Shibeishan Wind Power Generation Project in Huilai County, Guangdong Province

[Date of the VCS PD]
22 August 2008

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1 Description of Project:

1.1 Project title

Shibeishan Wind Power Generation Project in Huilai County, Guangdong Province
Version number of the document: 01

1.2 Type/Category of the project

- Shibeishan Wind Power Generation Project in Huilai County, Guangdong Province (hereafter referred to as the Project) satisfies the requirement of UNFCCC Clean Development Mechanism which is a program approved under the VCS 2007.
  This category of the Project would fall within sectoral scope 1:
  energy industries. (renewable-/non-renewable sources)
- The Project is not a Grouped project.

1.3 Estimated amount of emission reductions over the crediting period including project size:

It is expected that the Project activities will generate emission reductions for about 177,333tCO_2e per year over the first maximum10-year crediting period from 31 March 2006 to 30 March 2016.

Years	Annual estimation of emission reductions in tonnes of CO_2e
2006 (March 31st –December 30st)	133,000
2007(December 31st 2006 –December 30st 2007)	177,333
2008(December 31st 2007 –December 30st 2008)	177,333
2009(December 31st 2008 –December 30st 2009)	177,333
2010(December 31st 2009 –December 30st 2010)	177,333
2011(December 31st 2010 –December 30st 2011)	177,333
2012(December 31st 2011 –December 30st 2012)	177,333
2013(December 31st 2012 –December 30st 2013)	177,333
2014(December 31st 2013 –December 30st 2014)	177,333
2015(December 31st 2014 –December 30st 2015)	177,333
2016(December 31st 2015 –March 30st 2016)	44,333
Total estimated reductions (tonnes of CO_2e)	1,773,330
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	177,333

The project is belong to neither micro project nor mega project as the annual CO_2 equivalent emissions reductions is 177,333t which is more than 5,000t and less than 1,000,000t.

1.4 A brief description of the project:

The project is a grid connected renewable energy project with total installed capacity of 100.2MW. The objective of the project is to generate electricity using state-of-the-art wind power generation technology and delivered to China Southern Power Grid (CSPG). The project will achieve CO_2 emission reduction by replacing electricity supplied by fossil fuel fired power plant connected into CSPG.

The project is expected to deliver 198.96GWh per year to Guangdong Provincial Power Grid, an integral part of the CSPG. Through displacing the equivalent annual electricity generation of the

CSPG which is dominated by thermal power plants, the project will achieve emission reductions of 177,333tCO_2e annually.

Being as an environmentally sound energy supply technology, wind power is a priority development technology in China. The contributions of the Project to sustainable development are summarized as follows:

- Being located in a power grid dominated by fossil fuel fired power plants, the development of the project will not only reduce GHG emissions but also mitigate local environmental pollution caused by gas, water and solid waste emissions from fossil fuel fired power generation;
- The Project could be helpful to diversify power mix of CSPG;
- The project is located in Guangdong Province, where there is electricity supply tension. The implementation of the project will provide new power supply to the local power grid, which is helpful to mitigate electricity shortage;
- Wind power development is at beginning stage both in local area and China. The successful implementation of the project will set a sample for wider deployment of wind power technology in local and national level.

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

The Project is located in Jinghai Town, Huilai County, Jieyang City, Guangdong Province, close to the Shibeishan Lighthouse. The project site is originally non-agrarian wasteland, the foothill on the seashore of South Sea, 25km distance from the Huilai County Seat, as shown in following maps.

Figure 1.The location of Guangdong Province

Figure 2.The location of Jieyang City

Figure 3. The location of the Project

1.6 Duration of the project activity/crediting period:

Project start date: February 14th 2004 on which the financial commitment was made to the project and the project reached financial closure.

Crediting period start date: March 31st 2006 on which the first monitoring period commenced.

10 ×3 years was selected as the crediting period of the Project. That is, the length of the first crediting period is 10 years which will be renewed two times.

1.7 Conditions prior to project initiation:

The Project is located in Huilai County, Jieyang City, Guangdong Province. Huilai County has plenty wind resources, but the development and utilization degree of the wind resources is low. To encourage economic development in Huilai County, local government decided to promote construction of wind power project. The Project is a sample for wider deployment of wind power technology in local and national level. Construction of the Project will alleviate electricity shortage in Huilai County.

