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Evaluation of the actual performance of China's Green Economy stimulus package

A case study of China's "Feed-in-Tariff" system for wind energy in Chang River Delta region

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Abstract

This thesis aims to evaluating the actual performance of China's "Feed-in-Tariff" system for wind energy, especially the updated version after 2009 which being part of the Chinese economic stimulus package that intended to help the recovery of the economy from global financial crisis. The research started by looking thoroughly into the evolution and mechanism of the system. Then through a case study focuses on Chang River Delta region, the assessment undergoes by using indicators that covered four dimensions, namely economic, environmental, social and energy system respectively. The comparison of the intended and unintended outcomes of the system and their significance was done in the finding of the thesis, which helps to conclude that even the system had negative impact on some extreme situations, the general impact appeared positive.

Keywords: China's "Feed-in-Tariff" system; wind energy; Chang River Delta region; performance evaluation.

Executive Summary

The idea of low carbon economy which only address greenhouse gas emissions first brought up in 2003 and it has been enriched to the concept of green economy that covers a broader range of environmental issues after that. According to the well accept concept which established by UNEP in their report, green economy has been refer to a different kind of economy that would significantly reduce environmental risks and ecological scarcities along it developing and then lead to the further result of human well-being and social equity improvement.

Almost all the important economic bodies suffered big hits by the global financial crisis which occurred in 2008 and issued stimulus packages to help the recovery of the economy. Green economy has been considered as a great driving force of the economy which is more sustainable than ordinary ones, therefore it appeared as substantial parts of most countries' stimulus package. The policy instruments been using -whether they were regulations or monetary instruments- had different starting points with different goals. It has been some years after these stimulus policy instruments implemented and their performance needs to be assessed. Such assessments have been conducted for several policy instruments in different countries.

China is a big country with abundant wind resources. Wind energy has always been considered as one of the most important kind of renewable energy which would be taking a substantial percentage in national energy mix by the central government. But until China's "Feed-in-Tariff" system launched in 2006, there was no significant progress on its development. After the global financial crisis, Chinese government also issued stimulus package which includes the support for the development of renewable energy. As the most important method the government used to facilitate the development of wind energy, the "Feed-in-Tariff" system had been updated in 2009 as part of the stimulus package. And there was no systematical assessment on the performance of the updated version of system.

The objective of the thesis is to fill in the knowledge gap on the actual performance of the updated version of China's "Feed-in-Tariff" system for wind energy. The research started by look into the mechanism of the system. Then a case study was conducted to narrow the scope of the evaluation to Chang River Delta region. The Green Growth Analytical Indicators framework was chosen to analysis the data. Therefore the assessment was accomplished by using indicators that cover four dimensions, namely economic, environmental, social, and energy system, respectively. The performance of the system then been compared to the intended outcomes of the system.

China's "Feed-in-Tariff" system consists of five parts, namely national goals for wind energy development, mandatory procurement of wind energy order for grid companies, pricing policy for mandatory procurement, domestic manufacturing requirement, and taxation policy for wind energy respectively. In the stimulus package, the national goals for wind energy development, pricing policy for mandatory procurement, and domestic manufacturing requirement had been modified and remains stayed the same. The national goals for wind energy development revised to a larger installed capacity in the stimulus package and had been revised every year since according to the actual situation of development. The main change focuses on pricing policy. In principle, the mandatory procurement price for wind energy had been changed from case-to-case method to benchmarking price zone method. In the new method, the country has been separated into four price regions which depends on wind density, economic development level, and the cost of wind farm construction. The

procurement price is the same within each region. And in order to facilitate the development of wind energy technology therefore further stimulate the development of wind energy industry, the domestic manufacturing requirement had been cancelled in the stimulus package.

The case study was focused on Chang River Delta region which consists of Jiangsu province, Zhejiang province and Shanghai. This is the most developed region in China in the sense of economic situation and is one of the four rich wind resources region. The biggest manufacturers of wind turbine are located in Jiangsu province. It has the most abundant wind resources within the region and easier to explore. The wind resources in Zhejiang province and Shanghai are abundant as well but the construction cost of wind farm was substantially higher than in Jiangsu province.

From an energy system change point of view, the wind energy growth rapidly in the sense of both installed capacity and actual supply in the region in general. However, after the pricing policy been modified, the different impacts it had on different situations appeared. For instance, in Jiangsu province, the industry continued the rapid growth. But in other two regions, the growth ratio dropped dramatically because of the extremely situation that the generating cost of wind energy exceeded the benchmarking price because of the high construction cost of wind farm. The system helped the adjustment of energy structure. And the cancelation of domestic manufacturing requirement really facilitated the technology import therefore lead to the better development of wind energy technology.

The economic outcomes of "Feed-in-Tariff" system are shown by job creation, returns for the investors and contribution to GDP growth. The job has been created along the whole chain of the industry as its development at a relatively high ratio. The returns for the investors are secure and predictable and the contribution of wind energy development to GDP growth is substantial.

The development of wind energy lead to huge quantity of CO_2 reduction, SO_2 reduction, and waste water reduction. Even such reductions couldn't be observed in the statistic data, they can be estimated and calculated by comparing to business-as-usual scenario. Thus from an environmental point of view, the "Feed-in-Tariff" system contributed to the abatement of environmental burden caused by human activities.

Also, the "Feed-in-Tariff" system brings social outcome by contributing to the improvement of social equity. The main manifestations are higher female employee ratio and higher better education level employee ratio in wind energy industry. Meanwhile, the job benefit is better in the wind energy industry than social average.

The intended outcomes for the "Feed-in-Tariff" system are the substantial growth on installed capacity and actual supply of wind energy, and job creation. To these ends, the updated version of the system accomplished its job perfectly in most circumstances. Except for some extreme situations, the system supported the development of wind energy and facilitated its rapid growth. Meanwhile, relatively huge quantity of jobs had been created along the whole chain as wind energy developed. Addition to that, the system also lead to several positive unintended outcomes such as environmental progress and improvement of social equity.

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1 Introduction

1.1 Background to the research

The concept of green economy was first brought by British environmental economists David Pierce, Anil Markandya and Edward Barbier in 1989 (Pearce, Markandya, & Barbier, 1989). (Zhu D. J., 2012) After that, finding the pathway to transit towards such economy been put on governments agenda gradually. In 2003, Britain first put forward the idea of such economy and used the term Low Carbon Economy. (Bao, Miao, & Chen, 2008) Initially the concept was only addressing the issue of reducing greenhouse gas (GHG) emissions while economic growth. (Blair, 2003) According to United Nations Environment Programme (UNEP)'s report (UNEP, 2011a), a green economy is a more comprehensive and challenging kind of economy that not only aim for the reduction of GHG emission but also for reducing other environmental risks and ecological scarcities along with development and social goals to improve human well-being and social equity.

To cope with the impact of the global financial crisis in 2008-2009, many countries issued "Green Economy" stimulus packages to help the economic recovery and revitalization of the economy. (Song L. , 2010) Contents like substantial amount of direct investment with the focus of energy efficiency and renewable energy etc., and regulations with the purpose of facilitating the development of renewable energy etc. can be found in almost all these countries' stimulus packages. (Cheng, 2009) For instance, in US Obama's green economy stimulus package plans to invest 150 Billion USD for substitute energy resource research in ten years and creates 5 million jobs related to it. There were also tax reduction for the relevant companies. In Europe, the EU commission announced a 105 billion Euro investment plan to support the development of green economy in 2009. Among these, 54 billion Euro would be used for helping EU members to reach the EU environmental standard. In Japan, the government designed new emission trading scheme and environmental tax in 2009, which expected to stimulate the growth of green economy from total value of 700 billion USD to 1200 billion USD in 2020. (Mou & Li, 2009) China also established economic stimulus package in 2008 and the development of green economy was an essential part of the stimulus package. (Jin, 2009)

Then the question of how is the actual performance of these policy instruments on promoting the transition to green economy been raised. Different international organizations such as the Organization for Economic Co-operation and Development (OECD) and the World Bank and national level organizations have all developed frameworks to measuring the progress toward a green economy. (World Bank, 2012) (OECD, 2011)

1.1.1 Chinese Green Economy

When the Chinese government first officially used the term low carbon economy in its five year development plan, it combined with the concept of green economy and therefore refers to an economy that takes the environmental issues in general into consideration. (CCP, 2011). As the concept of "carbon emission" been attached great importance by more and more countries, it became more than just an economic issue, but more of a political and social issue as well. The traditional "high carbon emission" development mode in China has become a great obstacle to the further development of China's economy. (Cao, Zhao, & Yang, 2012)

Today, a green economy is defined by Chinese government as a new and sustainable type of economy with the core value of harmonic development between human and the environment, the goal of economic development harmonize with the carrying capacity of the environment, the direction of market mechanism and the foundation of traditional industry economy. (Mou & Li, 2009) Similar to the UNEP's definition for Green Economy (UNEP, 2011a), the sectors of the green economy in China covered was shown below: environmental infrastructure construction, clean technology, renewable energy, waste management, ecological diversity, sustainable transportation, etc.. (Su & Li, 2011) It has been considered as one of the right pathways to overcome the problems mentioned above, but for several years it hasn't found a break through. For instance the investment towards green economy was growing gradually but hadn't exceed 1.5% of the total GDP until the year of 2008. (Su & Li, 2011)

1.1.2 Chinese stimulus package for economic recovery

As one of the largest economic body in the world, Chinese economy suffered the assault by the financial crisis seriously. According to the data published by the National Bureau of Statistics of China (NBSC), Chinese GDP growth by 9.9% year on year in total after the first three quarters of 2008, which is a 0.5% decrease compare the first two quarters in total and a 2.3% decrease compare to the year on year growth ratio last year. And it was a continuity decrease in the growth ratio for the fifth quarter. (*Figure 1*) (Ma, Chen, Zhong, & Liu, 2009)

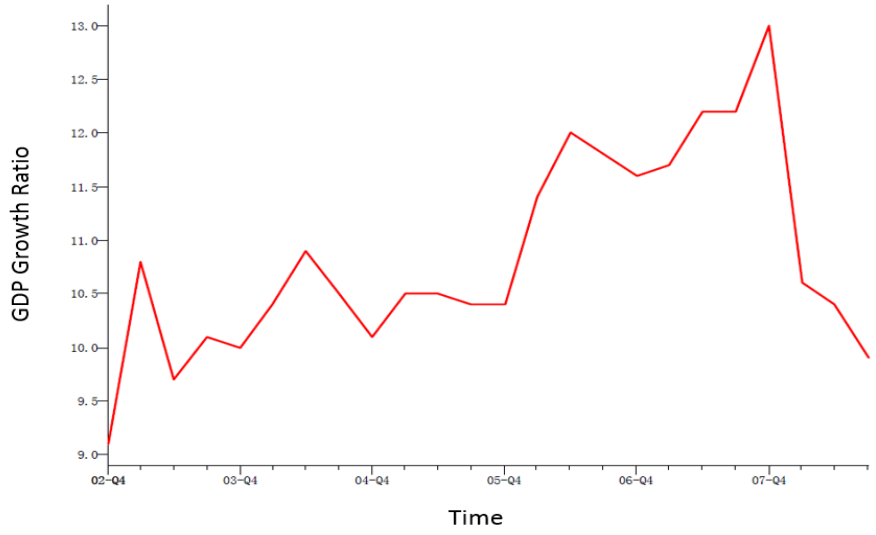

Figure 1 Chinese GDP growth ratio (2002.Q4-2008.Q3). Source: Wind data.

Under these circumstances, in November 2008, the prime minister Wen Jiabao announced a Ten-Measure economic stimulus package.[1] The core logic of the package is to stimulate economic growth by expand domestic demand. And to realize the political goal, the package

[1] By look into the ten measures, most of the policy instruments and investment projects were in the range of infrastructure construction and public affairs. They mainly covered 7 perspectives, namely indemnificatory housing projects for low-income people; countryside infrastructural facilities and people's living condition; public transportation infrastructural facilities; the health, culture, and education enterprise; ecological or environmental construction; structural adjustment and independent innovation; and reconstruction of the earthquake disaster area.

was backed up by a huge investment plan which amounted of 4 trillion RMB[2] [3](approximate 586 billion USD) that intended to be spend in the following two years.

The investment towards all the sectors in green economy which so called "green investment" was an important part of the economy already before the stimulus package came out. Among all the sectors in the green economy, waste management and public transportation attracted the most invests. In the announcement, there would be about 350 billion RMB been invest directly into ecological or environmental related projects which stands for 9% of the total investment plan, others like investment towards public transportation which stands for 45% of the total amount also contribute to the green economy.[4]

The fund specifically sets for green economy was significant, but still the more influential part was other instruments such as regulatory instrument. These instruments appears by the form of part of National Development Plan, development plan for specific industry, tax policy, financial policy, national quota and some specific policy design. The stimulus package also include value added tax reform (projected to cut domestic companies' tax burden by 120 billion RMB annually), structural tax reduction, interest reduction, line of credit increase, tax refund for exported goods increase etc.. These policy instruments were essential parts of the stimulus package as well. (Zeng, Xiao, & Chen, 2010) All these investments and other instruments together were argued to strengthen the policy efforts to encourage a green economy in China. (Su & Li, 2011)

1.2 Problem definition

The concept of green economy have been brought into China for years. Although it grew as the time went by, the percentage it stands for in the aggregated economy was still limited. The investment towards renewable energy in 2008 was over 15.6 billion USD which was an 18% increase compare to 2007, and it was the most among all the Asian-pacific area countries. (Su & Li, 2011) Until the end of 2008, renewable energy sector has created more than 1 million jobs in China, which was 20% more jobs compare to industries with similar value of industrial output. (Xiang & Zheng, 2013) There have been some studies ((Li, Liang, & Ren, 2010) (Wang & Zhang, 2011) (Liang Z. P., 2010) (Han, 2012) etc.) focus on the policy instruments that support the development of renewable energy themselves and tried to provide a view on the outcomes of such policy instruments. Most of these studies presented the direct outcome of the instruments such as the development situation of renewable energy, the growth on domestic manufacturing capacity, etc.. They conclude that most of the instruments fulfilled the intended outcome. However, none of them systematically analyzed the unintended outcome, also none of them made comparison between the reality and business as usual scenario.

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[2] The public data from the NBSC showed that among the 4 trillion RMB, only 1.18 trillion RMB was indubitable directly investment from central government, the rest part were projected local government investment and private investment stimulated by the central government investment.

[3] As on July 2013, 1 USD equaled to approximately 6.2 RMB, and 1 Euro equaled to approximately 7.9 RMB. (Data came from the Bank of China)

[4] In March 2009, the initial investment plan have been adjusted structurally by the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPCCC). Sadly the investment towards environment and ecological related projects been cut from 350 billion RMB to 210 billion RMB and the investment towards public transportation infrastructural facilities been cut from 1800 billion RMB to 1500 billion RMB. The investment towards other areas adjusted higher accordingly.

After the stimulus package been announced, its contents and details have been constantly questioned. The concerns were around subsequent arguments: whether the instruments and investment within the stimulus package were new or just a continuity of the previous ones; if they were new, how many of them were new; how the package would affect the government fiscal budget, or whether it would increase the fiscal deficit. Within the renewable energy sector, they were two industries attracting the most investment, namely wind energy and bio-energy.

Wind energy is an important kind of renewable energy. Compare to others renewable energy, the technologies been using in the wind energy industry are relatively mature, and with better business development potential. The policy instruments been using to support the industry could be separated into three categories, namely macro policy, price policy and taxation policy. As explained above, many instruments have been updated in the stimulus package, including those targeting the wind energy sector. However, no existing studies which tried to evaluate the outcome of the policy instruments used by the Chinese government could be found that made distinguish between the old and updated version of those instrument. Therefore, after five years of implementation, the actual performance of Chinese stimulus package is still unknown.

As one of the most important sector in renewable energy, the development of wind energy was backed up by the most policy instruments within the sector. A systematical assessment on the actual performance of these instruments is needed since it has been some years after these instruments been implemented and the information regarding this is still missing. As the most important policy package that support the development of wind energy, the evaluation of the China's "Feed-in-Tariff" system offers a considerable opportunity to measure and approach the performance of the Chinese "Green Economy" stimulus package.

1.3 Research objective and question

The thesis at hand represents the first attempt to evaluate the actual performance of China's "Feed-in-Tariff" system for wind energy - with the focus on its updated version that is part of the China's "Green Economy" stimulus package. The objective of the research is thus to increase our knowledge about Green Economy policy packages and their ex-post performance. To that end, the research at hand takes the "Feed-in-Tariff" scheme and the Chang River (Yangtze River) Delta region as a case study, which is one of the four major wind resource areas in China. In order to address this objective, the following research questions guided the work:

- How can the performance be evaluated from a systemic point of view?

- What were the intended and untended outcome of the system?

- What can be said about economic, environmental, social and energy systems aspects?

To perform the analysis, different methods are used (details in Chapter 2). By answering the research questions, this research aims to fill in the knowledge gap on the outcomes caused by the Green Economy policy package. By perform the evaluation, the question of whether the policy instruments have the capability to fulfil their jobs and if they do, how efficiency they are hope to be answered. Also, the evaluation would help to find out whether there is a need to improve the design and selection of the policy instruments. Such evaluation also makes it easier for other further study on same or similar policy instruments and comparison with other instruments.

1.4 Scope and limitations

In this thesis, the object under evaluation is China's "Feed-in-Tariff" system which is a policy package that consist of several policy instruments. The system targets at several renewable industry sectors. However wind energy is the only sector that under evaluation in this thesis. Also, only onshore wind energy is under evaluation since offshore wind energy applies different pricing mechanism. For the reason of having a holistic point of view, the policy mechanism towards offshore wind energy may been bought up in this thesis, but henceforth the expression wind energy only refers to onshore wind energy unless further specification.

As mentioned above, the China's "Feed-in-Tariff" system started to work since 2006, but being part of the China's stimulus package, it has been updated in 2009. This thesis mainly focuses on the policy instrument being part of the stimulus package. In order to keep a holistic point of view, even the emphasis has been given to the data after 2009, some data from 2008 or even some from 2006 was mentioned to be compared with.

The stakeholders relevant to instrument are central government, local government, wind farm owners, grid companies, domestic and foreign manufacturers of wind energy equipment and end users. For practical reason, not all the stakeholders' opinion and function have been analyzed and some of them will be mentioned more frequently being the source of the data.

