it is suggested that the government give priority to GSB by providing subsidies to enterprises. After a clearer definition of GSB, it should give priority to the GSB, make reasonable use of GSB to internalization the R&D spillover effect of enterprises, and generate the greatest incentive effect (Lach, 2000) to avoid blind and inefficient subsidies. The government needed to strengthen supervision in the event of GSB, especially for the technology research and development results of new ventures in the clean energy industry, so that the purpose of enterprise GSB was transparent, the direction of the use of subsidy funds was clear, and the information asymmetry between government and enterprises was reduced (Kleer, 2010), in order to prevent enterprises violating the intention of government subsidies for clean energy to change the use of funds.

6.2 Research implication

This research comprehensively discusses the function of GSB and GSA on entrepreneurial companies' growth at the same time based on the same samples in similar industries. Therefore, this research contributes to understanding the relationship between government subsidies and entrepreneurial companies' development, and exploring the differences between GSB and GSA, which promote entrepreneurial companies' development.

The theoretical value of the study is to provide a theoretical logic for explaining the field of clean energy subsidies (including GSA and GSB) how to influence the growth of entrepreneurial enterprises, and also analyse GSA and GSB on the growth of the enterprise.

Based on the above analysis, practical management implications can be concluded as follows.

(a) Seen from the perspectives of government, it should exert the economic orientation functions and provide scientific and rational subsidy standards for the industry with a good development prospect. Subsidy programs should also be strictly assessed to promote the harmonious development of the industrial structure. The government should take the realistic condition of economic development as the basis and help firms to progress with sufficient guidance and supervision. (b) For firms, they should be oriented to market, and

take full advantage of government preferential policies. In addition, they should also save the costs, innovate new products and make rational resource allocation, thus achieving the long-term sustainable development. Moreover, firms must get a clear self-localization analysis and a clear understanding of the starting point and the direction of GSA. Only when government subsidies meet firms' own pursuits, a win-win situation can be achieved. Otherwise, it wastes resources and even may cause firms' exit from the market competition.

6.3 Limitations and future research

This study only chose 3 years' data in certain industry (clean energy industry) to test the hypotheses about R&D, GSB, GSA and ECG. The samples are also limited. Obviously, it will also influence the judgement on the function of government subsidies to influence the relationship between R&D and entrepreneurial companies' growth. Therefore, in the future research, it is better for us to trace these samples and select more time series data to test the model in this research again.

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Table 3 Descriptive statistics and correlations (N=59)

Variables	Min	Max	Mean	Std.	Z	P	ECG	IC	AGE	SIZE	R&D2012	R&D2013	R&D2014	GSB2014	GSA2014
ECG	19.23	25.3	21.62	1.16	0.8	0.544	1	-.144 (.280)	.103 (.440)	.828*** (.000)	.703*** (.000)	.693*** (.000)	.745*** (.000)	.621*** (.000)	.684*** (.000)
IC	1	10	5.4	3.03	10.316	0.063		1	.158 (.236)	-.053 (.694)	-.133 (.319)	-.085 (.524)	-.046 (.731)	-.247 (.062)	-.244 (.065)
AGE	2.08	3.5	2.86	0.33	0.972	0.301			1	.155 (.244)	.003 (.981)	.038 (.778)	.010 (.940)	.124 (.353)	.276* (.036)
SIZE	5.87	11.2	7.99	1.11	0.472	0.979				1	.632*** (.000)	.641*** (.000)	.684*** (.000)	.638*** (.000)	.684*** (.000)
R&D2012	14.7	21.48	17.81	1.43	0.486	0.972					1	.943*** (.000)	.738*** (.000)	.391*** (.002)	.583*** (.000)
R&D2013	14.81	21.4	17.92	1.44	0.729	0.663						1	.785** (.000)	.371** (.004)	.549*** (.000)
R&D2014	13.32	21.84	17.91	1.61	0.65	0.792							1	.458*** (.000)	.561*** (.000)

GSB2014	13.63	22.45	17.57	1.72	0.554	0.791								1	.774*** (.000)
GSA2014	11.96	20.74	16.49	1.65	0.952	0.559									1

***. Correlation is significant at the 0.001 level (2-tailed)

**. Correlation is significant at the 0.01 level (2-tailed)

Table 4. Results of hierarchical moderated regression analysis (N=58)

	Model 1	Model 2	Model 3	Model 4
<i>Control variables</i>				
IC	-0.099 (-1.302)	-0.083 (-1.195)	-0.051 (-.690)	-0.053 (-0.814)
Age	-0.009 (-.118)	0.033 (0.476)	0.017 (0.222)	0.051 (0.766)
Size	0.824*** (10.811)	0.547*** (5.592)	0.466*** (4.089)	0.512*** (5.538)
<i>Independent Variables</i>				
R&D2012		0.285 (1.376)	0.256 (1.196)	0.370 (1.879)
R&D2013		-0.149 (-0.669)	-0.107 (-0.474)	-0.157 (-0.742)
R&D2014		0.273* (2.305)	0.250* (2.084)	0.148 (1.212)
<i>Moderating Variable</i>				

GSB2014			0.109 (0.937)	-0.356* (-2.270)
GSA2014			0.033 (0.249)	0.455** (2.907)
<i>Interaction effects</i>				
R&D2014 GSB2014				-0.360* (-2.282)
R&D2014 GSA2014				0.444** (2.812)
R ²	0.696	0.769	0.778	0.805
Adj. R ²	0.679	0.742	0.741	0.773
ΔR^2		0.046***	0.009***	0.027
F	41.158***	28.292***	21.423***	25.224***

Note:

1. N=59.

2. + p<0.1, *p<0.05, **p<0.01, ***p<0.001. All reported significance levels are two-tailed.