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

As a zero-discharge renewable wind power project, the project will achieve GHG emission reductions by displacing equivalent annual amount of electricity delivered by CSPG which is dominated by fossil fuel fired power plants. Hereby equivalent annual electricity supplied by the CSPG is identified as the baseline scenario of the project.

1.9 Project technologies, products, services and the expected level of activity:

The total installed capacity of the project will be 100.2MW, composed by 167 wind turbines with 600kW per unit. The type of the wind turbines is S43/600 produced by Xinjiang Gold Wind Technology Co. Ltd. The line spacing of the wind turbines is 240m, and the row spacing is 160m.

Two 110kV transformer stations will be constructed within the wind farm. Each turbine will have a 690V-to-10kV transformer, every 7 transformers are parallel-connected to the 10kV side of the 110kV transformer stations, and the transformer stations will be link to the local 220kV substation through two circles of 110kV lines.

The expected annual operation time of the wind power plant is 2000h, and there will be 198.96GWh power supply to the grid annually. The development of the Project will contribute to promoting the application of 600kW wind technology, accelerating the accumulation of experiences and absorption of this kind of technology and advancement of domestic wind power technology.

Both the turbines and generators of the Project are made in China, so the Project involves no technology transferred from abroad.

1.10 Compliance with relevant local laws and regulations related to the project:

With the purpose of enhancing the development of renewable resources, increasing energy supply, improving the structure of energy resources, ensuring the security of energy resources, and achieving the economical and social sustainable development, the Chinese Renewable Energy Law was put into force on 1st June, 2006[1]. As a grid connected wind farm electricity generation project, the Project is compliant with Chinese Renewable Energy Law.

In addition, the project is also compliant with construction procedure and approval regulation published by State Planning Commission on 29 July 1999[2]. Hence, the project is in compliance with the Chinese relevant laws and regulations. The detailed laws and regulations related to the Project are explained in table 1.

Table 1 Description of the laws and regulations to the project

Item	Requirement by laws and regulations(Yes/No)	The real action of the project
Environmental Impact Assessments (EIA)	Yes	The EIA was approved by Environment Protection Bureau of Jieyang City on August 8th 2006.
Feasibility Study Reports (FSR)	Yes	The FSR was approved by NDRC on January 29th 2004.
Approval of Construction Lands	Yes	The relevant documents was provide by Huilai Conunty by overnment on Novemer 2th 2003 .

[1] http://www.sepa.gov.cn/law/law/200802/t20080202_117982.htm.

[2] ttp://www.zhuhai.gov.cn/xxfw/zzjg/srmzf/sxzfwzx/bsfw/bsdt/fgj/yjwj/200711/t20071117_35701.html

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

There are some risks that may substantially affect the project's GHG emission reduction or removal enhancement:

Financial risk

According to the demonstration and assessment of additionality, the project faced investment and technical barriers and was economically unattractive, which showed it was an additional project. Therefore, risks that may substantially affect the project's CO_2 emission reductions will result from insufficient investment.

Natural disasters

Besides the risks mentioned above, the project's GHG emission reduction or removal enhancement may be affected by natural disasters, such as flood, typhoon, earthquake and snow or ice storm.

Conclusion

The VCU revenues will reduce the risks from financial risk and natural disasters, and improve the financial attraction. Therefore, the application of VCU provides a financial guarantee for achieving GHG emission reduction of the Project.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The Projects a renewable resource based power project, which generates no emission in operation period. Thus, the Project doesn't fall into categories that creating GHG emissions primarily for the purpose of its subsequent removal or destruction

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

The project developer confirmed that the project has not created another form of environmental credit.

1.14 Project rejected under other GHG programs (if applicable):

Not applicable.

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants:

The Project Developer, Guangdong Yudean Shibeishan Wind Power Development Co. Ltd, is the Project Proponent. The roles and responsibilities of the Project proponent are explained in Table 2:

Table 2 Description of the roles and responsibilities of the Project proponent

Project proponents	Roles and responsibilities
Guangdong Yudean Shibeishan Wind Power Development Co. Ltd.	- Construct and operate the Project - Apply VCU of the Project - Provide proof of title for validation and verification - Provide this VCS PD - Provide monitoring plan and report - Possess VCU

In the following table 3, the contact information of all project participants is shown.