As mentioned above, the policy is implemented in the whole country and applies to all the provinces. In order to avoid the unexpected complicity and uncertainty, the geographic boundary is set on Chang River (Yangtze River) Delta region which includes three provincial administrative districts, namely Jiangsu province, Zhejiang province and Shanghai. All these regions have the similar development level in the sense of economy. Normally they have the similar policy responding to the development plan or quota given by the central government. The culture is also relatively similar and the interaction between these regions are really frequently on most dimensions of the society. In this particular case, the region was chosen mainly because these regions were three of the few regions that actual energy supply from the wind energy equal to or close to the installed capacity because of the relatively mature construction of the grid. (Qi, 2008) This fact made the data and result from the regions more valuable. However, even the three regions are relatively similar in many ways, but the reader should aware that they still have differences in many senses. For instance most of the large wind turbine producers are located in Jiangsu province which lead to the result that the cost of equipment procurement is different. Also, the difference on land condition also leads to the difference on cost of wind farm construction. (Details will be explain in section 2.4) These differences may affect the result of the actual performance of the policy instrument in these regions.

Furthermore, the reader should also aware that the "Evaluation problem" and "impact problem" effect exists, meaning that the development situation and the fact appears on other dimensions are simultaneously affected by more than just one policy instrument. In most of the cases, it's impossible to separate the result from others which would affect it. Also, because of the data availability, some of the data will cover the whole region but some of them will only cover a more narrowed geographic region.

1.5 Target audience

This thesis targets in most of the stakeholders of the policy mentioned above, namely central government, local governments, wind farm owners, grid companies, domestic and foreign manufacturers of wind energy equipment and end users, and academia. But the nature of evaluation of the performance of a policy instrument makes this thesis more valuable for policy makers, academia and suppliers. Also, the international investors especially those have special interest in renewable energy may interested in the result of this thesis as well.

1.6 Outline

This thesis is comprised of five chapters.

In Chapter one, background information around the policy instrument under evaluation in this thesis is being introduced. And it's followed by problem definition and scope setting. The research questions are also presented. Target audiences outlined.

In Chapter two, the methodology being used is presented, both for data collection and data analysis. After that, a detailed case study is conducted.

In Chapter three, findings of the thesis are presented. By corporate with the framework introduced in Chapter two, the actual performance of the policy instrument under evaluation is presented through different indicators which being separated into four different dimensions.

In Chapter four, other factors may affect the results of the study are being reviewed and examined. And the problems of the research are confronted.

In Chapter five, the main findings of the thesis are conclude in order to answer the research questions which raised in Chapter one.

2 Research Methodology

This chapter introduces the methodology has been used during the research and gives detailed description about each stage. The research process has been separated into two stages- namely data collection and data analysis- like most research did. Each research stage builds upon several different tools and methods, which altogether formed the methodology employed by this thesis. As mentioned above, this thesis is an assessment of the actual performance of a policy which facilitates the development of one certain type of renewable energy-in this case wind energy. In order to do make the evaluation, a profound understanding on both the policy itself and the outcome of the policy is needed. For the first part, policy analysis method was used thus according to Fischer explained in his book *Evaluating public policy*, policy itself became the object of the analysis. (Fischer, 1995) The policy-relevant information which have been used in the political setting process, the goals the policy designed to achieve or the problems the policy designed to overcome need to be identified. (Dunn, 1981) But since this thesis is not about the evaluation of the policy itself per se, the data collected for policy analysis and the result of such analysis maybe come in to support other assertion in the thesis, they will not be presented in whole separated. As for the second part, the research method and process will be explained below.

2.1 Analytical approach

The logic of research normally involve several steps: identifying and defining the problem, gathering facts and proofs (methods of data collection round 1) to identify the knowledge gap, gathering more data to fill in the gap (methods for data collection round 2), analyzing the data and establishing indicators or benchmarks for conclusion drawing (methods or framework of analysis), and then come up with the conclusion. The *Figure 2* below outlined each step of methodological approach of this thesis. They then are explained in further detail in this chapter.

Figure 2 Process and methods of research

As shown in *Figure 2*, the research process started with reviewing journal papers and academic articles with the object of updated version of China's "Feed-in-Tariff" system. Knowledge gap on the evaluation of the actual performance of such system was then been identified. Therefore in data collection round 2, data regarding the performance of the system been

collected by further literature review and interviews. These data include the theoretical logic of the policy design and the enforcement mechanism of the policy, intended goals and unannounced expectations of the policy, and statistic data relevant to the system that covers different dimensions. In the analysis process, data been analyzed under the framework of "Green growth analytical indicators" that separated into four dimensions.

2.2 Methods for data collection

Data used in this thesis were collected from a variety of sources based on credibility and availability. As shown in *Figure 2*, the collection process was separated into two phases. In each phase, the starting point was a preliminary research that help to specify what data would be needed therefore making the collecting process more efficient and aiming to more accurate goal. Then data was collected through different sources and methods (details below). In Data collection round one, only quantitative data was collected and both quantitative and qualitative data were collected in round two. Since the qualitative data was more for the author to gain a better understanding of the whole picture, most of the data presented directly in this thesis was collected with the quantitative approach. Along with the data collecting process, some conflict data from different sources were identified. In these cases, the general principle of this thesis is that qualitative data especially this kind of data from the officials are more credible than quantitative data. Primary quantitative data is more credible than secondary quantitative data.

2.2.1 Literature review

Basic knowledge about the framework (Green Growth Analytical Indicators framework, (USDC, 2010) (UNEP, 2012)) would be used in the data analyzed was collected through literature analysis. Background information about the Chinese stimulus package and more specific information about the policy package under analysis of this thesis was collected through the review of journal paper and academic literature (most of these were outlined in previous chapter). Neither literature about the exact actual outcome of the stimulus package nor literature about the actual performance of the updated version of the policy package was found. There are some articles about the approximate outcome of the Chinese stimulus package but the credibility of such articles are questionable.

More specific quantitative data was collected by literature review in the second round of data collection. Most of statistical data was obtained from local government of Yancheng city, Jiangsu. Other official data were obtained from the Chinese Statistic Year Book. And the officials' statistical data also complemented with statistical data from private companies and international organization database such as OECD database. The governmental document states the enforcement mechanism of the policy instrument clearly. The data relevant to the performance of the policy also collected in this phase in order to be analyzed in the next stage.

Scientific journal articles that evaluated the outcomes of policy instruments used by government to support the development of renewable energy in China were reviewed. Even some of them touched upon the new content in the stimulus package, they didn't specify to wind energy. Other scientific journal articles that evaluated the outcomes of policy instruments which support the development of wind energy in China were also reviewed. However, they didn't make distinguish on before or after the mechanism of the policies been changed in the stimulus package.

2.2.2 Interviews

Several semi-structured interviews were conducted during the second round of data collection. The people been interviewed include local government representatives, wind energy association representatives, wind farm owners and wind energy equipment producing company representatives. (See detailed list of interviewees after bibliography. Note that according to personal willingness, some of the interviewees remain anonymous with indication of department they belong to.)

The main goal of the interview with officials was to gain a profound understanding of the initial purposes of such policy instrument which would also lead to a better understanding about the logic of the mechanism. Meanwhile, during the interview, some questions touched upon the potential local government has to expand the range or time period or to go even further than the way it was of the policy instrument. Also, the officials' perception of the performance has been tested here and gave a unique perspective of it. All these further helped to guide subsequent interviews with other stakeholders and to guide accurate selection of indicators.

Interviews with other stakeholders have been proved to be useful that provided additional insights which could not be gained from the literature and documents. These insights were extremely useful when it came to understanding the unexpected outcome of the policy instrument. Additional to that, these interviews provided a great deal of information that interpret the actual outcome of the policy instrument from a more micro perspective which is not the object of this thesis but would be helpful for the better understanding of the whole picture. Therefore the information falls into this category is presented in the discussion chapter.

2.3 Method for data analysis

The method for data analysis in this thesis is based on "Evaluation Indicators". The method consists of measurements of a certain policy instrument from different dimension. In order to make the measurements more comprehensive, various indicators are used to quantify the performance of the policy instrument.

The process began with a detailed examination of existing frameworks. Different international organizations and national level department such as OECD, UNEP, and U.S department of Commerce have developed frameworks to measure progress towards a green economy in the corresponding geographic region or the region of concern. (Muro, Rothwell, Saha, & Practice, 2011) (USDC, 2010) (UNEP, 2012) All these frameworks have a similarity that based on indicators and separate them into broad categories of social, economic and environment.

In UNEP's report, a green economy was considered more as a tool to achieve the goal of sustainable development than the goal in itself. Therefore the indicators been used to the evaluation of a green economy policy need to identify the goals of the policy instrument and track their progresses. By comparing the goals and the actual progress, the performance of the policy being assessed. The indicators were separated into following categories: indicators for environmental issues and targets, indicators for policy interventions and indicators for policy impacts on well-being and equity. The report also gave lists of commonly used indicators under each categories and example of utilizing them. (UNEP, 2012) The framework developed by U.S department of Commerce were introduced along with their evaluation of the U.S green economy. It provided detailed method to identify a green economy policy and

introduced indicators that could be used to evaluate the direct effect of a green economy. (USDC, 2010)

To evaluate the environmental progress, UNEP established a framework that influenced greatly by the Driving force-Pressure-State-Impact-Response (DPSIR) framework which was developed by the OECD, the European Environment Agency and the United Nations Commission for Sustainable Development (UNCSD) and the United Nations System of Environmental-Economic Accounting (SEEA). Indicators such as CO_2 emission are used to measure the progress on the issue it addressed-in this case climate change. Various indicators can be used to address almost all the major environmental issues. *Figure 3* listed some of these issues and the indicators that fall into that category from UNEP's global perspective.

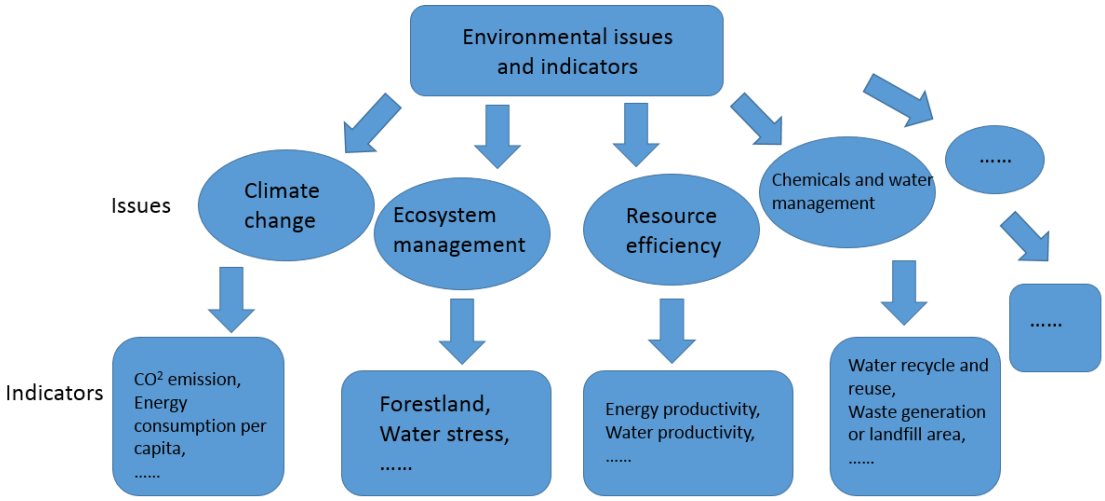

Figure 3 Environmental issues and corresponding indicators used by UNEP to measure environmental progress of a green economy.

The most frequently used indicators to assess the economic progress by academia were included in the Social Accounting Matrix theory (Pyatt & Round, 1985) and System of National Accounts. (UNEP,2012) The common indicators includes direct economic outcome, the revenue generated, costs and so on. As for green economy policy, use these framework to monetary assess the performance of the environmental goods and services sector (EGSS) (UNSD, 2003) is also important. For instance, the value of the nature resource been protected, value added to the whole society. Indicators like these really helped to understand the actual economic progress because of the policy closer to reality, if not complete yet. Beyond that, the employment is also one of the most important indicator. The most common indicators to assess economic progress included in the frameworks mentioned above have listed below in *Figure 4*.

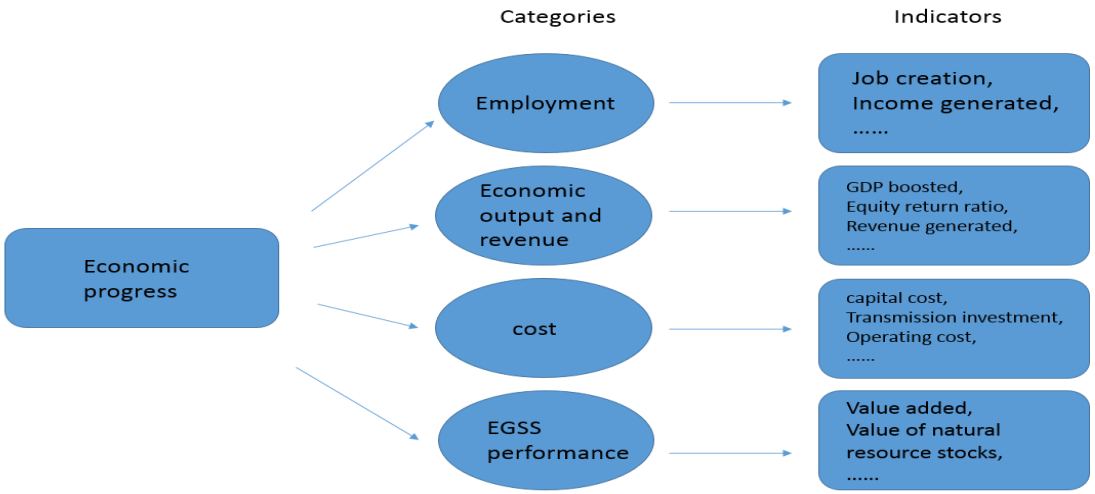

Figure 4 Commonly used indicators for economic progress.

It's quite rare that a green economy policy has social target as its primary goal. But the indicators under this dimension with a qualitative nature that complemented other more quantitative indicators well and made them more comprehensive and holistic. For instance, job can be created in almost every industry so long as the money has been invest in it, therefore only if the quality of the jobs been created in the green economy are higher than others, the performance of the green economy policy can be seen as positive.[5] Thus the indicators under the category quality of green jobs become important to evaluate the green economy policy. The indicators under this category include average income, education level, working condition, welfare system, etc. Other categories include but not limit to distribution of the jobs by demography and geography, access to green jobs, health benefit etc..

Based on the nature of those studies, the initial purpose of these frameworks are to make horizontal comparison between several countries nature rather than focus on one certain country and even one certain kind of renewable energy like this thesis do. However, by using different indicators, not only the result are more intuitional, but also easier for comparison- either horizontal comparison, for instance between different geographic regions, or vertical comparison, for instance between different time period on same region, or both. Therefore the indicator-based method been chosen in the thesis is consistent with existing analytical framework and the purpose of the research.

For the more specific reason, inspired by UNEP study on measuring the green economy (UNEP, 2012) and the study delivered by researchers from energy-based economic development (EBED) (Carley, Brown, & Lawrence, 2012), the framework been used in this thesis have then been established. As shown in *Figure 5*, the indicators are categorized into four different dimensions, namely energy system, environmental, economic and social. Detailed indicators within each category explained below.

[5] The green economy should be more sustainable and more efficient than other economy, and the cost benefit ratio should be higher in general. (UNEP, 2012)

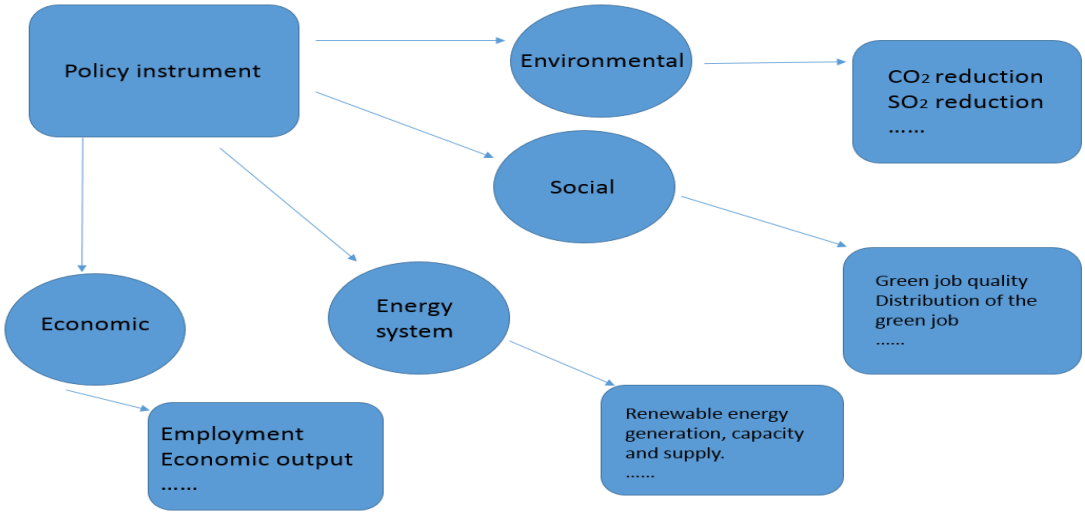

Figure 5 Four dimension of the indicators

2.3.1 Environmental progress

It's common that a policy instrument chooses economic or social issues as its starting point, but still addresses the environment issues. (UNEP, 2012) Especially for those we considered as green economy policies. China's "Feed-in-Tariff" system was designed by the government to facilitate the development of the wind energy. As a green economy policy it has the environmental perspective in nature. This dimension deals with effects the system would have on the environment.

Considering China's "Feed-in-Tariff" system for wind energy, the indicators have been chosen were CO_2 reduction, SO_2 reduction and waste water reduction. As mentioned above, in the literature, this dimension encompasses the indicators that address different environmental issues. Therefore the selection of indicators to be used in this thesis was mainly based on the environmental issues the system would have effects on. Renewable energy is often been link to the issue of climate change. (Wang & Zhang, 2011) Therefore the indicator CO_2 reduction that address the issue of climate change have been chosen. Meanwhile, the main energy source in China is coal-fired power and the environmental issues relevant to that are certain kinds of gas pollution and waste water pollution. Combined with the reason of data availability, the indicators of SO_2 reduction and waste water reduction were chosen.

The reduction of the gas pollutant and waste water was calculated by comparing the reality to business-as-usual scenario. As the economic growth, the energy demand in China continued to expand in the past years. Thus even the development of wind energy didn't lead to the decrease of coal-fired power supply, it replaced part of the coal-fired power supply growth. Therefore the baseline was calculated by estimate the emission from the amount of coal-fired power growth been replaced. However, the coal-fired plant is not the only source of electricity in the region although it is the biggest. Therefore based on data availability, some indicators take the percentage of different energy sources in the energy mix into account and also compare to a more holistic baseline. Also in some cases, the data from Clean Development Mechanism (CDM) projects are used to be compare with.