3. Standardized coefficients are reported; the numbers in parenthesis are the t values

Appendix: Basic Information of Samples

Samples	Number of Employees (2014)	Established Year	Sub-classification of Clean Energy
Xinjiang Goldwind Science & Technology Co., Ltd.	5002	1998	Wind power
Titan Wind Energy (Suzhou) Co., Ltd.	491	2005	Wind power
Shanghai Taisheng Wind Power Equipment Co., Ltd.	868	2001	Wind power
Huayi Electric Co., Ltd.	1803	1986	Wind power
Ning Xia Yin Xing Energy Co., Ltd.	749	1998	Wind power
Xiangtan Electric Manufacturing Co., Ltd.	7499	1999	Wind power
Shanghai Hi-Tech Control System Co., Ltd.	1170	2000	Wind power
Sufa Technology Industry Co., Ltd., CNNC	1221	1997	Nuclear power
Shenzhen Woer Heat-shrinkable Material Co., Ltd.	4088	1998	Nuclear power
Jiangsu Shentong Valve Co., Ltd.	750	2007	Nuclear power
Zhejiang Jiuli Hi-tech Metals Co., Ltd.	2587	1987	Nuclear power
Dongfang Electric Co., Ltd.	21379	1993	Nuclear power
Shanghai Electric Group Co., Ltd.	29261	2014	Nuclear power
SDIC Power Holdings Co., Ltd.	7415	2014	Hydropower
Sichuan Chuangtou Energy Co., Ltd.	910	1988	Hydropower

Hubei Energy Group Co., Ltd.	3646	1993	Hydropower
GD Power Development Co., Ltd.	28335	1992	Hydropower
Guangxi Guiguan Electric Power Co., Ltd.	2853	1992	Hydropower
TBEA Co., Ltd.	15488	1993	Photovoltaic power
Hareon Solar Technology Co., Ltd.	4257	2004	Photovoltaic power
Jiangsu Akcome Science & Technology Co., Ltd.	2251	2006	Photovoltaic power
Xi'an Longi Silicon Materials Corp.	5451	2000	Photovoltaic power
SUNGROW	1164	1997	Photovoltaic power
Huabei Expressway Co., Ltd.	1003	1999	Photovoltaic power
Zhongli Sci-Tech Group Co., Ltd.	5427	1996	Photovoltaic power
Wuxi Little Swan Co., Ltd.	8497	1993	Solar energy
Sichuan Minjiang Hydropower Co., Ltd.	809	1993	Solar energy
Shengyi Technology Co., Ltd.	9018	1985	Solar energy
Ningbo Weken Co., Ltd.	6047	1998	Solar energy
Advanced Technology & Materials Co., Ltd.	6414	1998	Solar energy
Lanzhou Great Wall Electric Co., Ltd.	4082	1998	Solar energy
Leshan Electric Power Co., Ltd.	4469	1988	Solar energy
Nanjing Huadong Electronics Information & Technology	3378	1993	Solar energy

Co., Ltd.			
Zhejiang Linuo Flow Control Technology Co., Ltd.	467	2014	Solar energy
Tibet Rhodiola Pharmaceutical Holding Co., Ltd.	790	1999	Solar energy
North Electro-Optic Co., Ltd.	2911	2000	Solar energy
Shanghai Aerospace Automobile Electromechanical Co., Ltd.	2009	1998	Solar energy
Csg Holding Co., Ltd.	10432	1984	Solar energy
Xin Nan Yang	3130	1992	Solar energy
Ningbo Shanshan Co., Ltd.	3059	1992	Solar energy
Fengfan Stock Limited Company	6890	1958	Solar energy
Shanghai Tongji Science & Technology Industrial Co., Ltd.	1738	1993	Hydrogen
Jonjee Hi-tech Industrial and Commercial Holding Co., Ltd.	3248	1993	Hydrogen
Jiangsu Chunlan refrigerating equipment stock co., ltd.	1166	1989	Hydrogen
Aucma Co., Ltd.	5836	1987	Lithium battery
TCL Corporation	73485	2002	Lithium battery
Wanxiang Doneed Co., Ltd.	353	1995	Biological energy
Gansu Ronghua Industry Group Co., Ltd.	831	1998	Biological energy
Cofco Biochemical (Anhui) Co., Ltd.	7201	1998	Biological energy

Jiangmen Sugarcane Chemical Factory (Group) Co., Ltd.	626	1993	Biological energy
Baotou Huazi Industry Co., Ltd..	541	1998	Biological energy
Hainan Yedao Group Co., Ltd.	963	1993	Biological energy
Wuxi Huaguang Boiler Co., Ltd.	2410	2006	Biological energy
Huadian Power International Corporation Limited	24399	1994	Biological energy
ZZEFU Co., Ltd.	1674	2008	Tidal energy
Zhejiang Dunan Artificial Environment Co., Ltd.	9374	2001	Geothermal energy
Yantai Moon Co., Ltd.	1776	1989	Geothermal energy
Dalian Refrigeration Co., Ltd.	2030	1993	Geothermal energy
Shanghai Highly (GROUP) Co., Ltd.	4730	1992	Geothermal energy
Shanghai Hanbell Precise Machinery Co., Ltd.	663	1998	Geothermal energy
Zhejiang Weixing New Building Materials Co., Ltd.	2911	2007	Geothermal energy
Guangzhou Seagull Kitchen and Bath Products Co., Ltd.	4101	2003	Geothermal energy
Haerbin Air Conditioning Co., Ltd.	862	1952	Geothermal energy
Zhejiang IDC Fluid Control Co., Ltd.	2616	2001	Geothermal energy
Jiangsu Changfa Refrigeration CO., LTD.	3338	2002	Geothermal energy
Shuangliang Eco-energy Systems CO., LTD.	3087	1982	Geothermal energy