Table 3 Contact information of the Project proponent

Organization:	Guangdong Yudean Shibeishan Wind Power Development Co. Ltd
Street/P.O.Box:	Shibeishan, Jinghai County, Huilai Town
Building:	-
City:	Jieyang
State/Region:	Guangdong Province
Postfix/ZIP:	515223
Country:	P.R.China
Telephone:	0663-6872222 ext. 2848
FAX:	0663-6874987
E-Mail:	shibeishan@163.com
URL:	-
Represented by:	Cai chun
Title:	Department Assistant
Salutation:	Ms.
Last Name:	Cai
Middle Name:	-
First Name:	Chun
Department:	Dept.of General Affairs
Mobile:	13622234266
Direct FAX:	020-85138604
Direct tel:	020-85138605
Personal E-Mail:	caichun@gdyd.com

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.):

Table 4 Key documents needed to be approved before construction of the Project:

Completing date	Title of the Documents needed to be approved before construction
15/07/2006	Environmental Impact Assessment Form (EIA)
08/08/2006	Approval of EIA
11/2003	Feasibility Study Report(FSR)
29/01/2004	Approval of FSR

The annual emission reductions are 177,333tCO_2e in the first crediting period. Key information and data used to calculate the emission reduction of the project is described as follow:

Table 6 Key Information and Data Used to Calculate Emission Reduction

Variable	Value/Unit	Original Data Source
$EF_{OM,y}$	0.9998tCO_2e/MWh	Calculated from the China Energy Statistic Yearbooks 2003-2005 and the China Electric Power Yearbooks 2003-2005.
$EF_{BM,y}$	0.5658 tCO_2e/MWh	Calculated from the China Energy Statistic Yearbook 2006 and the China Electric Power Yearbooks 2003-2005.
$EF_{CM,y}$	0.8913tCO_2e/MWh	Calculated from the China Energy Statistic Yearbooks 2003-2005 and the China Electric Power Yearbooks 2003-2005,
Net electricity supplied by the Project to CSPG	198.96GWh	FSR

1.17 List of commercially sensitive information (if applicable):

Not applicable.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

The approved baseline and monitoring methodology ACM0002 (Version 06).
"Tool for the demonstration and assessment of additionality" (Version 03).

For more information please refer to the link:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

2.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The Project can meet the applicability criteria of the baseline and monitoring methodology (ACM0002), therefore, the methodology is applicable to the Project as:

- The Project is newly built gird connected wind power plant;
- The Project is not an activity that involves switching from fossil fuels to renewable energy at the Project site;
- The power grid (CSPG) which the Project is to be connected to is clearly identified and information on the characteristics of this grid is publicly available;

The additionality of the Project can be verified using "Tools for the demonstration and assessment of additionality" requested by the baseline methodology ACM0002.

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

	Source	Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plant that is displaced due to the Project activity.	CO_2	Yes	Main emission resource.
		CH_4	No	Minor emission resource.
		N_2O	No	Minor emission resource.
Project Activity	On-site fuel combustion to the project activity	CO_2	No	Excluded. It is a clean energy project.
		CH_4	No	Excluded. It is a clean energy project.
		N_2O	No	Excluded. It is a clean energy project.

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

To provide the same output or services comparable with the VER project activity, there would be the following alternatives:
a) No construction of the Project, and the regional power grid as the provider for the same electricity output as the Project.
b) The Project not undertaken as a GHG Program activity (i.e CDM or VCS project) activity.
c) Construction of a fossil fuel fired plant with the same capacity or annual electricity output as the project.
d) Construction of another type of renewable energy power plant with the same capacity or annual electricity output as the project.

The alternative b) is unrealistic because the investment analysis in section 2.5 step 2 will show that the Project without VCU revenues is lack of the attraction for the potential investors.

The alternative c) is also unrealistic because the analysis in section 2.5 Step 1b will show that this alternative does not comply with Chinese legal and regulatory requirement.