2.3.2 Economic progress

The entry point of the policy package under evaluation in this thesis was economic cause. As part of the stimulus package, the policy package has economic motivation in its nature, and the design of the policy was to reach specific economic target. Even some economic goals could be found directly in governmental document (NDRC, 2008), unannounced economic outcome also exists. This dimension deals with the economic outcomes of the policy package, both announced and unannounced ones.

The indicators been chosen in this thesis are employment generation, revenues and job earnings, and investment levels. The interviews revealed that employment generation was the most important outcome which the government expected the policy package to bring even it didn't appear in the official governmental document. This was the reason the indicator been chosen. The other two indicators were chosen because they are the direct reflection of the policy package had on the economic dimension and data availability.

The business-as-usual scenario was also set up in the economic dimension to be compare with. The job creation ratio in coal-fired power sector was calculated and used for comparison. And the average earning for each job in wind energy sector was compared with the average earning of the electricity industry.

2.3.3 Social progress

This dimension deals with the effects the policy package had on the human welfare and social equity. It is relatively different compare to the other dimensions since it has a macro perspective nature and the results are harder to quantify. It is inappropriate to draw data or results of this dimension from single project or a very narrow scope. Thus the scope of this dimension may be broader than the others.

Chinese scenario makes it even harder to measure because of some unique administrative activity. For instance the existence of household registration system makes it practically more difficult for industrial companies which located in cities to hire people with a countryside registered permanent residence. Thus it becomes a huge obstacle for people from outside the city to find a job in the city. Therefore from this point of view, none of the industry sectors' development could contribute to the progress of social equity. And there are some other similar matters and issues facing the similar situation.

However, there are still some indicators could be used. For instance, women in China were almost no chance to find jobs in industrial companies if their partners were not in it. But nowadays, the percentage of female employee is raising, especially in certain sectors such as manufacture of foods etc. Therefore the indicators been chosen under this dimension were female employee ratio, benefit level, and education level of the employee. The reasons for such choice were they reflect the progress on social equity, they are able to be quantified and data availability.

Reader should aware that the wind energy industry is considered as an urban industry in China even sometimes some companies or wind farm located in the rural area therefore all the data present below is for urban area only.

2.3.4 Energy system change

It's notable that most of the green economy measuring literature do not have this object as a separate dimension. The reason is that this dimension of indicators is very specific and only aimed for policies which focus on renewable energy. Since the policy package is designed for facilitating the development of the wind energy, this dimension that deals with the effects it would have on energy mix structure in China becomes an essential part of the puzzle.

This dimension tests the factors along the whole electricity industry instead of the single sector. That is because most of sectors within the industry are closely linked, and the policy targets the renewable energy would very possibly affect the whole industry. For instance, tax reduction on certain energy sector would not only boost the installation capacity of that energy, but also change the energy mix, stimulating the invest on the production of the equipment of that energy, stimulating the innovation investment into that energy etc.. Only if all these been taking into consideration, the assessment of this dimension can be more holistic. The most common categories and indicators of this dimension have shown below in *Figure 6*.

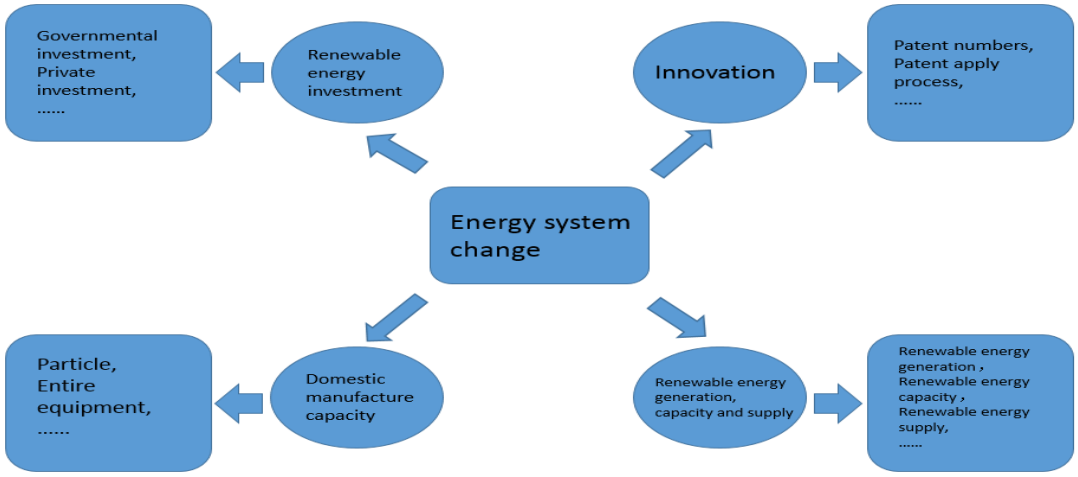

Figure 6 Commonly used categories and indicators for energy system change

The indicators been chosen were installed capacity and supply, and innovation. The reason of such choice was that they reflect important angle under this dimension. The issue of investment has been touched upon in the economic progress dimension and further detailed data was not available. The indicators under the category of domestic manufacture capacity were not chosen because they are more affect by international trading situation.

In general, the development of wind energy was mainly triggered by the establishment of the "Feed-in-Tariff" system. Without the existence of the system, the progress of wind energy on energy system would remained negligible. In order to estimate the net effect of the updated version of the system, the data for old version of the system was listed to be compare with.

2.4 Case study: China's "Feed-in-Tariff" system for wind energy and its enforcement in Chang River Delta region

As mentioned above, the policy instruments used by the government can be separate into macro policy, price policy and taxation policy three categories. Macro policy provides the direction of the development and the target. There are explicit goals about the development of wind energy in governmental documents such as China's five-year plan for wind energy.

Meanwhile in specific legislation such as <The Law of the People's Republic of China on Energy Conservation> <Renewable Energy Law of the People's Republic of China>, etc., it clearly stated that government would support wind energy and the way of doing it. In these legislations, the foundation of "Feed-in-Tariff" system in China been built. (Yang & Liu, 2012) The system is a national wide policy package. It almost covers all the different kinds of renewable energy-especially wind energy- and been always considered as the most important policy package which facilitating the development of renewable energy in China. (Zhou, Zhang, Dong, & Zhang, 2012) In particular, it stimulates the investment towards wind energy by establishing a mandatory procurement mechanism of wind energy for grid companies. The enforcement mechanism of the system had been updated in China's stimulus package.

The development of the price policy went through five phases. From early 90s of 20th century, started with complete competition phase, the price policy undergone the administrative examination and approval phase, combined open tender and administrative examination and approval phase, open tender and ratify phase, and finally reached benchmark price phase. The benchmark price method provides enforcement mechanism of the "Feed-in Tariff" system in China and the new version of it will be explained in below. (Tan & Ju, 2013) The government designed a complex tax incentivize system to support the domestically manufacturing and innovation. Started with tax refund for the all the imported wind energy equipment, the incentivize system was gradually adjusted and focuses more and more on domestic producing and innovating, and large capacity equipment. The relevant tax instruments include export and import tariff, value added tax and enterprise income tax. (Zhang X. , 2009)

2.4.1 Wind resources distribution and wind energy development

As the rapid growth ratio on GDP and other statistic figures, the demand on energy also increased dramatically in China. The policymaker in China considers the development of renewable energy as the important method to fill in the energy demand gap meanwhile relieved the environmental burden caused by the rose of the energy demand. The policymaker further expects the development of renewable energy would facilitating the progress of energy structural adjustment and economic growth transformation. As a country with great wind resource, wind energy has been considered as one of the most important kind of China's renewable energy. Wind resource in China is mainly distributed in four regions, namely Northeast, North part of North China, Northwest and East coastal line and islands. (Liao, Liu, & Li, 2008) The regions are shown below in *Figure 7*.

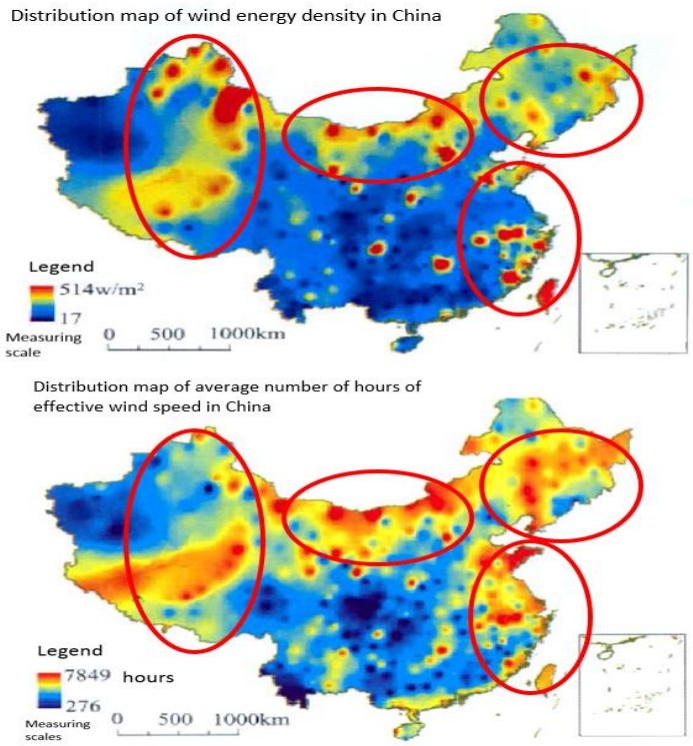

Figure 7 Distribution map of wind resource in China. Source: http://sourcedb.igsnrr.cas.cn/zw/lw/200906/P020090625751011083372.pdf. Retrieved at 2013. 7.13.

Chang River Delta region locates in the east coastal line and islands area. The reserve which can be developed in theory is over 53.0 GW (wind above the ground by 10 meters), and the technology developable reserve is about 5.5 GW which stands for 1.5% of the total reserve of the whole country. The offshore wind energy reserve is far more than that onshore. The detailed data of reserve can be found in *Table 1* below.

Table 1 Total quality of wind energy resources in the Chang River Delta. Source: Renewable Energy Development Feasibility Analysis by Jiangsu Economic and Information Technology Commission.

	Onshore			Offshore	
	Developable reserve in theory (GW)	Technology developable reserve (GW)	Percentage to country total (%)	Developable reserve in theory (GW)	Technology developable reserve (GW)
Jiangsu	30.3	2.4	0.9	71.4	47.6
Zhejiang	20.8	1.6	0.6	62.0	41.0
Shanghai	19.1	1.5	-	47.0	27.3
Delta region	53.0	5.5	-	180.4	115.9

According to Chinese Academy of Meteorological Science, the density of the wind resource has been separated into four levels, namely abundant, relatively abundant, usable and insufficient. In this region, the geographic distribution of wind resource appears decreasing from offshore, coastal line to in land, and the difference is dramatic. In these three regions, Jiangsu province have the most wind resources, almost the whole region has the wind density over 50 W/ m². Shanghai also has great potential on wind resources, especially on the east

shore. In Zhejiang province, most part of the coastal line can be developed into wind farms. *Figure 8* shows the wind resources distribution in the region.

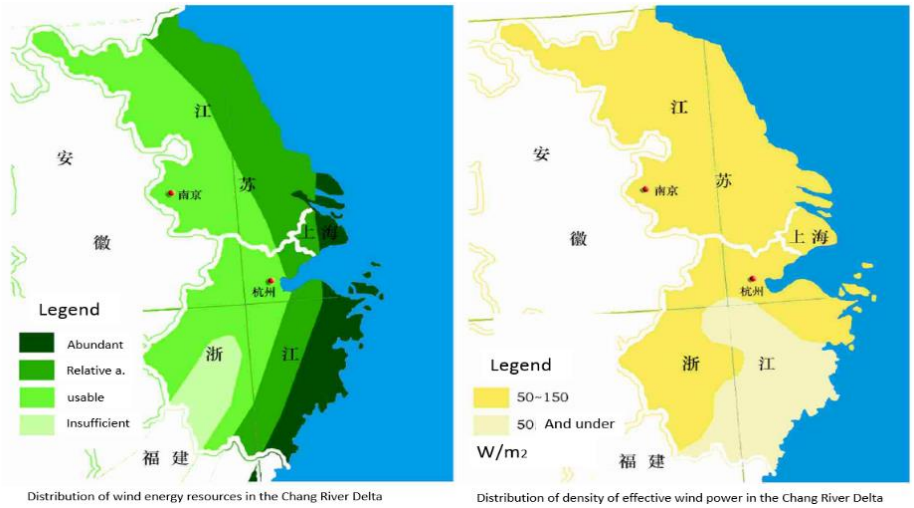

Figure 8 Distribution of wind resource in Chang River Delta region. Source: Renewable Energy Development Feasibility Analysis by Jiangsu Economic and Information Technology Commission.

There are factors other than wind resource would affect the potential of the development of wind energy such as the land condition, grid condition, transportation condition and weather condition etc. In Jiangsu province, the coastal line is more than 950 km and almost all of it is suitable for wind farm construction. According to the analysis did by local government, there are more than 10 regions in the province have the great potential to develop the wind energy. (Luo, 2007) The wind resource in Zhejiang province is abundant but the weather condition really limit the development of wind farm. Most of the coastal line regions in Zhejiang province are frequently influenced by typhoons, therefore the construction and maintenance of wind farm is harder and it appears directly on the wind energy price. The character of the current wind farms in Zhejiang province is that most of them are small scale and constructed for local use. The mud flat zone in Shanghai is more than 2000 km^2 and most of them are suitable for wind farm construction especially for large scale farm. (Qi, 2008)

The central government has always considered to support the development of wind energy by unanimous national wide policy because that except for east coastal line and islands area, local government of all other three major wind resource regions do not have enough resources to support the development of wind energy. Meanwhile, the central government preferred regulatory method than directly investment since they expect that the wind farms could compete with other energy resources under market mechanism after a few years of governmental support. After several years of discussion by the congress and several times of public opinion solicitation, the idea of "Feed-in-Tariff" became mature in 2004. The legislations and policies gradually came out in the coming years. (Zhu G. H., 2010)

During the time period of China's 11^{th} five-year plan, installed capacity of wind energy expended rapidly. It reached 12.15GW by the end of 2008 from 4200KW in 1989 and made China the third place in the sense of installed capacity. (Meng, 2010) The accumulated installed capacity was 12.15GW and 25.2 GW in 2008 and 2009 respectively which was a 106% and 107% growth compare to the year before respectively. New added installed capacity was 6.25 GW and 13 GW and increased 89% and 108% in 2008 and 2009 respectively. Therefore in 2009, the new added installed capacity in China outnumbered U.S became the largest in the world. And the accumulated number also became the largest in 2010. (Tan & Ju, 2013)

Meanwhile, domestic wind turbine industry also expanded rapidly in these years. In 2007, it was the first time that the market share of domestic producer for new added market surpassed the foreign company and reached 57.5%. In 2008, this number went up to 75.6% and the accumulated market share reached 61.8%. (Meng, 2010) In 2010, the number of wind turbine producers with more than 100 MW new added capacity installed was more than 20. Among these, there were five companies reached 1000 MW on new added capacity installed. The largest one Huarui (4386 MW) became one of the five largest wind turbine producer in the world in 2009. (Wang & Zhao, 2011)

2.4.2 Key policy design elements of the China's "Feed-in-Tariff" system

China's "Feed-in-Tariff" system is one of the most stable policy package with least modification through years. From a wind energy point of view, the system support its development through the mechanism of development goal setting, mandatory procurement, pricing policy, domestic manufactured equipment usage requirement and taxation policy. (Zhou, Zhang, Dong, & Zhang, 2012)

Firstly, Chinese government set out the goal by clarified the specific goal of wind energy development in the governmental development plan. In 2007, the National Development and Reform Commission (NDRC) published the development plan for renewable energy (NDRC, 2007), stated that the goal of wind energy was total installed capacity over 5000 MW by 2010. But by the end of 2007, this goal has already reached. Therefore at March 2008, the goal has been adjusted to 10000 MW by 2010 (NDRC, 2008). In NDRC's 2008 version of five-year development plan, it clearly stated that the priority job of the wind energy development was the establishment of the "Feed-in-Tariff" system and its pricing mechanism. The goal from a policy point of view was to finalizing the system design within the five-year period of time.

Secondly, the most important component of "Feed-in-Tariff" was about the mandatory procurement of wind energy. In July 2007, the State Electricity Regulatory Commission (SERC) published an administrative legislation (SERC, 2007), which clearly states that all the grid companies in the country must fully purchase the electricity generated by wind and other five types of renewable energy. Plus, the electricity from renewable source has the special position to be dispatch first. In addition to that, except for electricity from hydro power plant, all the electricity from renewable resource does not involved in the on grid price competition. At last, the legislation states that grid companies should fully follow the instruction, otherwise they must compensate renewable energy plants' economic loss.

Thirdly, to balance out the economic burden laid on grid companies, central government designed a pricing policy which complemented by a special subsidy. In 2006, the NDRC published the first version of price allocation policy. It stated that grid companies will be subsidized for three kind of cost[6]. The fund of such subsidy comes from the renewable power surcharge collected country wide-no matter there is a local renewable energy project or not. The amount of the subsidy adjusts every half a year. (NDRC, 2006) In the first version of price policy, the procurement price was calculated case by case, and depends largely on the bargain power of the wind farm. In 2009, being part of the China's stimulus package, NDRC updated the pricing policy and revised the calculation method of the procurement price.

[6] First, if the procurement price of a renewable source electricity exceeds the procurement price of electricity from local desulfurization coal-fired units, the exceeding part will be subsidized. Second, the cost of connecting renewable energy project to the grid will be subsidized. Third, if the maintenance cost for electricity projects that invested by the central government and local government are different, the difference in such cost will be subsidized.

According to the governmental document (NDRC, 2009a), the country has been separated into four different price region depending on the economic development level, the density of the wind resource and the cost of wind farm construction. Within each region, the procurement price for the renewable source electricity is the same, but the subsidy local grid company can get is different because of the difference on the procurement price of electricity from local desulfurization coal-fired units. The mechanism about how to calculate the benchmark price will be explained in detail later.

Fourthly, the movement towards domestic manufacturing the wind turbine was the first legislation of the package which was published in July 2005. In this governmental document (NDRC, 2005), it explicit required that the percentage of the domestic manufacturing equipment must be over 70%. If the percentage is not achieved, then the construction proposal will be denied. In NDRC's five-year development plan, the principle of domestic producing has been reiterated. The emphasis has been addressed to large-scale wind power farm that the percentage was mandatory, and for medium size or small scale wind farm the percentage became flexible. (NDRC, 2008) In 2009, being part of the stimulus package, NDRC passed a new legislation that cancelled the domestic percentage requirement in order to further development the wind energy industry and facilitating the technology import from the countries with most advance wind energy technology. (NDRC, 2009b)

Lastly, taxation policy was designed in order to complement the "Feed-in-Tariff" system. According to the "Renewable Energy Law of the People's Republic of China" (NPC, 2005), central government should set up special fund to subsidize renewable energy industry for their tax reduction. To be more specific, for wind energy, as long as the electricity feed into the grid, a wind farm would get a half reduction on value added tax from 17% to 8.5%. Addition to that, the wind farm would also get a "three plus three" reduction on income tax, which means it does not have to pay income tax for the first three years and get a half reduction for the next three years. After that, it still gets a reduction tax rate from 33% to 25%. In 2010, the amendment version of the law was implemented and more funds have been set up.

2.4.3 Wind energy development in Chang River Delta region before the "Feed-in-Tariff" system updated

The development of wind energy started really early in this region but before the implementation of "Feed-in-Tariff", there was no substantial progress on actual construction. (Qi, 2008) In the next two years of implementation, both the number of wind farm and the total installed capacity grew rapidly. Until the year of 2007, the number of wind farm built and under construction reached 18, the number of wind turbine reached 546, and the total installed capacity and installing capacity reached 1363.7 MW, which stood for 13.19% of the national installed capacity. *Table 2* shows the detail of the wind farms in the region.

Table 2 Built and under construction wind farm in the Chang River Delta by the year of 2007. Source: Energy Statistical Yearbook 2007 by Jiangsu Economic and Information Technology Commission.

		Shanghai	Jiangsu	Zhejiang	Whole delta
Wind farm been built	Number of wind farm	3	3	2	8
	Number of wind turbine	18	68	57	143
	Installed capacity (MW)	24.4	108.0	33.3	165.7
	Percentage of capacity (%)	0.86	3.82	1.18	5.86
Wind farm under construction	Number of wind farm	3	4	3	10
	Number of wind turbine	20	176	207	403
	Installed capacity (MW)	248.0	750	200	1198
	Percentage of capacity ()%	3.30	9.98	2.66	15.94
Aggregate	Number of wind farm	6	7	5	18
	Number of wind turbine	38	244	264	546
	Installed capacity (MW)	272.4	858.0	233.3	1363.7
	Percentage of capacity (%)	2.63	8.3	2.26	13.19

2.4.4 The pricing mechanism of China's "Feed-in-Tariff" system and its affect in Chang River Delta region

The factors which would affect the procurement price of wind power were different between the three regions in Chang River Delta region. First was the cost. As mentioned above, the environment for wind farm construction such as weather condition and land condition is worse in Zhejiang province than in other two regions. This leads to the fact that the cost of construction and maintenance of a wind farm in Zhejiang province was higher than the other two regions. (Fan, Tang, & Hu, 2009) (Chen & Cao, 2013) (Sun & Ma, 2007) Meanwhile, several major domestic wind energy equipment producers are located in Jiangsu province which lead to fact that the cost for equipment was lower in Jiangsu province than the other two. From a loan interest point of view, Shanghai had the most advantage but all three regions were close on that matter. Thus the result was the cost of wind energy was much higher in Zhejiang province, and followed by Shanghai. In Jiangsu province, the cost was relatively low.

The second factor was the bargain power of the wind farm owner. In China the owner of wind farm normally consist of investors and wind energy equipment producers. They form a team and participate the bidding for franchise together. Since the development of a wind energy equipment producer in China rely largely on the local government and the biggest producers in China are located in Jiangsu province, thus the bargain power of the wind farm owner was really low in Jiangsu province. These two factors led to the fact that the procurement price in Jiangsu province was the lowest (around 0.48 RMB/kW*h in 2008) in the region in the early years of "Feed-in-Tariff" system implemented. And it was even lower than the national average. On the other hand, the procurement price in Zhejiang province was the highest in the region and reached 0.67 RMB/ kW*h (include tax), which was the highest throughout the country and far more than national average. The price in Shanghai was almost equal to national average in 2008 which was about 0.57 RMB/ kW*h.

Because of the higher procurement price, before the updated version of "Feed-in-Tariff" system's pricing mechanism came out, the producers' of wind energy equipment actually quite enthusiastic about participating the bidding for the wind farm project in Zhejiang province rather than Jiangsu province. But the new pricing mechanism changed the whole situation.

In the updated version of pricing policy, the benchmark price is calculated by central government. The price is consist of three parts, namely generating cost, reasonable profit and tax. As the components of the price fluctuates, the benchmark price is adjusted accordingly. (Zhou, Zhang, Dong, & Zhang, 2012)

The generating cost is consist by fixed cost and variable cost. The fixed cost means the construction cost of the wind farm, which includes the cost of wind turbine, infrastructure construction, subsidiary roads, the install of the equipment, back up equipment and others etc.. Addition to that, most of the investments toward wind farm are by the form of bank loan or credit, therefore the fixed cost also includes the interests of the loan or credit. Among all these, the cost of the wind turbines and their installation is the biggest part. In common cases this part would stand for more than 80% of the total investment, and the equipment alone would stand for about 60% of the total investment. The variable cost includes the cost of maintenance, operation and others. The variable cost is a substantial part of the annual cost. (Normally the investment towards equipment and infrastructure is separated into years by a fixed rate of depreciation. For instance, the investment for a farm is 200 million USD and the rate of depreciation is 20% annually, then the fixed cost for this part is 40 million USD a year for five years. After five years, the fixed cost for this part becomes zero.)

The second part is so called reasonable profit. This equals the difference between the total profits which a wind farm get from the selling of the electricity that generated and income tax. The calculation equation is:

$$P = A * WACC \quad (1)$$

In this equation, P stands for the reasonable profit, and A stands for the value of effective assets at that year which generates electricity. WACC stands for the weighted average of the investment cost. WAAC is calculated by the equation shown below:

$$WACC\ (\%) = CC * (1 - ALR) + DAC * ALR \quad (2)$$

In this equation, CC stands for cost of equity capital, ALR stands for asset-liability ratio, DAC stands for cost of debt capital.

The tax consist of value added tax, additional tax for value added, and income tax. The component of the taxes are explained in the <Renewable Energy Law> and taxation mechanisms for value added tax and income tax have explained above. One thing should be noted is that there is no deduction for additional tax for value added. The tax rate of this is 8% which include 5% of city construction tax and 3% education tax. (Zhou, Zhang, Dong, & Zhang, 2012)

The new price mechanism eliminates the loopholes one can use in the system and the area for black box operation. However, even the cost difference has been taken into consideration, some extreme situation was not treated differently. The generating cost of wind energy in some region exceeds the procurement price set by central government, thus this hurt the passion of the local governments have to further develop the onshore wind energy. For instance it was the case in Zhejiang province and Shanghai.

In Chang River Delta region, all three provincial regions belong to the IV zone and procurement price for them was 0.61 RMB/kW*h (include tax). (NDRC, 2009a) The

interviews revealed that the generating cost in Jiangsu province was 0.5753 RMB/kW*h (include tax). This lead to the result that the installed capacity in Jiangsu province reached 1370 MW by the end of 2010, almost five times of the number by the end of 2007. (Feng, 以及其他人, 2011) However, the generating costs in Zhejiang and Shanghai were about 0.63 RMB/kW*h (include tax) and 0.62 RMB/kW*h (include tax) respectively. Therefore after 2009, even there were still new onshore wind energy projects being built, the development rate was dropped rapidly. And the focuses in these two region have transfer to offshore wind energy development which procurement price setting remain autonomy after 2009. (Zhu, Zhao, & Jiang, 2010) Until the end of 2012, the installed capacity of wind energy in Zhejiang province was 320 MW. (Chen & Cao, 2013)

3 Findings and analysis

This chapter presents the data been collected and applies the chosen framework to the data. By summarizing the main findings which appears by the form of indicators from different dimension, this chapter tries to accomplish the purpose of evaluating the actual performance of China's "Feed-in-Tariff" system in Chang River Delta region. The framework follows the outlined presented in Chapter 2, analysis the findings from 4 different perspectives.

3.1 Environmental progress

Considering the reason of resource availability, energy security, the development level of technology and economic performance, coal-fired power has always been the single biggest source of electricity in China's electricity mix. According to the official statistic number (EBoEPYoC, 2010), until the year of 2010, the coal-fired power still stands for more than 74% of the electricity supply. This fact lead to the result that electricity industry is the major source of some gas pollutants such as sulfur dioxide, and huge quantity of waste water, especially that with relatively large quantity of mercury in it. Recent years, even the total amount of gas pollutants and waste water are increased, the ratio of emission of sulfur dioxide and other gas pollutants as well as waste water caused by electricity industry to electricity been generated and used was dropped. The development of wind energy which mainly caused by the "Feed-in-Tariff" system contributes to the abatement of environmental burden caused by the coal-fired power. But reader should aware that in Chang River Delta region, even the development speed of wind energy was magnificent after the implementation of the "Feed-in-Tariff" system, still it has only replaced a tiny part of the coal-fired power.

In this section, the baseline was calculated in order to further calculate the indicators which are amount of reduction on CO_2, SO_2 and waste water. The calculation of the baseline was based on business-as-usual scenario which is the increased supply is filled by coal-fired plant.[7] Therefore the amount of reduction equals to the baseline minus actual emission or pollution.[8] Also as mentioned in the methodology section, the current situation of energy mix and data for CDM projects were taken into account in some of the indicators in order to calculate alternative baselines that the result can be better compare with.

3.1.1 Carbon dioxide reduction

Carbon dioxide as the most important greenhouse gas has always been taken into consideration in similar evaluations. In the time period of 11th five-year plan, the development of renewable energy and nuclear power in the whole country replaced roughly 1.5 billion ton of coal and therefore lead to 3 billion ton of carbon dioxide emission reduction in total. (NEA, 2011) In Chang River Delta region, the amount of CO_2 emission is always magnificent and continues to increase because of the economic growth. (Qi, 2008) However, thanks to the improvement on efficiency of traditional energy and the development of renewable energy especially wind energy and hydropower in the region, the density of CO_2 emission to economic growth keep the trend of decreasing from about 0.27t/k*RMB in 2005 to 0.12t/k*RMB in 2009. (Hua & Ren, 2012) The main reasons for such reduction of density are

[7] According to some of the interviewees, even there are other types of renewable energy in the energy mix, wind energy is the only renewable energy that keep on growth.

[8] These calculations mainly focused on the production phase of wind energy therefore the CO_2 and SO_2 emission and waste water discharging were counted as zero.

the increased ratio of renewable energy and nuclear power in the energy mix and the improvement in efficiency of coal-fired power. According to the local government representative, the latter reason contributes far more than the previous one since the percentage of renewable energy in the energy mix was still tiny. But as the renewable energy especially the wind energy continues their rapid growth in both installed capacity and actual supply, their contribution to such reduction increased accordingly.

According to the information revealed by local government representatives, combined with author's own calculation, roughly 2203 kW*h electricity could be generated out of 1 ton of standard coal in Chang River Delta region until the end of 2012[9]. Also, electricity generated by 1 ton of standard coal in the region causes 1.83 ton of CO_2 emission[10]. Therefore the baseline of unit CO_2 emission was roughly 831g/kW*h[11]. Thus the total amount of CO_2 reduction been calculated and presented in *Table 3*.

The sources and shares of the energy mix until 2011 in the region was as following: coal-fired power (91.6%), hydro (2.1%), nuclear (5.8%) and wind (0.5%).[12] Using the RETScreen[13] software with above data, the alternative baseline of unit CO_2 emission was roughly 795g/kW*h. This means if the energy growth keep on the pace of current pencentage of energy mix, the CO_2 reduction would be lower than the BAU scenario, but not much.

There are some CDM wind energy projects in the region. The data about the average level of unit CO_2 reduction was not available. However, interviewees from local government of the region revealed that the unit CO_2 reduction were 498g/kW*h for a CDM project in Jiangsu province and 814g/kW*h for a CDM project in Zhejiang province. They also stated that the estimated average level for the region was about 600-700g/kW*h.

Table 3 Total amount of CO_2 reduction in Chang River Delta region caused by the development of wind energy. Source: Author's calculation based on Energy Statistical Yearbook 2007-2010 by Jiangsu Economic and Information Technology Commission.

Unit: ton	Shanghai	Jiangsu	Zhejiang
2007	33240	174510	41550
2008	49860	648180	108030
2009	58170	1204950	290850
2010	182820	1911300	390570

The trend on such reduction in Jiangsu province is smoother than the other two regions because the positive effects that China's "Feed-in-Tariff" system had on wind energy

[9] A wind energy project in the region generated 59780000 kW*h electricity in 2012 and marked as replaced 27140 ton of standard coal in a governmental document. According to the interviewees, the project represents the average level in the region. Therefore the calculation was done by divide the amount of electricity by the amount of standard coal been replaced.

[10] In the governmental document mentioned in footnote 7, it clearly stated that the same wind energy project lead to 49766 ton of CO_2 emission reduction. Therefore the calculation was done by divide the amount of CO_2 emission reduction by the amount of standard coal been replaced.

[11] 1.83 ton divided by 2203 kW*h

[12] Author's calculation based on Energy Statistical Yearbook 2011 which developed by Jiangsu Economic and Information Technology Commission.

[13] Further information about the software is available at http://retscreen.gc.ca. (Retrieved 2013.10.10)

development in Jiangsu province didn't change as the system updated. On the other hand, the negative effects can be observed in Zhejiang province since the growth ratio on such reduction clearly slowed down. In Shanghai, the dramatic increase in 2010 was mainly because of the large-scale offshore wind energy project.

3.1.2 Sulfur dioxide reduction

As one of the most major gas pollutant caused by electricity industry in China, the amount of Sulfur dioxide emission is a very important indicator to evaluate the effectiveness of local government on the issue of developing the green economy, more specifically renewable energy and more sustainable industry. The data about the total sulfur dioxide emission and it emitted by the electricity industry has been collected by the government annually. It also been considered as an important presentation of energy mix and the efficiency of electricity industry.

Table 4 Sulfur dioxide emission in Chang River Delta region. Source: Energy Statistical Record by Environmental Protection Bureau of Yancheng, Jiangsu.

Unit: kt	Shanghai	Jiangsu	Zhejiang
2007	498	1218	797
2008	446	1130	741
2009	378.9	1074	701
2010	358.1	1050	678

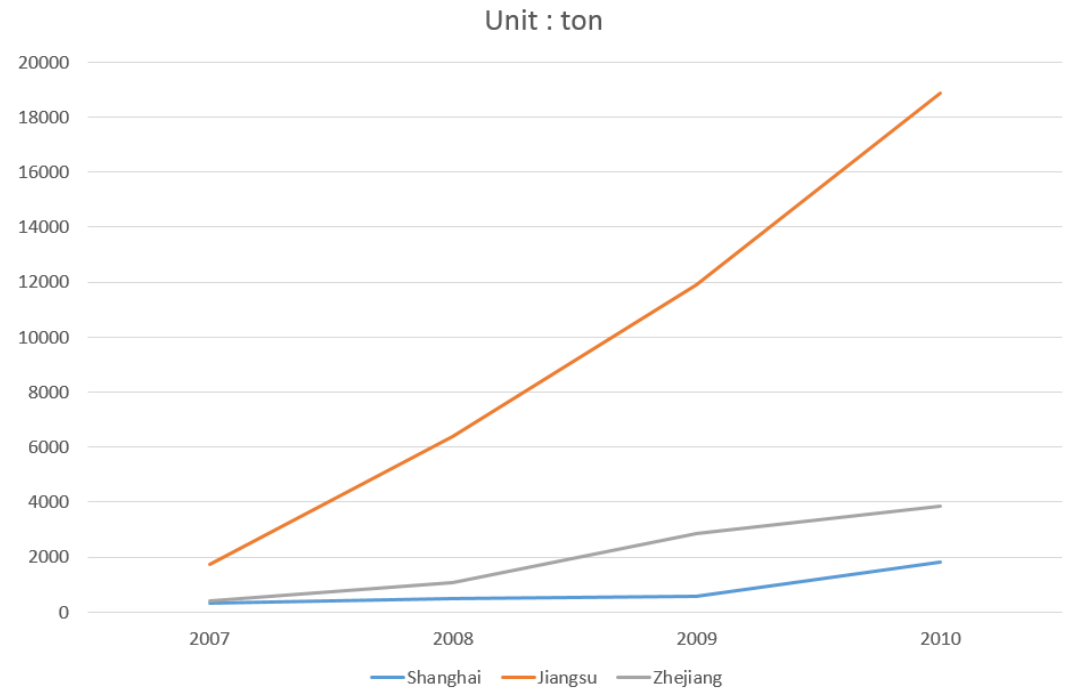

Figure 9 The SO_2 reduction caused by development of wind energy in Chang River Delta region. Source: Author's calculation based on Energy Statistical Record by Environmental Protection Bureau of Yancheng, Jiangsu.

Table 4 shows the number of total sulfur dioxide emission in the region. The interviews revealed that the major source of such emission is electricity industry which stands for almost half of it. There is a clear trend of reduction through the years. The baseline of unit SO_2 emission was roughly 8.2g/kW*h in the region[14]. Therefore *Figure 9* shows the emission of SO_2 been reduced by wind energy in Chang River Delta region. And the trend over the years is similar to CO_2 reduction.

Similar to CO_2 emission, the efficiency improvement on coal-fired power contributes the major part of the SO_2 reduction in the electricity industry, but the influence by increasing percentage of renewable energy especially the wind energy is growing. From a long-term perspective, if the goal of national development plan for renewable energy accomplished (According to the timeline, all the goals has been accomplished earlier than planned until now), the growing percentage of wind energy stands for in the energy mix would become the major driving force of the reduction of SO_2 emission.

3.1.3 Waste water reduction

Interviews revealed that electricity industry in China is one of the major source of waste water discharging. Also according to interviewees from local government, because of the improvement on waste water treatment technology and the adjustment of the energy structure, the waste water discharge caused by electricity industry decreased gradually in Chang River Delta region during recent years. *Figure 10* shows the trend of the amount of waste water discharge caused by electricity industry in Jiangsu province. (Similar data for Zhejiang province and Shanghai could not be found) There was a significant drop on the amount in 2007. According to the opinion which held by one of the interviewees, the drop was mainly caused by the dramatic increase on the installed capacity and actual supply of energy from renewable source. Wind and hydro are the two major source of renewable energy in Jiangsu province and the implementation of "Feed-in-Tariff" system in 2006 boosted the development of such energy. There were no big change of the amount in 2009 and 2010 after the implementation of the updated version of "Feed-in-Tariff" system in 2009 even the percentage wind energy stood for in the energy mix continued to increase because of the system. The reason for that was the revitalization of coal-fired power caused by the price drop on international coal trading which balanced out the abatement in amount of waste water discharge contributed by wind energy and hydropower.