As to alternative d), among Chinese current renewable energy power generation technologies for choice are also unrealistic and should be eliminated from the following consideration. First, the hydro power is unrealistic because of the lack of exploitable hydro recourses in the project. According to the feasible study report of the project, Jinghai City, the Project site, is originally no agrarian wasteland, the foothill on the seashore of South Sea. Therefore, around the site of the project, there would be no hydro power resources[3]. Secondly, the technology of Solar PV has not been well developed. Meanwhile the solar resource is relatively limited[2][4] in the place where the project located. Thirdly, there is no established biomass power plant with an installed capacity of 100MW in china, the same capacity as the project. Otherwise the Project owner is only dedicated to wind power development in Guangdong Province, and has no experience and ability to develop other renewable energy power plant. Hence, the alternative d) is unrealistic too.

[3] http://www.agro-labs.ac.cn/21c/jpg/2-1-5.jpg
[4] http://cwera.cma.gov.cn/upload/b_3_left_02.jpg

To summarize, the baseline scenario is concluded to be only alternative a), "No construction of the project, and the regional power grid as the provider for the same electricity output as the project".

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality):

The Feasibility Study Report (FSR) for the project was completed in November 2003 and approved by NDRC in January 2004.

Immediately the project owner had to seek the bank loan. During the pre-evaluation process of the loan application both the bank and project owner noticed that the project IRR would be lower than the estimation in the FSR due to the raising of turbines prices and construction materials directly resulting in the investment increase[5]. In February 2004, the project owner received "*Evaluation Report on Shibeishan Wind Farm*" by China Industrial and Commercial Bank Guangdong Branch, which was stated that applying for CDM project was one of the conditions the project owner should meet to be granted loans on the project. Then on 21 July 2004 the first Directorate decision was made to actively participate in CDM to make the project financially attractive[6].
From above, it has been demonstrated that the project owner had seriously considered CDM before the project construction permission was obtained on 20 August 2004[7]. The VER project is the Pre-CDM project with the emission reduction claimed for VCU from April 1st 2006 to September 1st 2008.

The following steps are used to demonstrate the additionality of the project according to "Tools for the demonstration and assessment of additionality (Version 03)" agreed by Executive Board and requested by the baseline methodology (ACM0002).

Step1. Identification of alternatives to the project activity consistent with current laws and regulations.

Sub-step 1a. Define alternatives to the project activity.
As shown in Section 2.4, to provide the same output or services comparable with the project activity, there would be the following alternatives:

a) No construction of the project, and the regional power grid as the provider for the same electricity output as the project.
b) The project not undertaken as a GHG Program activity (i.e CDM or VCS project) activity but as a commercial project.
c) Construction of a thermal power plant with the same capacity or annual electricity output as the project.
d) Construction of another type of renewable energy power plant with the same capacity or annual electricity output as the project.

The alternative b) is unrealistic because the investment analysis in Step 2 will show that the project without carbon emission reducutin revenues is lack of the attraction for the potential investors.

[5] The minutes for pre-evaluation of the bank loan, January 2004.
[6] The 1st Directorate decision document has been submitted to DOE.
[7] The notice of new start construction projects for the 8th & 9th group of 2004 issued by Guangdong province NDRC dated 20 August 2004 (Doc. No: [2004] 688#).

The alternative c) is also unrealistic because the analysis in Step 1b will show that this alternative does not comply with Chinese legal and regulatory requirement.

As to alternative d), among Chinese current renewable energy power generation technologies for choice, are also unrealistic and should be eliminated from the following consideration. First, the hydro power is unrealistic because of the lack of exploitable hydro recourses in the project. According to the feasible study report of the project, Jinghai City, the project site, is originally non-agrarian wasteland, the foothill on the seashore of South Sea. Therefore, around the site of the project, there would be no hydro power resources. Secondly, the technology of Solar PV has not been well developed. Meanwhile the solar resource is relatively limited in the place where the project located. Thirdly, there is no established biomass power plant with an installed capacity of 100MW in china, the same capacity as the project. Otherwise the project owner is only dedicated to wind power development in Guangdong Province, and has no experience and ability to develop other renewable energy power plant. Hence, the alternative d) is unrealistic too.

Step1b. Consistency with mandatory laws and regulations:
The applicable legal and regulatory requirement for the project include laws, central government regulations, local regulations, departmental rules and disciplines related to electricity and environment protection.

The related laws and regulations can be found and downloaded on the website of State Electricity Regulatory Commission (SERC) and National Development and Reform Commission (NDRC): http://www.serc.gov.cn/opencms/export/serc/laws/index.html and http://nyj.ndrc.gov.cn .

Since the coal fired power plant operation hours are 2-3 times of wind farm operation hours, to provide the same output as the project, the capacity of the above alternative c) will be less than 50MW, which will be categorized as the small scale coal power plant and should be shut down according to the regulations from NDRC (No.50 NDRC Bulletin of P.R.C). According to this regulation, the thermal power plants of under 50MW should be shut down and the construction of thermal power plant under 135MW will be prohibited within the grid connected area (On Prohibition of 135 MW and Smaller-scale Thermal Power Plants, General Office of State Council).

The project owner does not have obligations to construct a wind farm, and the alternative a) is realistic, credible alternative which is in compliance with all applicable legal and regulations, which is considered as the baseline scenario of the project. The following analysis shows that the major obstacles for the project are its financial barriers and some technical risks.

Step2. Investment analysis.
Sub-step 2a. Determine appropriate analysis method.
Three options can be applied for the investment analysis: the simple cost analysis, the investment comparison analysis and the benchmark analysis.

The simple cost analysis is not applicable for the project because the project activity will produce economic benefit (from electricity sale) other than CDM related income. The investment comparison analysis is also not applicable for the project because the baseline scenario, “no construction of the project, and the local power grid as the provider for the same electricity output as the project”, is not a project.

To conclude, the benchmark analysis will be used to identify whether the financial indicators (FIRR) of the project is better than relevant benchmark value.

Sub-step 2b Apply benchmark analysis.

According to the *"Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects"*[8], a project will be financially acceptable when the Financial Internal Return Rate (FIRR) is better than the sectoral benchmark FIRR.

The sectoral benchmark FIRR on total investment for power industry is 8%.

The FIRR of the project is calculated and compared as follows.

Sub-step 2c. Calculation and comparison of financial indicators.

Table B.1 Main parameters for calculation of financial indicators[9]

Items	Unit	Amount	
Capacity	MW	100.2	
Total Investment (Total fixed asset investment)	Million Yuan	709.30	
Annually output	GWh/year	198.96	
Annually O&M costs	Million Yuan/year	10.77	
Electricity Tariff (including VAT)	Yuan/kWh	0.5013	Within 30000h operation hours
Electricity Tariff (including VAT)	Yuan/kWh	0.3038	After 30000h operation hours
Value Added Tax (VAT)	%	8.5	
Income tax	%	33	
Expected CER Price	$/tCO$_2$	10	
Expected VCU Price	$/tCO$_2$	5	
Project operation life time	Year	23	
crediting time	Year	10	

Note: The detail parameters needed for calculation of IRR and the calculation process of IRR for the project are listed in Annex 5. The aforementioned parameters are taken from the project design report of Preliminary Design Report (PDR) and developed by the*" Modification of Financial Analysis on Shibeishan Wind Farm"*, which is a component of PDR. The PDR was developed by the Guangdong Electric Power Design Institute in July 2004, and approved by Guangdong Province Construction Bureau dated 30th July 2004[10].

The financial indicators (FIRR) with and without income from selling VCUs are listed in Table B.2. Without income from selling VCUs, the FIRR of the project is lower than the benchmark FIRR and the project is financially unacceptable because of its low profitability. While considering such income (assumption: 10US$/tCO$_2$), the financial acceptance will be changed, the FIRR of the project is better than the benchmark then the project is financially acceptable.

Table B.2 Comparison of financial indicators with and without income from CERs

[8] State Power Corporation of China. *"Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects"*. Beijing: China Electric Power Press, 2003.

[9] *"Modification of Financial Analysis on Shibeishan Wind Farm"*, Guangdong Electric Power Design Institute, July 2004, which is a component of the project design report of Preliminary Design Report(PDR).