[14] The calculation method was similar to the method used for CO_2 reduction. And 1 ton of SO_2 emission was caused by 478.2 tons of standard coal in 2012.

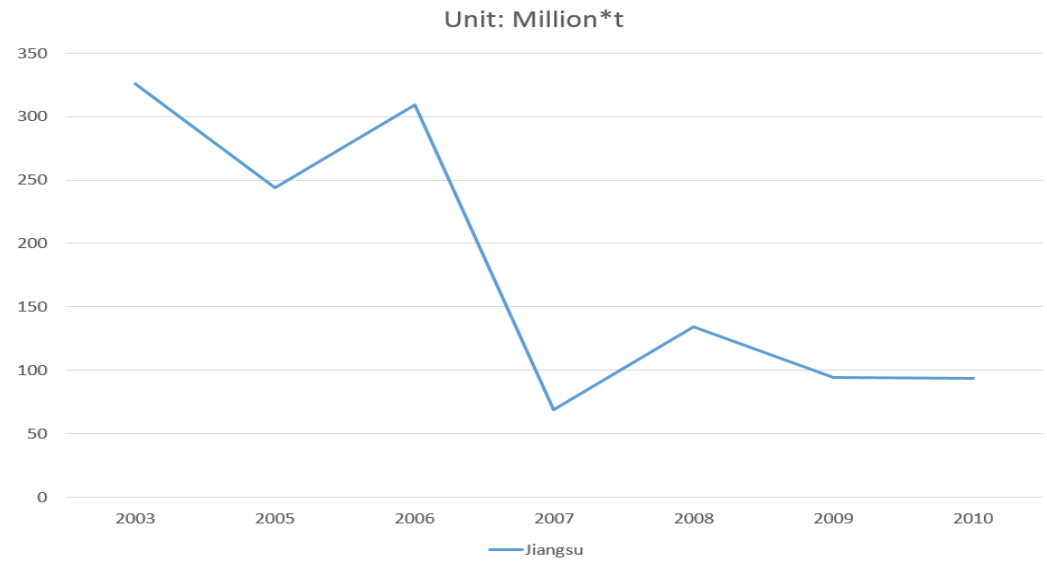

Figure 10 The amount of waste water discharged by electricity industry in Jiangsu province. Source: Energy Statistical Record by Environmental Protection Bureau of Yancheng, Jiangsu.

According to the interviewee from local government, the efficiency of coal-fired power plant in Chang River Delta region on waste water discharging was roughly 0.00063 m^3/kW*h. And it is the unit baseline of waste water discharging in the region. The reduction on waste water discharging was then calculated and present in *Figure 11*.

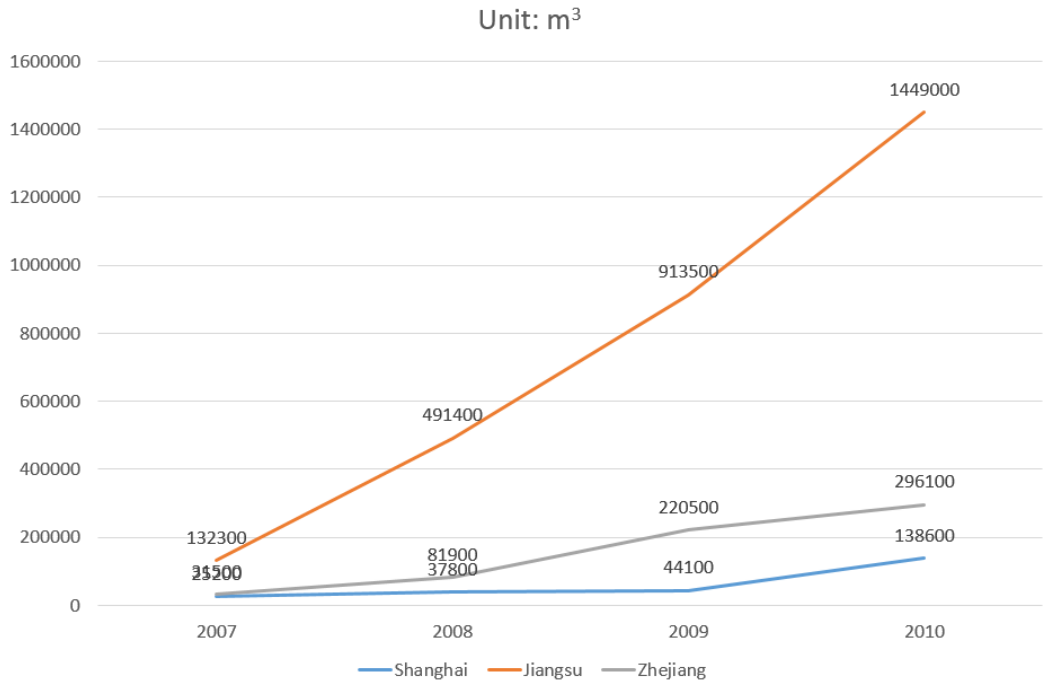

Figure 11 Waste water reduction cause by development of wind energy in Chang River Delta region. Source: Author's calculation based on Energy Statistical Record by Environmental Protection Bureau of Yancheng, Jiangsu.

3.1.4 The trend on waste gases

Figure 12 shows the total quantity of waste gas been emitted in Shanghai over the years. The trend was relatively stable and smooth before 2009. At that time, associated with the economic growth, the waste gas emission was increased slowly, and the speed was slower than the economic growth. Interviews revealed that the reasons for that were increasing usage of wind energy and the improvement of efficiency on coal-fired power. In 2009, the completed of the East Sea bridge offshore wind farm construction contributed to the slightly drop on total waste gas emission. (Aware the offshore wind energy is not in the scope of this study) In 2010, a dramatic increase on waste gas emission appears. The main reasons for that were the dramatic price drop in the international trading on coal which lead to the revitalization of coal-fired plant and the negative impact of updated version of "Feed-in-Tariff" has on onshore wind energy development. Also, the situation was similar in Zhejiang province according to the local government representative but the detailed data could not be found.

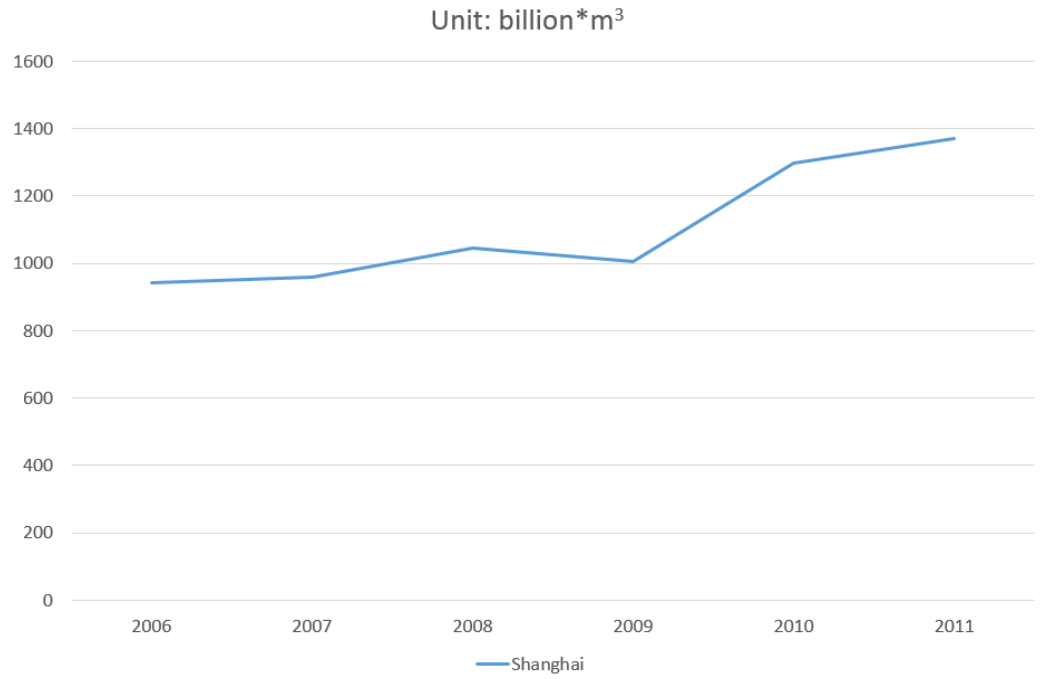

Figure 12 The total waste gas emission in Shanghai. Source: Shanghai Statistical Yearbook by Shanghai Municipal Electric Power Co., Ltd.

3.2 Economic progress

From a Chinese policymaker point of view, the economic outcome in general is one of the two intended outcomes. Over the years, the central government has always emphasized that the growth ratio of GDP should be above 8%. The reason for that is only by keeping the growth ratio on this speed, the average number of people become working age annually can be absorbed by the opportunities that created by the accrued social capital. According to the interviewee from local government, the unwritten principle for prioritizing the public issues on government agenda is that the employment ratio always come first at all events. Thus the pace of economic development was actually based on the goal of keeping the unemployment ratio under 4-5%.

3.2.1 Employment generation

Neither central government nor local government expected the development of electricity industry could create huge quantity of working opportunity directly. Especially under the circumstance that the coal-fired power is the dominating source of electricity in China since the technology is relatively mature and relevant companies rather focus on improving efficiency of the plant than building new ones. Thus for coal-fired power, the more investment put into it, the less job will be created in the field. *Figure 3-5* shows the amount of employment by electricity industry in Chang River Delta region over the years.

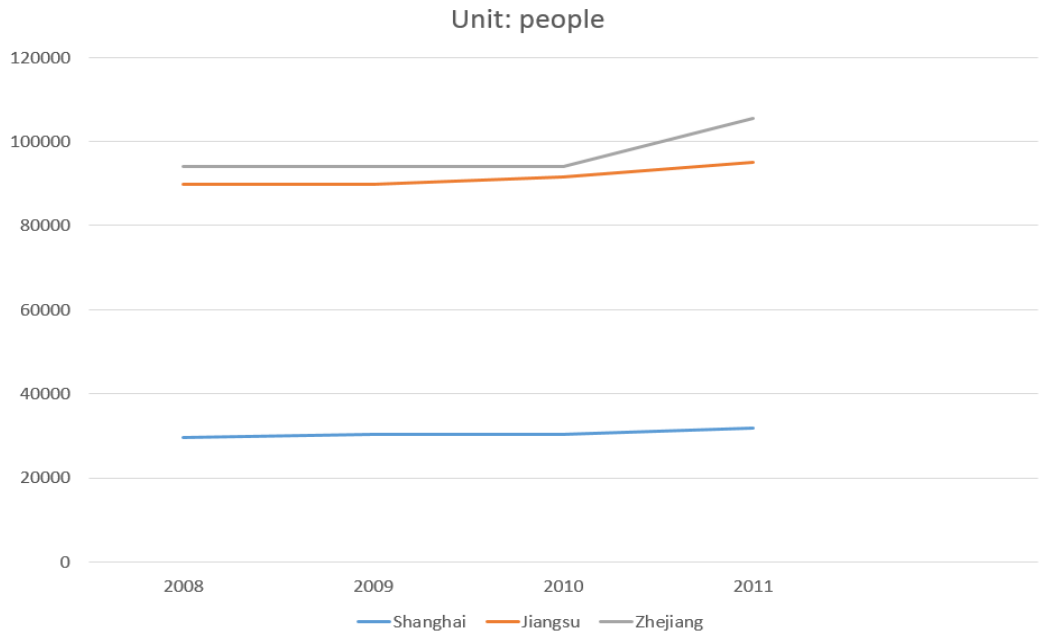

Figure 13 Employment by electricity industry in Chang River Delta region. Source: China Population and Employment Statistics Yearbook, Regional Statistical Record by Statistical Bureau of Jiangsu, Zhejiang and Shanghai.

However, by supporting the development of renewable energy especially wind, new job was created. Even the percentage of renewable energy in the energy mix was small, the new job been created directly caused by the development of renewable energy still offset the diminished job because of improved efficiency of coal-fired power. Therefore in *Figure 13* a slightly increase on the total number of jobs in electricity industry annually can be observed.

Even the job creation potential of the development of wind energy can be seen, the main incentive for local government to support wind energy is not the number of jobs could be directly created by the electricity industry itself. The local government of Chang River Delta region considers that the support for wind energy would facilitate the development of the whole industrial chain, which includes the development of relevant research institute that focus on the wind technology, the development of wind equipment manufacturer (which the biggest ones in China are located in Jiangsu province), the development of construction industry which relevant to wind farm construction, the development of electricity industry itself and the development of local grid company.

The exact number of jobs that the whole chain would create been calculated carefully by the local government of Jiangsu province. They chose the most representative sample companies

in the region, record the data for years and modified the record as time went by. The calculation method is as follow:

Five sample companies were chosen. Company A and company B[15] are whole wind turbine manufacturers. Company C is the wind turbine blade supplier of company A and company B. Company D is a wind energy company and E is a wind farm.

（1） For company A and B, the income directly came from manufacturing wind turbine stands for roughly 91% of total income. The average installed capacity of each company was 2393 MW, and the average job positions in the company was 2700, thus the job created by whole wind turbine manufacturers was 1.2 person/MW.

（2） The new installed capacity for the whole country in 2008 was 6300 MW and the average capacity of single wind turbine was 1.5 MW. Thus the number of wind turbine blade needed was 4200 set. Since the numbers of job needed are similar for wind turbine blade and all other parts aggregated, thus the job created by spare part supplier was 5.1 person/MW.

（3） The total installed capacity of company D was 566 MW in 2008 and the number of employee was 141. The installed capacity of wind farm E was 36.55 MW in 2008 and the number of employee was 18. Thus the job created by wind energy company was 0.3 person/MW.

In a nutshell, the whole chain of wind energy created 6.6 jobs/MW which consists of 6.3 jobs/MW in manufacturing stage and 0.3 jobs/MW in electricity generating stage. Before 2009, the domestic manufacturing requirement on wind turbine secured this job creation ratio. After 2009, even the mandatory requirement cancelled, local wind energy companies still have the tendency to procure domestic equipment since they are generally cheaper. Therefore the number was relatively stable over years.

If compare the number to business-as-usual scenario, the net effect of wind energy has on job creation was huge. In 2009, Chinese government established the new development plan on coal-fired power industry and announced that new construct coal-power plants should use the plant with capacity higher than 300 MW and desulfurization facilities are mandatory for the new plants. According to the data given by one of the interviewees, the job creation ratio for such plant alone was 0.603 jobs/MW in 2010. Plus the job creation ratio of the desulfurization facilities which was 0.320 jobs/MW, the total job creation ratio for coal-fired power plant was 0.923 jobs/MW in 2010. It's far lower than the ratio for wind energy.

One thing should be noted that the calculation can only be apply to the situation that there are wind equipment manufacturers in the region. Otherwise only the last part of data which is the job directly related to the wind energy company and wind farm can be counted. There was no whole wind turbine manufacturer in Zhejiang province and Shanghai, but there are suppliers in these two regions. And in Jiangsu province, both manufacturing company and wind energy company exit. Thus the performance of the "Feed-in-Tariff" system on the issue of job creation in Chang River Delta region is different between provincial regions. The number in Jiangsu province was 6.6 jobs/MW and in other two regions was 5.4 jobs/MW. *Figure 14* shows the estimate number of jobs that related to wind energy development in Chang River Delta region.

[15] Company A provided new installed capacity of 1402 MW in 2008 which stood for 22.45% of the national number that year. Accumulated installed capacity for company A was 2157 MW which stood for 17.75%. Company B provided new installed capacity of 1132 MW in 2008 which stood for 18.1% of the national number that year. Accumulated installed capacity for company B was 2629 MW, which stood for 21.63% of the national number.

Figure 14 Number of jobs related to wind energy. (Estimated) Source: Author's calculation based on China Population and Employment Statistics Yearbook, Regional Statistical Record by Statistical Bureau of Jiangsu, Zhejiang and Shanghai.

In the year of 2011, the number of jobs related to wind energy stood for roughly 10% of the total jobs in electricity industry in Jiangsu province. However the installed capacity of wind energy only stood for roughly 2.2% of the total installed capacity from all sources. Clearly in Jiangsu province, the development of wind energy created more job than other sources. In Zhejiang province and Shanghai, the situation were similar. Number of jobs related to wind energy stood for roughly 1.6% and 3.5% of the total jobs in electricity industry in Zhejiang and Shanghai respectively, and the installed capacity of wind energy were 0.5% and 1.1% of total number respectively.

3.2.2 Revenues and job earnings

Electricity industry which include wind energy sector is an industry that generates relatively high earnings each job. *Table 5* shows the total revenuews of electricity industry in Chang River Delta region from 2008 to 2011 and average earning for each job. In Zhejiang province, people who works in electricity industry earns twice as average earning for all industries. In Jiangsu province and Shanghai, the number also close to twice as much. *Figure 15-Figure 17* show the total earning of wind energy sector and average earning each job in the sector. Compare to the whole electricity industry, average earning in wind energy sector was even higher. In both Jiangsu province and Shanghai, a more rapid growth in total earning can be observed in 2009 to 2010. The reason for that was the development of wind farm in the region, namely onshore wind farm in Jiangsu and offshore wind farm in Shanghai respectively. In contrast, the growth of total earnings slowed down in Zhejiang province in the same time period which mainly because of the negative impact of updated version of "Feed-in-Tariff" system on wind energy development. (Li & Dong, 2011) (Liang & Chen, 2012)

Table 5 Total revenues of electricity industry and average earning in Chang River Delta region. Source: Jiangsu Labour Statistical Record 2008-2011, Zhejiang Labour Statistical Record 2008-2011, Shanghai Labour Statistical Record 2008-2011.