[10] *The project preliminary design report and the approval letter by Guangdong Province Construction Bureau, Construction [2004] No. 306, dated 30 July 2004.*

	Without income fromVCUs	Benchmark	With income from VCUs
FIRR (%)	7.05	8	8. 25

As early as July 2004, the potential benefit of the CDM was considered by the project owner in a case study[11] and accordingly *"Modification of Financial Analysis on Shibeishan Wind Farm"*[12] to take the potential CDM revenue into account.

Sub-step 2d. Sensitivity analysis.

The objective of this sub step is to show the conclusion regarding the financial attractiveness is robust to reasonable variations of the critical assumptions.

Three factors are considered in following sensitivity analysis:

1) Total investment.
2) Annual operation and maintenance cost.
3) Annual electricity output.

The tariff is not considered in the sensitivity analysis because the project belongs to concession project, the price of which has already been fixed[13]. Assuming the above factors vary in the range of -10%-+10%, the FIRR of the project (without income from selling CERs) varies to different extent, as shown in Figure 2.

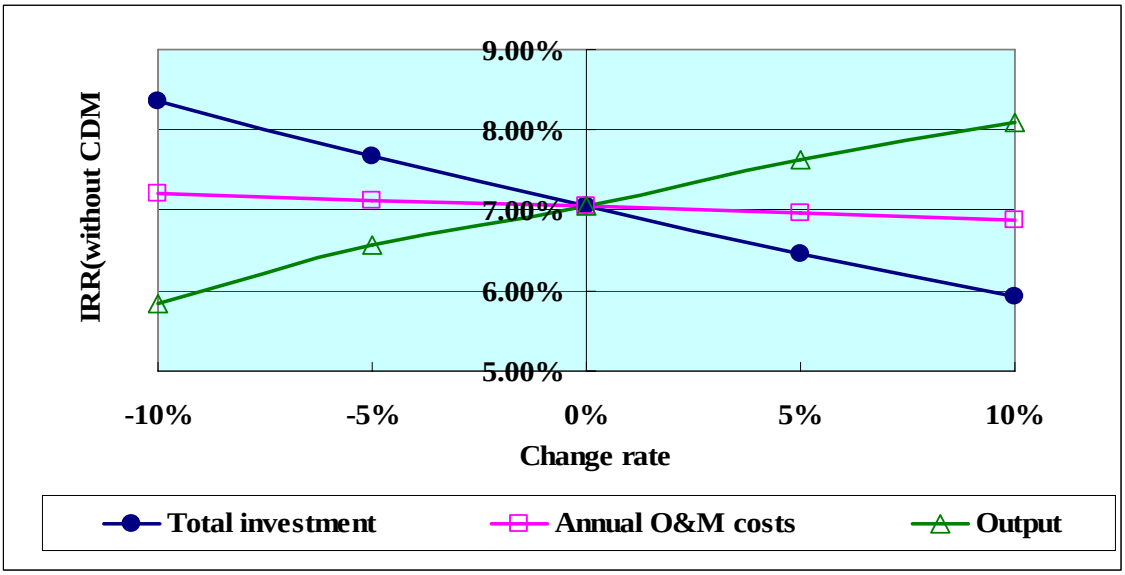

Figure 2 Sensitivity analysis of the project

The change of total investment is one of the most important factors affecting the financial attractiveness of the project. The impacts of the annual electricity output and annual operation and maintenance cost are less significant. In the case that the total investment

[11] *"Case Study of Clean Development Mechanism Project of Shibeishan Wind Farm Project"*, China Academy of Sciences Guangzhou Institute of Energy Conversion July 2004.

[12] *"Modification of Financial Analysis on Shibeishan Wind Farm"*, Guangdong Electric Power Design Institute, July 2004, which is a component of the project design report of Preliminary Design Report (PDR).

[13] The extract of *"Franchise Rights Agreement of Shibeishan Wind Farm Project"* has been submitted to DOE.

decreases by about 10%, the FIRR of the project will exceed the benchmark. However, considering the majority of total investment is due to wind turbine which had already been contracted[14]. It is very difficult to lower the total investment of the project. Therefore, the project is always lack of financial attractiveness within the reasonable range of total investment.

The change of electricity output is another important factor affecting the financial attractiveness of the project. In the case that the annual electricity output increases by about 10%, the FIRR of the project will exceed the benchmark. However, it would require the project annual operation hours raise significantly as much as 2200 hours, which is not realistic according to the actual operation data of two wind power projects(one is the propose project, the other is Huilai Haiwanshi Wind Farm that is near the propose project and has been come into operation in Year 2000[15]). From the "Certificate of main operation date for Guangdong Huilai Shibeishan Wind Farm Project"[16] that collects the main operation data from Sep 28, 2005 till now, it shows that the historical annual operation hours are less 1600h.According to the two years data, it could demonstrate that the annual operation hours were impossible reached 2200 hours. The other evidence, "Certificate of main operation date for Guangdong Huilai Haiwanshi Wind Farm Project"[17], showing that the historical annual operation hours are less 1800h, which also strongly demonstrates that in the area of propose project didn't reach 2200 hours according to the operation date from Year 2000 to Year 2006. Therefore, the project is always lack of financial attractiveness within the reasonable range of electricity output.

The impact of the annual O&M cost is the slightest, the FIRR of the project begins to exceed the benchmark when the annual O&M cost decreases by more than 10%. Therefore, the project is always lack of financial attractiveness within the reasonable range of annual O&M cost.

To conclude, under the reasonable variations in the critical assumptions, the conclusion regarding the financial additionality is robust and supported by sensitivity analysis.

Step 3. Barrier analysis.

Sub-step 3a. Identify barriers that would prevent the implementation of the CDM project activity:

Financing Barriers: Compared to commercialize fossil fuel power generation projects, wind power projects have the risks of high investment costs per unit and low financial return rates, which make it hard for the project owner to get loan from commercial banks. According to the analysis in Step 2, CDM would help to improve wind power projects' financial benefits and reduce the financial risks. China Industrial and Commercial Bank (CICB)[18] agreed to

[14]The extract of "*Wind turbine purchase contract*" has been submitted to DOE.

[15] http://baike.baidu.com/view/94079.htm

[16] "*Certificate of main operation date for Guangdong Huilai Shibeishan Wind Farm Project*", Guangdong Yudean Shibeishan Wind Power Development Co. Ltd, Oct, 2007 has been submitted to DOE.

[17] "*Certificate of main operation date for Guangdong Huilai Haiwanshi Wind Farm Project*", Guangdong Wind Power Co.Ltd, Oct, 2007 has been submitted to DOE.

[18] "*Evaluation Report on Shibeishan Wind Farm*", China Industrial and Commercial Bank Guangdong Branch, Feb, 2004.

extend a loan to the project owner relying to a great extent on considering that the project risks would be partially compensated by the potential CER revenues.

Therefore, the project faces great financing barriers and risks.

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the project activity):

As discussed in the above Steps, the only realistic and credible alternative is a) "no construction of the project, and the local power grid as the provider for the same electricity output as the project", in case of which the barriers mentioned above would not exist.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the project activity:

The wind farms existing or under construction in China Southern Power Grid with installed capacity above 20 MW are listed in the following table:

Table 3 Wind farms with installed capacity above 20 MW in China Southern Power Grid

Wind farm	Owner	Installed Capacity
Guangdong Honghaiwan Wind farm	Guangdong Jihua Wind Energy Co. Ltd.	20.4MW

Source: http://www.cwea.org.cn/upload/200612391640820.doc

Sub-step 4b. Discuss any similar options that are occurring:

Faced on the similar financial and technical barriers as the project, the Guangdong Nanao Wind farm[19] and Guangdong Jiadong Wind farm[20] has already applied for CDM registration.

According to the Notice on Issuing Electric Power Sector Reform Programme by State Council on 10th February 2002[21], China began undertaking significant electric power sector reform including dividing the former single national power company into regional companies and separating generation and distribution responsibilities. This electric power sector reform has the following features:

Firstly, the State Power Grid Corporation and the China Southern Power Grid Corporation were established. The State Power Grid Corporation was responsible for establishing limited liability companies or corporations in five districts including North China, Northeast China, Northwest China, East China and Central China. The China Southern Power Grid Corporation was consisted of the grid assets of the former State Electric Power Corporation in Yunnan, Guizhou, Guangdong and Guangxi. According to the held grid assets ratio, ultimate controlling party was responsible for establishing the China Southern Power Grid Corporation. The electric power enterprises in Tibet were managed by the State Power Grid Corporation.