Unit: Thousand RMB		Shanghai	Jiangsu	Zhejiang
Total revenues of electricity industry	2008	2453131	5609439	6709580
	2009	2903780	6241735	7195930
	2010	3338787	6991714	8150582
	2011	3913719	8145871	9670921
Average earning for each job in electricity industry	2008	83.194	62.432	71.305
	2009	95.632	69.512	76.482
	2010	110.420	76.368	86.716
	2011	122.964	85.632	91.621
Average earning for each job in all industries	2008	52.122	31.297	33.622
	2009	58.336	35.217	36.553
	2010	66.115	39.772	40.640
	2011	75.591	45.487	45.162

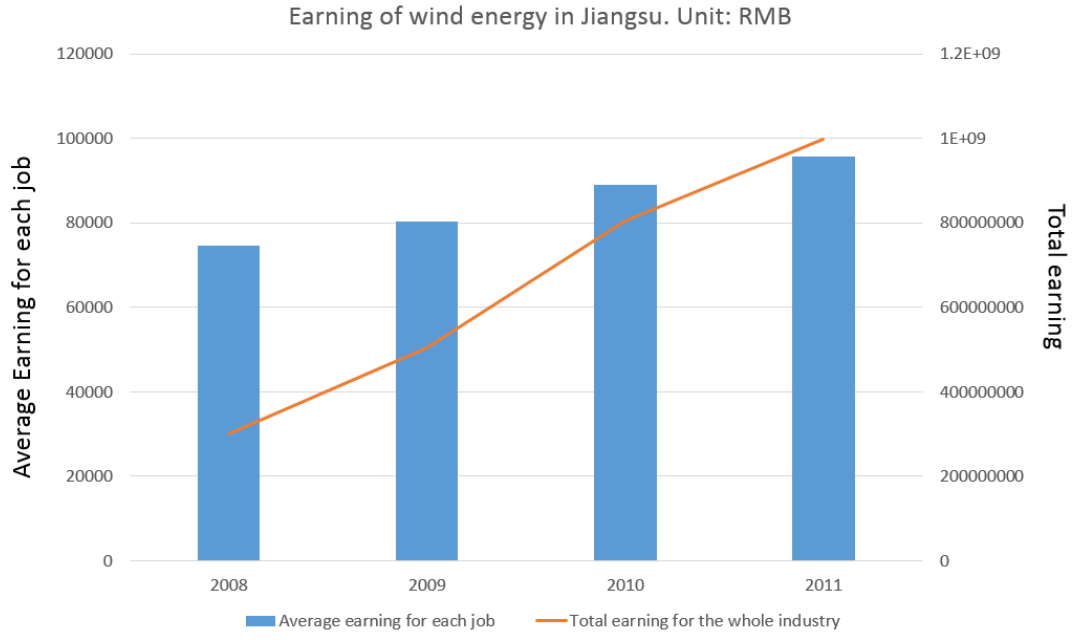

Figure 15 Earning of wind energy in Jiangsu province. Source: Author's illustration based on Jiangsu Labour Statistical Yearbook 2008-2011.

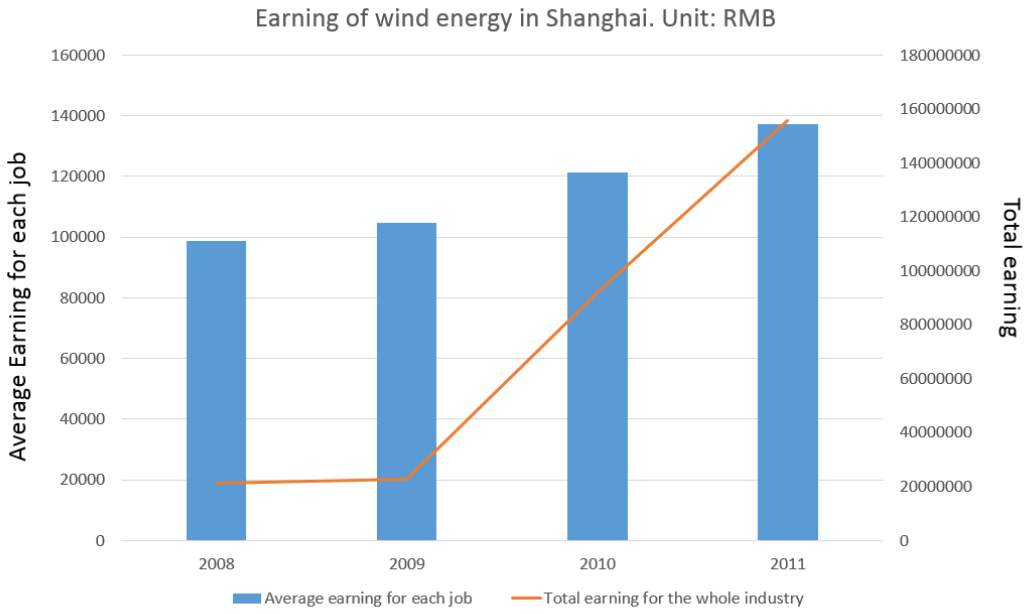

Figure 16 Earning of wind energy in Shanghai. Source: Author's illustration based on Shanghai Labour Statistical Yearbook 2008-2011.

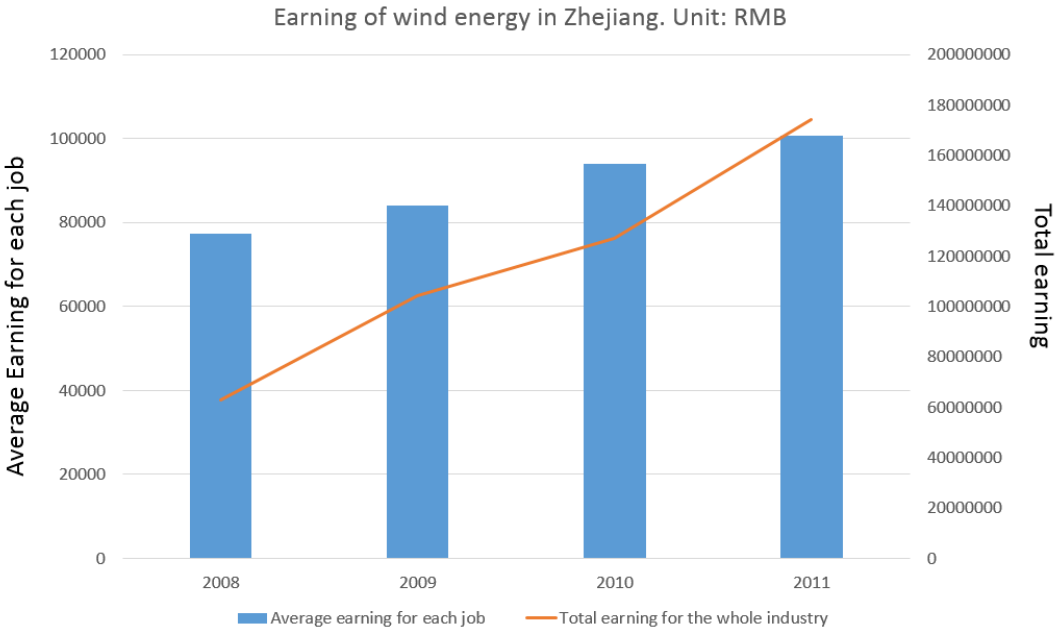

Figure 17 Earning of wind energy in Zhejiang province. Source: Author's illustration based on Zhejiang Labour Statistical Yearbook 2008-2011.

3.2.3 Investment level

The percentage of investment towards renewable energy in the GDP was relatively small. Even there was no data could be found that states how much fund in the stimulus package exactly been spent in renewable energy sector, one thing can be sure that there was no

significant increase in investment. (He, Zhou, Liu, & Sun, 2010) That was because the government mainly support renewable energy sector by regulatory instrument and technology support. (Su & Li, 2011)

Until the end of 2010, there were almost 900 wind energy projects invested by more than 80 wind energy developing companies over the country. The main investors of wind projects were national owned companies. In 2010, the new installed capacity of wind energy invested by the five largest national owned electricity companies stood for 62.2% of the total number. With all the support from the government, which mainly include "Feed-in-Tariff", tax reduction and low or no interest loans or credits, investors of wind energy normally got a 7.38%~13.55%[16] return on equity. Until the end of 2009, the return on equity for wind energy projects investment in Chang River Delta region was 10.7% annually. After 2009, the return on equity for onshore wind farm in Shanghai and Zhejiang province dropped but the number increased to roughly 16% annually in Jiangsu province because of the dropping in price of wind turbine. (Liang & Chen, 2012)

The equipment cost and construction cost stands for roughly 80% of wind farm investment. In 2009, the investment per unit for wind energy in Chang River Delta region was 11098 RMB/kW which was a 1000 RMB/kW drop compares to 2008. The new installed capacity in the region was 420 000 kW, thus the investment towards wind energy contributed 4.66 billion RMB (roughly 0.73 billion USD) to GDP. In 2010, the price of wind turbine dropped by 1500 RMB/kW, which lead to the investment per unit in region dropped to 9598 RMB/kW. *Figure 18* shows the contribution investment towards wind energy made to GDP in the region.

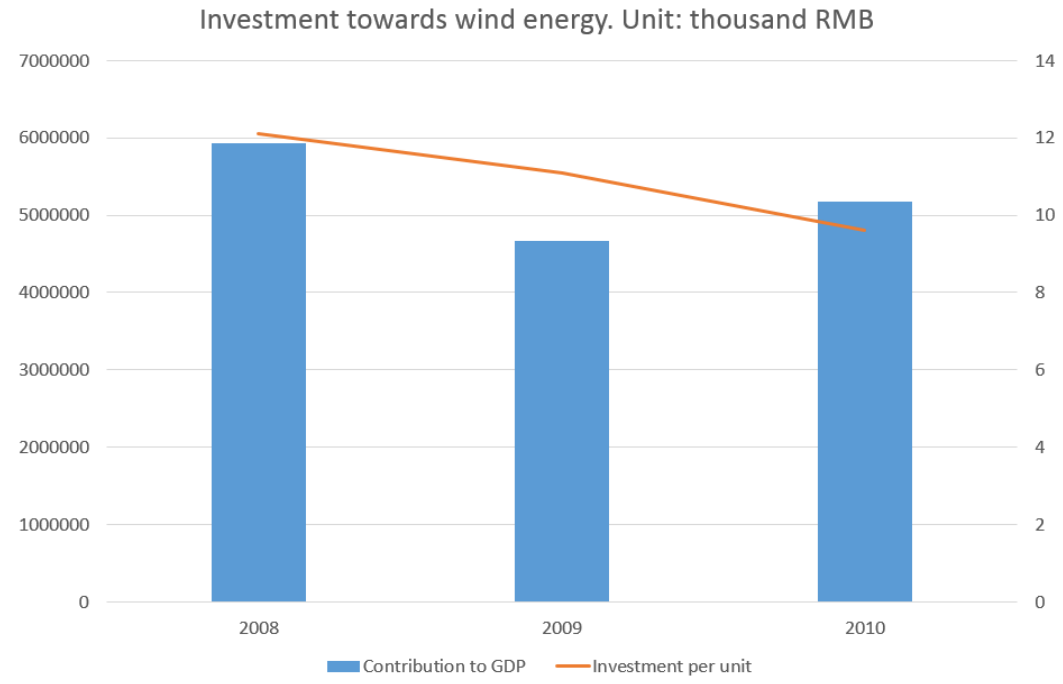

Figure 18 Contribution to GDP by investment towards wind energy in Chang River Delta region. Source: Author's calculation based on Record of Energy Development in Chang River Delta region by Jiangsu Economic and Information Technology Commission.

[16] The capital ratio is 20%, others come from bank loan with 6.7% of interest. The interests are paid by season and the total length of the loan is 15 years. The ratio of salvage value of fixed assets is 5%. The accounting method is straight line depreciation method and the depreciation period is 15 years.

3.3 Social progress

Compare to other dimensions, this one is relatively harder to be quantified. In general, the jobs related to wind energy perceived as better jobs. As mentioned above, the average wage of them is relatively higher than the average wage for the whole electricity industry which is already higher than those for other industries. Addition to that, from a social equity point of view, the job is also better. The female employee ratio is higher in wind energy sector than other sectors and education level is relatively higher. The benefit of the job is also better.

3.3.1 Female employee ratio

It is a fact that females are generally harder to get jobs than males in urban area in China. Between 2008 and 2011, the percentage of female employee in urban area was in the range of 36-38% for the whole country and was between 38-42% in Chang River Delta region. This ratio was higher in some certain sectors as mentioned above, for instance it was around 63% in manufacture of textile sector. *Figure 19* shows the female employment ratio in the urban area for the whole
country.

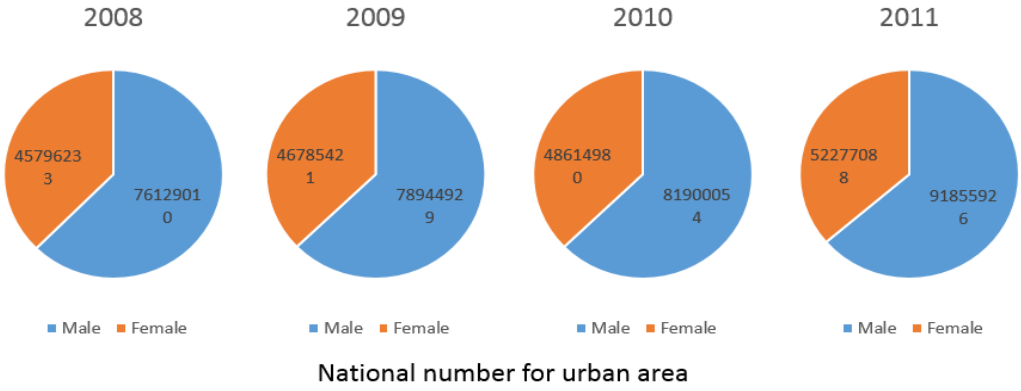

Figure 19 Gender ratio of employment in urban area. Source: Author's illustration based on China Population and Employment Statistical Yearbook.

Table 6 shows the number of female employee in wind energy sector in Chang River Delta region and *Figure 20* shows the comparison of female employment in wind energy sector and the whole electricity industry in the region. Compare to the whole electricity industry, the female employment in renewable energy sector especially wind energy was higher. The interviews revealed that the reason for that is coal-fired plant prefers male employee for manual labor.

Table 6 Number of female and total employee in wind energy sector in Chang River Delta region. Source: Regional Record of Population and Employment for Jiangsu, Shanghai and Zhejiang.

		2008	2009	2010	2011
Shanghai	Female	47	52	199	302
	Total	216	216	756	1134
Jiangsu	Female	1092	2149	2812	3004
	Total	4026	6270	9042	10428
Zhejiang	Female	266	309	361	506
	Total	810	1242	1350	1728

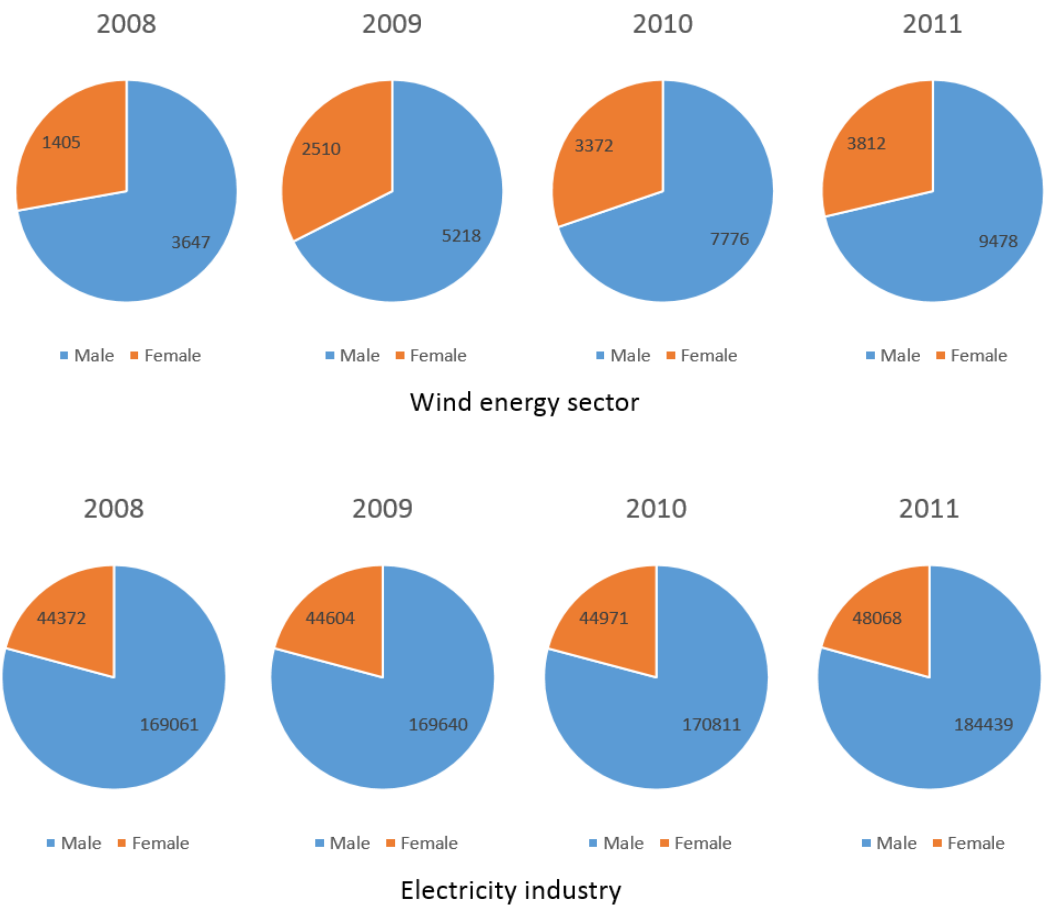

Figure 20 Female employment in wind energy sector and electricity industry in Chang River Delta region. Source: Author's calculation based on Regional Record of Population and Employment for Jiangsu, Zhejiang and Shanghai.

As a relative weaker group of people in the sense of finding jobs in urban area, females are easier to find a job in wind energy sector than in coal-fired power sector in the electricity industry. Thus the development of wind energy contributes to social equity by creates better chance for weaker group people to compete with others. As the percentage of wind energy in energy mix increasing, the female employment in electricity industry would be increasing accordingly.

3.3.2 Education level of the employee

The education level of the employment was relatively low in China even it has been improved quite a lot over the years. Until the end of 2011, employees with high school or higher education background only stood for 29.6% of society's total employment. Most of the employees (48.7%) only hold a junior school diploma. In electricity industry, the circumstance was better and the education level was generally higher than social average. *Table 7* shows the composition of different level of education for the employment of electricity industry. In general, the education level was raising over the years.

Table 7 Education level of the employee in electricity industry. Source: China Labour Statistical Yearbook.

	%	Illiterate	Primary school	Junior school	High school	College	University	Graduate
2008	Total	0.2	4.4	30.2	37.3	17.7	8.9	1.2
	Male	0.1	4.4	33.5	37.1	15.5	8.1	1.2
	Female	0.2	4.5	22.1	37.8	23.3	10.7	1.3
2009	Total	0.3	4.6	29.8	37.5	20.0	7.3	0.6
	Male	0.3	4.8	31.5	37.0	18.9	7.0	0.5
	Female	0.5	4.1	26.1	38.4	22.4	7.9	0.7
2010	Total	0.2	4.2	28.3	33.1	22.0	11.5	0.8
	Male	0.2	4.5	30.8	32.9	20.0	10.8	0.8
	Female	0.3	3.4	22.1	33.5	26.9	13.1	0.7
2011	Total	0.3	3.0	28.4	31.6	22.3	13.1	1.2
	Male	0.0	3.5	31.1	31.9	20.4	11.8	1.2
	Female	1.1	1.6	21.2	30.9	27.6	16.5	1.1

In electricity industry, most employees hold a high school or even higher diploma. And it is quite clear that women's education level was generally higher than men in electricity industry. The reason for that is women need a higher education background to overcome the disadvantage which brought by the tradition opinion that men is better. According to the interviewee from local government, from a geographic point of view, in more developed region such as Chang River Delta region, the education level of employees are generally higher. For instance in Shanghai, over 50% of employees hold a college or even higher diploma in electricity industry.

For the jobs related to renewable energy especially wind energy, the requirement on education level is higher because one need more sophisticate knowledge about the technology to work in the sector. Although the official statistic data could not be found, according to the estimation made by interviewee from local electricity company, the education level of the employees from wind energy sector would be mainly college and higher in Chang River Delta region. The percentage of it should be over 50% in the region and might be over 60% in Shanghai which is much higher than other sectors in electricity industry and average for the whole society. And as the wind energy sector developed, both the education level and percentage of employees with higher education level would be increased in electricity industry.

3.3.3 Benefit level

According to the local government representatives, they expected wind turbine manufacturers and wind energy companies last longer than companies in other sector of the electricity industry since they considered wind energy as one of the solutions for coming energy shortage. Therefore there would be no surprise that all the jobs related to wind energy are permanent position in the relevant companies which has been proved by the data shared by interviewees from local wind turbine manufacturers. And as the data shown above, the education level in wind energy sector is higher. In order to stabilizing the human resource flow, normally wind energy related companies are willing to provide better benefit packages than other companies in order to earn competition advantage in attracting higher educated people. All the companies relevant to wind energy that have been interviewed by author provide complete social insurance and benefit package which include different kinds of insurance, house subsidies and other allowance. Addition to that, all of them are qualified to sponsor local registered permanent residence.

3.4 Energy system change

3.4.1 Capacity and supply

There are still some problems and obstacles about the development of wind energy in China. For instance the low capacity of the grid really restrained the development of wind energy. In many cases that substantial amount of installed capacity is wasting because local grid don't have the capacity to transport the electricity been generated. Also, lack of the financing mechanism also anchors the development of wind energy. (Zhang X. , 2009) Therefore until 2008, just before the updated version of "Feed-in-Tariff" system came out, wind energy was still an almost negligible part of Chinese energy mix.

From the year of 2007 to 2011, the electricity been generated in this region has increased in general as the economic growth. (The electricity demand increased even more rapidly than the supply, but it is not in the scope of this study, therefore it will not be discussed here). *Table 8* presents the growth ratio of electricity been generated in total, by coal-fired power and by wind energy. It's clear that the growth of coal-fired power has always been in line with the aggregated number, therefore the growth of electricity generation from other sources contributed to the aggregated number. The wind energy consist a quite important part of that.

Table 8 Growth ratio of electricity been generated in Chang River Delta region. Source: Energy Development Statistical Record by Yancheng Economic and Information Technology Commission.

	%	Shanghai	Jiangsu	Zhejiang
Aggregated	2007	2.1	11.4	17.8
	2008	7.2	2.2	2.6
	2009	-1.5	3.4	5.5
	2010	20.6	17.3	14.1
	2011	8.7	12.4	8.7
Coal-fired power	2007	2.1	7.8	22.8
	2008	9.4	1.0	1.4
	2009	-1.6	3.3	6.1
	2010	20.4	17.0	12.3
	2011	8.6	12.9	12.5
Wind energy	2007	-9.8	4320.9	1.6
	2008	39.8	266.0	162.2
	2009	28.2	86.5	175.9
	2010	189.2	59.1	32.2
	2011	86.6	19.2	21.1

During these years, the installed capacity of wind energy in the region welcomed a significant growth. Among the three provincial region, the growth ratio in Jiangsu was the biggest. *Figure 21* shows the change in installed capacity of wind energy in the region. As explained above, the different circumstances of wind source lead to the difference in growth ratio within the region. Especially the year of 2009 and 2010, after the implementation of the updated version of "Feed-in-Tariff" system, a clear slowing down in the growth ratio for Zhejiang province can be seen, meanwhile it continued to appear rapidly in Jiangsu province.

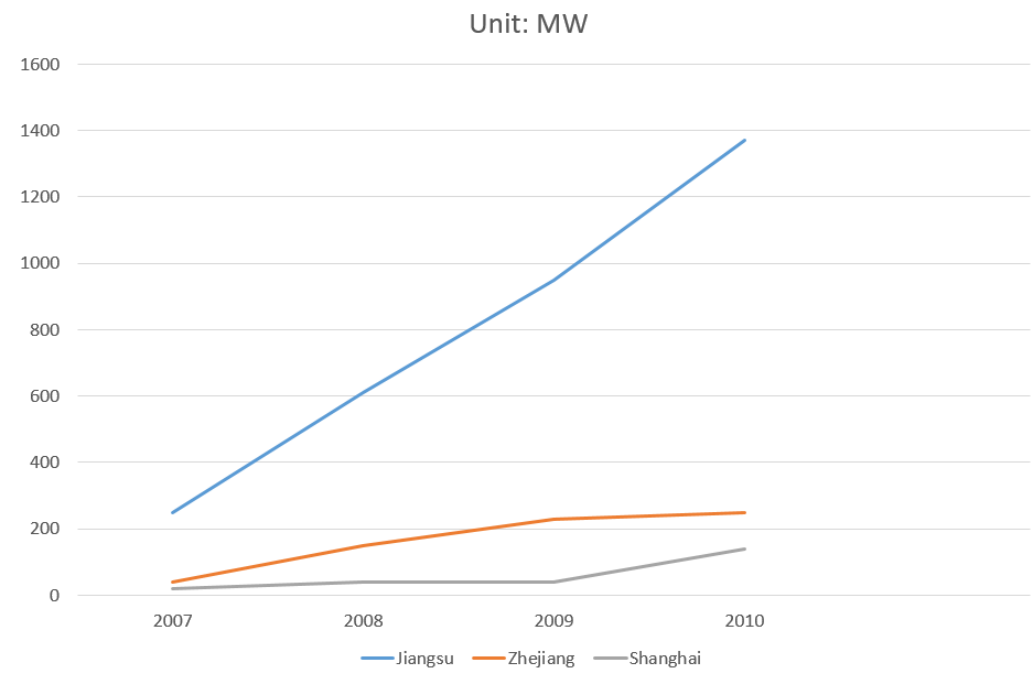

Figure 21 Installed capacity of wind energy for Chang River Delta region. Source: Author's illustration based on Renewable Energy Statistical Record by Yancheng Economic and Information Technology Commission.

As mentioned above, since different provincial regions faced different situations after the pricing mechanism of "Feed-in-Tariff" system been updated in 2009, the development of wind energy appeared different trends in Chang River Delta region. *Table 9* shows the installed capacity, actual supply and the growth ratio on actual supply for wind energy in the region.

For Jiangsu province which was benefited from the new mechanism, both the installed capacity and actual supply kept up the rapid growth ratio. From an installed capacity point of view, the growth ratio kept above 40% each year from 2006 to 2011 and in the extreme situation such as 2006, the ratio went up to 1000%. The growth ratio of actual supply was even higher for the most of time but appeared a dramatic drop in 2011. According to the interviewee from a local grid company, it was mainly because of the limit of grid capacity. For Zhejiang province, the growth speed of new installed capacity of wind energy appeared an obvious drop after 2009 which mainly because of the negative impact for onshore wind energy development the new pricing mechanism of "Feed-in-Tariff" system had. But since there is a delay for such negative impact to reach the actual supply, the growth ratio on that didn't seem to be influenced much. In Shanghai, a huge offshore wind farm which was the largest in Asia completed the construction and started operating in 2009. Thus even the new mechanism had a negative impact on the development of onshore wind energy in Shanghai, it couldn't be seen from the data of new installed capacity and actual supply.

Table 9 Installed capacity and actual supply of wind energy in Chang River Delta region. Source: Energy Development Statistical Record by Yancheng Economic and Information Technology Commission.

		2007	2008	2009	2010	2011
Jiangsu	Installed capacity (MW)	250	610	950	1370	1580
	Actual supply (million kW*h)	200	800	1450	2300	2741
	Growth on actual supply (%)	4321	266	86.5	59.1	19.2
Zhejiang	Installed capacity (MW)	40	150	230	250	320
	Actual supply (million kW*h)	50	130	350	470	570
	Growth on actual supply (%)	1.6	162.2	175.9	32.2	21.1
Shanghai	Installed capacity (MW)	20	40	40	140	210
	Actual supply (million kW*h)	40	60	70	220	410
	Growth on actual supply (%)	-9.8	39.8	28.2	189.2	86.6

Figure 22 shows the percentage of wind energy's actual supply in the total electricity supply in the Chang River Delta region. Jiangsu province had the highest percentage within the region but even until the end of 2011, the number still not reached 1% yet.

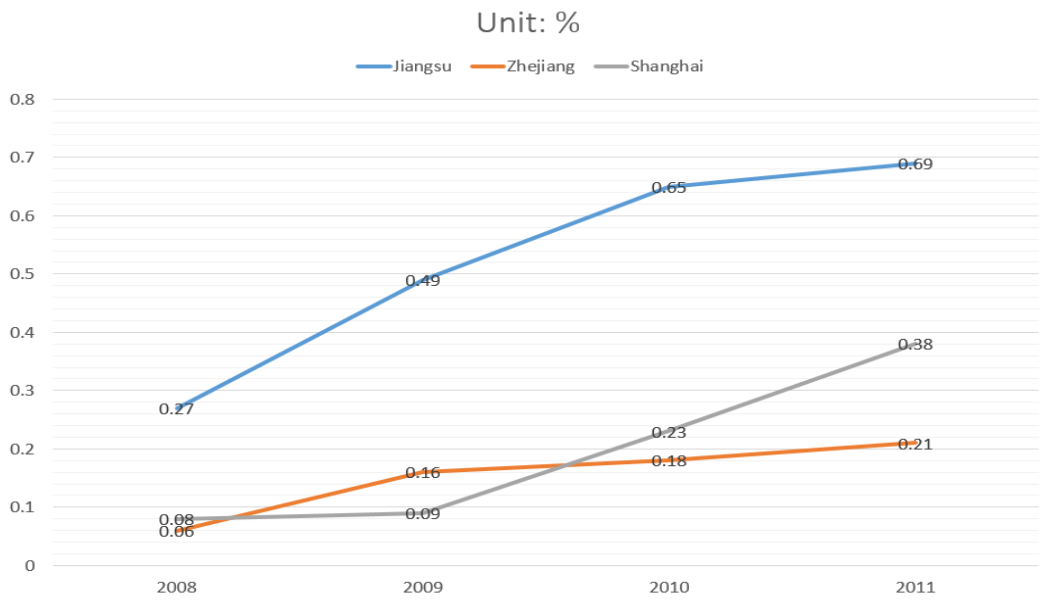

Figure 22 Percentage of electricity from wind energy in actual supply in Chang River Delta region. Source: Author's illustration based on Renewable Energy Statistical Record by Yancheng Economic and Information Technology Commission

The percentage in Zhejiang province was lower than Shanghai in 2008, but surpass Shanghai in 2009. After the offshore wind farm mentioned above started to operation in Shanghai, the percentage went up again and surpassed Zhejiang province in 2010.

3.4.2 Innovation

Started from 2001, the number of patent applications for wind technolocy increased rapidly. Except for 2003, the increased ratio were over 50% each year until the end of 2007. Before 2006, the main driving force of such increase were foreign companies. It was in 2005 that first time the number of patent applications were relatively similar from domestic applicants and foreign applicants. Among these domestic applicants, only 30.3% of them were wind energy companies. The ratio was surprisingly low compare to foreign countries (average number was 81.7%) which shows that domestic wind energy companies had relatively low innovative ability. (Bi, Yuan, & Meng, 2010)

After 2006, the dramatic development of wind energy in general also boosted up the development of the technology. Especially under the influence of the domestic manufacturing requirement, the number of domestic patent applications appeared a magnificent increase in 2006 and 2007. The number was 125 in 2005, increased to 248 in 2006 and 410 in 2007. However, the domestic manufacturing requirement became an obstacle of technology development after these two years of rapid growth because it prevented domestic companies from competing with foreign companies. Thus in 2008 and 2009, the patent application number remained almost the same level of previous years. The central government realized the problem and cancelled the domestic manufacturing requirement in 2009. After that, the application number started to increase again. (Chi, 2012)

Over the years, the average length that domestic patent could last was 3.06 years until 2011 and it was 4.17 years for foreign patent in China. This means the wind energy technology developed really fast. From a geographic distribution point of view, the patent application

mainly came from the east coastal line region which is economically more developed. *Figure 23* shows the percentage of wind energy related patent applications by provincial region by the year of 2009. Jiangsu province had the most applications, follow by Shanghai. Zhejiang province also in the top 5. The reasons for that were more developed technology level in general in the region, more input on R&D and more strong the research capability of local academia institutes. (Bi, Yuan, & Meng, 2010) From a composition of the applicant point of view, only in Jiangsu province and Shanghai the percentage wind energy companies stood for was over 50%. The application from research institutes stood for over 30% in Shanghai. In Zhejiang province, most of the patents were applied by individuals therefore they were harder to transfer to the market. The reasons for that were the manufacturers mainly located at Jiangsu province and the research institutes were really good at wind technology in Shanghai and Zhejiang province.

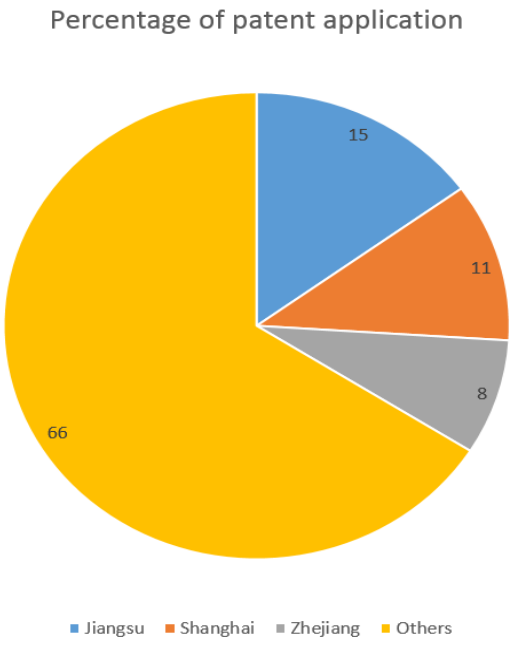

Figure 23 The percentage of patent applications by provincial region in 2009. Source: Author's illustration based on Technology Progress Record by Jiangsu Economic and Information Technology Commission.

Due to the data availability and the fact that Jiangsu province was the region with most domestic manufacturers, most patent applications and highest application ratio from wind energy companies, the number of patent applications in Jiangsu province present below in *Figure 24*. A drop in 2010 can be observed mainly because of the decrease in foreign patent applications. By look into the content of the patent, the patent relevant to bigger capacity and more advanced technology was still hold by foreign companies even domestic applicant surpassed them by numbers.

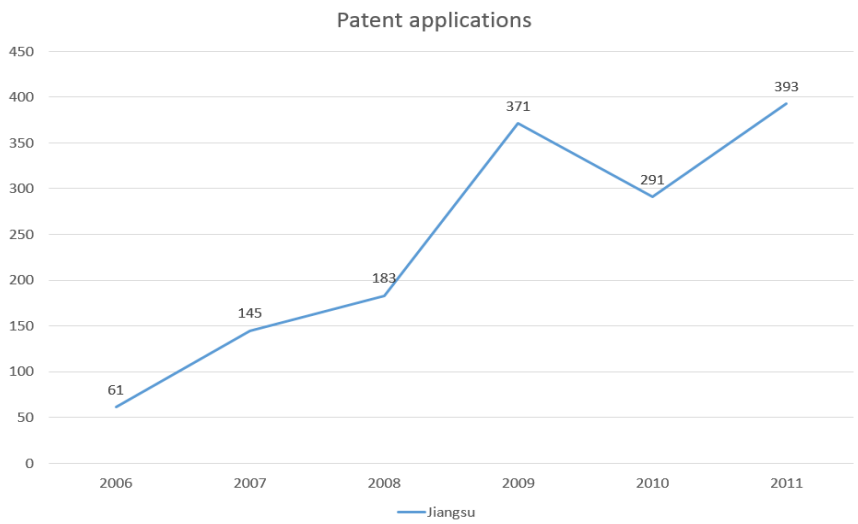

Figure 24 Patent applications related to wind energy in Jiangsu province. Source: Author's illustration based on Technology Progress Record by Jiangsu Economic and Information Technology Commission.

4 Discussion

This chapter reviewed and explained the factors that influencing the performance of China's "Feed-in-Tariff" system. These factors been separated into following categories: institutional aspects, economics aspects, political aspects and local grid capacity and methodological aspects. Then other difficulties been faced in the process of research is explained.

This thesis represents the first attempt to evaluate the actual performance of China's "Feed-in-Tariff" system for wind energy in Chang River Delta region. Therefore the legitimacy for the designed research question was made apparent by the lack of empirical studies on the subject. The findings have gave the opinion of what outcomes the system has delivered and to which level by using different indicators which include different parameters to be compare with. The framework been chosen and explained in chapter two was customized and modified to fit into China's scenario. The choice of indicators took the significance of the data to final conclusion and data availability into consideration.

4.1 Institutional aspects

When the stimulus package been announced, the question of how many contents were new was raised. By comparing the stimulus package with the China's 11th five-year plan, it was quite clear that substantial parts of the 4 trillion RMB investment plan were covered by the five-year plan. The covered parts were concentrated on public transportation sector and reconstruction of earthquake disaster sector and the total amount of these was around 900 billion RMB. This means among the 4 trillion RMB investment plan, 3.1 trillion RMB was new added. (Merrill Lynch, 2008) But on the other hand, most of the policy instruments were new or updated version of previous ones. Thus from long-term perspective, these policy instruments were expected to be more influential. (Tang, 2009)

People also concerned about how the package would affect the government fiscal budget. The reason people concerned about it was that the total amount of the investment plan stands for 13.5% of the annual GDP by that time. But the fact that only one fourth of it was direct investment from central government and it still would divided into two years made the burden of the fiscal deficit much less than imagined. Meanwhile, at that time Chinese central government was planning to issue treasury bonds to raise fund. Since public debt was only stands for 21% of the GDP, Chinese government was relatively easy to raise fund by this means. (In most industrialized countries this number is around 60%-100%, in Japan this number is around 200%) (Merrill Lynch, 2008)

As the most important policy instruments package targets on developing wind energy, China's "Feed-in-Tariff" system really facilitated the development of wind energy in China. After it been implemented, both the installed capacity and the actual supply increased significantly. It leveraged the society's investments into the industry and helped the adjustment of energy structure in China. After the system been updated in 2009, the positive impact of it enlarged except for some extreme situation. In the future, the percentage wind energy stands for is expected continue to growth. From a technology point of view, the system also facilitates the development of it.

In most of cases, the positive effects the unanimous policy package across the country brings overweight the negative effects of it. However, the design of the policy ignored some local situations that lead to the fact that it appeared negative effects on the development of wind energy in specific regions. This is the case for Zhejiang province which generating cost of

wind energy is higher than the procurement price. According to the interviewees from local government, a special subsidizing mechanism for these extreme situations is under discussion by the central government. Hopefully it will come out soon and complement the "Feed-in-Tariff" system.

Acceptance of renewable energy by people is relatively low because of the policy design. The distinction of energy from renewable source and other source is only made by grid companies in their internal plan. Even the central governmental required that energy from renewable sources should be used first, but citizens do not have the chance to choose the source. Since the economic burden of procuring all the electricity generated from wind energy is shared by the whole country, citizens do not know much about the source of the energy they are using and the existence of the "Feed-in-Tariff" system. (Song, 2010)

4.2 Economics aspects

From an economic point of view, all three provincial regions in Chang River Delta region have enough resources to support the development of wind energy. And as data shows above, all of them have sufficient wind resources to be developed. Meanwhile, all the local governments have really positive attitudes toward the development of wind energy. The reasons for that are the economic outcome wind energy would bring therefore the employment opportunity followed up its development, the administrative achievement that can be show off to central government since there were specific development goal in national development plan, and it is a great opportunity to attract investors from outside the region to bring money into the region. All these facts lead to the result that at least in the early years of "Feed-in-Tariff" system been implemented, all three local governments had strong resolution to develop wind energy locally. However, there were still some differences between the provincial regions in the sense of economic development level and the economic resources that controlled by local government. Therefore even all of them had stroung willingness to development wind energy, the scale of actual installed capacity and supply, and the growth ratio were different.

After the system been updated in 2009, the economic outcomes brought by the development of wind energy differed in the Chang River Delta region because of the new pricing mechanism. Therefore the development trends appeared differently between provinces and only in Jiangsu province the rapid growth continued. Furthermore, the location of the manufacturers of wind turbine lead to fact that the development of wind energy carries more jobs in Jiangsu province.

4.3 Political aspects

According to the governmental memorandum regarding the development of renewable energy, the development of wind energy is urged by central government to be put on the top priority of local governments' agenda. (Han & Han, 2010) Over the years, the number of policy instruments used to support the development of wind energy is the most in the renewable energy sectors. (Song C. H., 2010) (Zeng J. F., 2009) Addition to that, among all the policies targeting at renewable energy, those for wind energy changed the most in China's stimulus packages since the government got the highest expectation for it. (Zhang, Zhang, Zhuang, & Yan, 2010)

It is a tradition for Chinese government to make development plans prior to implement policy instruments. But it is quite normal that the policy instruments been implemented deviate from the development goal in the plan completely on paper. Sometimes this is caused by culture

difference that one can understand the implied goal of the plan only if one can understand Chinese culture. To avoid complexity, this difference was not explained in the thesis.

For political achievement reason, most of the local governments in China only focus on economic development numbers if there is no specific requirement in the national development plan. Thus it quite often is the case that even the local government realized that it's more beneficial from a long-term perspective to prioritize the development of renewable energy, they choose the ordinary energy for short-term achievement. Addition to that, the lack of awareness to calculate the environment cost also made the ordinary energy seems more profitable.

4.4 Local grid capacity

Low grid capacity is one of the obstacles that anchoring the development of wind energy and renewable energy in general in China. One of the reasons that Chang River Delta region been chose as case study was that it is the only region which local grid capacity is almost enough for the new developed wind energy. In other regions, the installed capacity of wind energy has far exceeded the grid capacity which lead to the result that large quantity of electricity generated by wind been wasted. Therefore only the investor in Chang River Delta region was fully benefited from China's "Feed-in-Tariff" system since the grid companies only pay for the electricity that they actually procured, in this case equal to their grid capacity.

Even in Chang River Delta region, the grid capacity could also become an obstacle. The dramatic drop on growth ratio of actual wind energy supply in Jiangsu province which occurred in 2011 was mainly because of the limit on grid capacity. Thus in order to further develop the wind energy, the expansion of local grid capacity is essential. In the memo of newest version of national development plan for Renewable Energy, the central government was considering adjust the structure of financial support for renewable energy. According to the document, the proposal was 75% of the financial support should be given to the construction of local grid and therefore further stimulate the growth on actual supply of renewable energy.

4.5 Methodological aspects

The framework been chosen combined with the case study method has supported the attempt to assess the actual performance of China's "Feed-in-Tariff" system. The case study method helped narrowing the scope of the thesis down to a certain geographic region which gave the author opportunity to look thoroughly onto the policy instruments package itself and avoided unexpected uncertainty. Meanwhile, the different circumstances of the provincial region within the chosen area made it possible for author to do a comparative work. However, the case study method also have the draw back that unique situation of the case been chosen would affect the result and final conclusion. This means even the policy package led to this result in this region, giving different geographic region the result could be different. The reader should also aware that even it's quite common for Chinese government to use same or similar policy instrument on different kinds of renewable energy, the attitude government hold toward them may be different. Thus the outcome of same instrument on different energy source could be different. Therefore the conclusion from this thesis should not be apply to other energy sector that supported by same or similar policy instrument.

The "impact problem" was faced in this thesis. That means the outcomes of the policy package under evaluation were actually affected by several different policies and other factors. Although "Feed-in-Tariff" system is the most important policy package that supports the

development of wind energy, reader should aware that there are other factors influencing it. For instance in some cities of Zhejiang province, special funds had been set up by local government to support the wind energy. The funds not only overweight the negative effects brought by the new version of "Feed-in-Tariff" system, but also provide wind energy developer substantial income. Therefore the outcomes which caused by the development of wind energy in these regions are more relevant to the fund than "Feed-in-Tariff" system. Also for instance, the effects that brought by the CDM. Even the number of wind energy projects that registed as CDM projects in the region is still small, the number is growing rapidly in recent years. Compare to non-CDM projects, the selling of CERs brought an average of 3% higher profit in the past years which became a great incentive for investors to development wind energy projects (according to interviewees). To avoid the unexpected complexity, in this thesis the outcomes were not separated based on the source of the impact. Therefore reader should aware that causalities between the policy instruments package and the outcome were not exclusive and complete. However, in the process of choosing indicators, author took the relevance of the outcome to the package into consideration which means even the package under evaluation is not the only source of the result, it is one of the most important one.

Due to the limitation of time, resource and data availability, the choice of indicators could not cover all the perspectives. It is unavoidable that the indicators only represent a small part of the whole picture. And the subjective of the author would also influence the selection of the indicators thus further influence the objective of the conclusion. Reader should aware that in order to have a more holistic view of the performance of the policy package, more indicators will be needed and taken into consideration and comparison.

The availability and quality of data also affects the result of the thesis. Even the National Bureau of Statistics compels yearbooks on annual base, the data is more a national aggregated nature thus not very helpful to the specific purpose of this thesis. The collection of data relies heavily on the willingness of local government or private companies to share. And the data from unofficial source such as private companies weaken the credibility of the thesis. During the data collection process, data conflict was identified frequently. For instance the data from local government sometimes was different with the data from central government. And the difference also exists in the data from different local governments. In these cases, following principles were applied to select the most credible data: data from central government prior to others; published data prior to unpublished data; data from public sector prior to data from private sector; new data prior to old data. The same principle also applied when the content on governmental documents were identified conflict.

4.6 Other obstacle of the research

The visibility of the source of the data was a huge problem when it comes to reference issue. Because of the Chinese culture, most of the interviewees were willing to share their opinions but required to remain anonymous in this thesis. Especially those who are representatives from local government, practical reason for the political purpose made them extremely cautious on the issue of information revealing. In addition to that, in order to avoid trouble, some local government and private companies asked not to reveal the data source for the data author got from them. Therefore some data presented in the thesis remained vague. For instance some reference appeared governmental document without the actual name of it.

5 Conclusion

The objective of this thesis was to fill in the knowledge gap about the actual performance of China's "Feed-in-Tariff" system for wind energy. Through a case study method, the data was gathered specifically for Chang River Delta region and the analysis was focused accordingly. The research examined the outcome of the policy instruments package from four dimensions, namely economic, social, environment and energy system change respectively. By look thoroughly into the development process and evolution of the policy instruments package, insight about intended outcome and operating mechanism was offered. Therefore the evaluation was conducted in a more holistic and subjective way.

The "Feed-in-Tariff" system for wind energy is a policy instruments package which consisted by several different policy instruments. It supports the development of wind energy by guarantees the income of the wind energy companies so that the investors could project the return even before they actually made the investment. In order to absorb the price difference between wind energy and ordinary energy which is generally lower and not put too much economic burden onto the grid companies, the price difference was paid by a special subsidy that the fund of it is levied to the whole country no matter there is renewable energy plant on site or not. The amount of subsidy was calculated case by case in the early version of the pricing mechanism. As part of the China's stimulus package, the pricing mechanism was updated in 2009 and the amount of subsidy was decided by a national wide benchmarking price system henceforth.

The main findings of the thesis are summarized below as conclusion of the thesis in order to answer the research questions.

How can the performance be evaluated from a systemic point of view?

In order to be evaluated, the performance of a policy instrument need to be quantified. And this can be achieved by using the evaluation indicators. Each indicator appears in the form of detailed numbers or quantified description such as all of them, small part of them, none of them etc., and represents a certain aspect of the performance. Therefore the selection of the indicators need to cover different perspectives in order to make the evaluation holistic and systemic. According to the commonly used frameworks developed by different organizations for similar evaluation, the performance of a policy instrument is categorized into social, economic and environmental perspectives. For the special purpose of the thesis, energy system change perspective should also be added. Therefore the indicators been used were selected under these four perspectives.

When presenting the results, some of the indicators were compared to baseline which was calculated based on business-as-usual scenario in order to estimate the net effect of the policy instrument. In this thesis, the business-as-usual scenario was the development of coal-fired power plant. Such comparison made the result more comprehensive.

What were the intended and untended outcome of the system?

For the central government of China, the most important purpose of stimulating the recovery of the economy was to create jobs and keep citizens employed even this purpose hadn't been clearly stated in official announcements. They believe that the capability of an industry to provide working opportunities not only decided by the ratio of unit economic output to job, but also decided by the total economic output of the industry. Both central government and

local governments hold the opinion that the ratio of unit economic output to job for wind energy sector which include the wind energy industry and the whole chain is high. Therefore, they were expecting the support for wind energy lead to the result that both wind energy industry inself and the whole chain of the sector to growth. This would further energize the whole sector to create large quantity of new jobs. This was the most important outcome government expected to get from the policy instrument package.

As the economy continue to growth, the energy supply becomes a more and more important issue and possibly an obstacle to the sustainable development. The improvement on efficiency of ordinary energy is one way to overcome the problem, the development of renewable energy is a more sustainable way. It appears less economic outcome from short-term but exactly the opposite from a long-term perspective. From a government point of view, the expectation has been given to the development of wind energy to overcome the negative effects of limited energy supply would have on economic development, and to gentrify the energy mix structure in a long-term perspective. For now, this effects wind energy sector has are still limited since the scale of wind energy is relatively small compare to traditional enery. However, the continuity support would lead to the result of continuity growth of wind energy in both sense of installed capacity and supply, and the percentage in the energy mix. Therefore the expected outcome of optimize the energy structure and fill in the possible energy gap in the future would be fulfilled.

Along the way of accomplishing the goals mentioned above, other benefits of developing wind energy can also be project or perceived. The progress on environment is one important point. Coal-fired power is still the major source of energy in China, this lead to the fact that electricity industry in general responsible for large quantity of CO_2, SO_2 and other gas pollutant emission and waste water discharging. The development of wind energy would mitigate the environmental burden which caused by electricity industry. For now, limited by the scale of wind energy in the national energy mix, this mitigation effect is hard to be observed in statistic numbers but would become more and more obvious in the future. Development of wind energy also contributes to the improvement of human welfare and social equity in the sense of providing better opportunity for females to get jobs, facilitating higher education and providing jobs with better social benefits.

What can be said about economic, environmental, social and energy systems aspects?

From an economic point of view, the "Feed-in-Tariff" system led to higher job creation ratio, and higher average earning for each job in electricity industry. Compare to coal-fired power, the job creation ratio for wind energy was almost seven times higher which both of them take the job creation ratio in the whole chain into consideration. And as the Higher Efficiency Movement in coal-fired power sector continues, the difference in such ratio would enlarge. Thus as the development of wind energy, substantial number of job would be created in the electricity industry. Meanwhile, even the average earning for each job in the electricity industry is already higher than the average number for all industries, the number for wind energy sector is higher. This will also lead to the result that as wind energy sector expands, the average earning in electricity industry would become higher than the way it is. For the investors of wind energy, the existence of the system not only secured their return, but also make the number predictable. Thus more investors and investment would be attracted into the sector.

In social aspect, "Feed-in-Tariff" system facilitates the expension of an energy sector that hired more female employees, hired more higher-educated employees and provided jobs with better social benefits than other sectors in the electricity industry. Even these outcomes are indirect outcomes of the system itself, their effects therefore refer to the contribution that the

development of wind energy made to the improvement of human welfare and social equity should not be ignored.

The environment outcome is also an indirect outcome of the system therefore it is easy to be ignored. Worse than that, even the environmental benefits of the development of renewable energy were frequently been ignored because it is hard to be observed. The reason for that is renewable energy does not really substitute the ordinary energy but been added to that since the energy demand continued to growth. Thus the environment benefits can only be perceived if compare to business as usual scenario. By such comparison, we can conclude that the existence of the system led to large quantity of gas pollutant reduction and waste water reduction. However, as the coal-fired power continue to growth at the mean time, such reduction will still hardly be observed in aggregated numbers and can only be estimated by comparing to business-as-usual scenario.

To the energy system aspect, "Feed-in-Tariff" system led to continuity rapid growth of wind energy in the sense of both installed capacity and actual supply in general. However, under certain circumstances, the system had negative impact on the local development of wind energy which let to the trend of growth ratio appeared dramatic drop. This led to the conclusion that despite all the positive impacts a unanimous policy across the country would has, special situation need to be taken into consideration and treat differently.

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Appendix 1 List of interviewees

Interviewee's No	Authority/Company	Department	Position
1	Environmental Protection Bureau of Yancheng, Jiangsu	Policy and Regulation	Director
2	Environmental Protection Bureau of Yancheng, Jiangsu	Eco-Technology	Vice Director
3	Environmental Protection Bureau of Yancheng, Jiangsu	Radiation Secrity Supervision	Director
4	Environmental Protection Bureau of Yancheng, Jiangsu	Assessment of Environment Influence	Director
5	Environmental Protection Bureau of Yancheng, Jiangsu	General Office	Director
6	Environmental Protection Bureau of Yancheng, Jiangsu	Planning and Financial	Vice Director
7	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	General Office	Office Secretary
8	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Market Supervision	Vice Director
9	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Electricity Transmission	Vice Director
10	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Electricity Supply	Director
11	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Policy and Regulation	Office Secretary
12	Yancheng Economic and Information Technology	Security	Vice Director

	Commission, Electric Power Energy Office	Supervision	
13	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Electricity Inspection	General Inspector
14	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Administrative Admission	Registration Officer
15	Yancheng Economic and Information Technology Commission, Electric Power Energy Office	Information Statistics	Office Secretary
16	Jiangsu Economic and Information Technology Commission, Electric Power Office	Electricity Sale	Vice Director
17	Jiangsu Economic and Information Technology Commission, Electric Power Office	Power Station Design	Vice Director
18	Jiangsu Economic and Information Technology Commission, Electric Power Office	Scientific Research	Director
19	Shanghai Municipal Electric Power Co., Ltd	Technology Research Institute	President of the Institute
20	Shanghai Municipal Electric Power Co., Ltd	Electricity Transmission	Office Secretary
21	Shanghai Municipal Electric Power Co., Ltd	Research and Development	Vice Director
22	Zhangjiang Electric Power Co.,Ltd	Electricity Transmission	Director
23	Zhangjiang Electric Power Co.,Ltd	Scientific Research	Director
24	Sinovel Wind Group Co.,	Research and	Director

	Ltd	Development	
25	Sinovel Wind Group Co., Ltd	Security Management	Vice Director
26	Sinovel Wind Group Co., Ltd	Project Construction	Vice Director
27	East China Grid Co., Ltd	General Management	Office Secretary
28	East China Grid Co., Ltd	Electric Power Transaction Center	Office Secretary
29	East China Grid Co., Ltd	Regulation and Control	Vice Director
30	American Superconductor Corporation, China	General Administrative Office	Chief Assistant to General Manager

Appendix 2 Interview protocol[17]

1. What's your opinion on central Government's expectation of "Feed-in-Tariff" system (hereinafter referred to as "the system")?

2. Does central government give local government any guidance on how to carry out the system?

3. As a local administrative authority officer, what's your expectation of wind energy projects (hereinafter referred to as "the projects")?

4. Does central government give local government any target in respect of the projects?

5. Have you encountered any obstacles during the process of carrying out the projects?

6. Is there any conflict between local policies and policies delivered by the central government? If so, how do you adopt the policies?

7. What's the most significant accomplishment of the system and the projects?

8. What's the change or influence as the result of the project in terms of environment, economy and society?

9. As to the adjustment in 2009, does it affect the implement and effect of the project? In which way and how?

10. What's your comment on the system and the project?

[17] Original interviews were conducted in Chinese.

11. Do you have any suggestions on how to improve the effect of the system and the project?