Secondly, the five main electricity generation groups were restructured. In the aspect of electricity generation, five electricity generation corporations were established including

[19] http://cdm.unfccc.int/Projects/DB/TUEV-RHEIN1144397841.66/view

[20] http://cdm.unfccc.int/Projects/DB/BVQI1189424843.32/view

[21] http://www.lawon.cn/law/detail.dox?id=2211075

China Huaneng Corporation, China Datang Corporation, China Huadian Corporation, China Guodian Corporation, and China Electric Power Investment Corporation. In addition, four assisting corporations were established: China Electric Power Engineering & Consulting Corporation, China Hydropower Engineering & Consulting Corporation, China Hydropower Construction Corporation and China Gezhouba Corporation.

Thirdly, tariff competition policy has been shaped. The core content of this electric power sector reform was price competition, cost reduction and forming new electricity pricing system. The new pricing system designed by this electric power sector reform is, differentiating grid-in tariff, transmission/distribution tariff, and terminal sale tariff. The grid-in tariff was consisted of capacity price fixed by the state and electricity price from market competition price. For grid corporations still in operation/management monopoly status, their transmission/distribution pricing mechanism should be fixed by the government under strict efficiency principle, cost restriction and incentive policy, and their terminal sale price should be based on the above mentioned prices and the established grid-in electricity tariff linkage mechanism. If possible, electricity generation enterprises can supply electricity to big clients directly through negotiation, implement transmission/distribution price fixed by the state, and finally form relatively reasonable electricity sale price.

Fourthly, the State Electricity Regulatory Committee was established. According to the setting of vertical management system, it was necessary to dispatch delegate institution to regional grid corporation and electricity trade dispatching centre and encourage inner industry competition.

In conclusion, Guangdong Honghaiwan Wind farm project, which started its construction before 10th February 2002, has the essential difference and will be excluded from the similar projects

Therefore, the common practice analysis does not oppose but confirm the additionality of the project.

As described above, the project activity passed all criteria of “Tool for the demonstration and assessment of additionality”. In conclusion, the project is additional and not the baseline scenario.

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

The project is a grid-connected wind farm project, so it meets all the applicable criteria of following methodology:
ACM0002 (version 6): Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources. More information about the methodology can be found on the website: http://cdm.unfccc.int/methodologies/approved .
Tool for the demonstration and assessment of additionality (Version 03).

For more information regarding the methodology, please refer to the link:
http://cdm.unfccc.int/methodologies/ SSCmethodologies/approved.html.
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches:

Purpose of monitoring

Monitoring is a key procedure to verify the real and measurable emission reductions from the proposed project. To guarantee the proposed project's real, measurable and long-term GHG emission reductions, the monitoring plan is established.

Types of data and information to be reported, including units of measurement

i. The baseline emission factor: fixed on ex-ante calculation and need not to be monitored every year.
ii. The electricity output to the power grid: ex-post monitoring by year.

Origin of the data

The electricity output by the Project will be continuously measured by the ammeters located in the project site. The project site will install two series of measurement and monitoring equipments, one as the main equipment and the other as standby.

Monitoring, including estimation, modelling, measurement or calculation approaches

The emission reduction of the Project is the result of multiplying the emission factor by the net quantity of electricity supplied to the grid by the Project. The emission factor in the first crediting period is 0.8913 which can be find in the website of China DNA. The electricity output by the project will be contiunously measured by the ammeters in the Project site.

Monitoring times and periods
The electricity output by the Project will be continuously measured by the ammeters located in the project site.

Monitoring roles and responsibilities and Managing data quality

The monitoring plan will be executed and implemented by the monitoring principal who is appointed by the project developer. The local power grid company should cooperate in the check of data.

3.3 Data and parameters monitored / Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Data / Parameter:	**EG_y**
Data unit:	MWh
Description:	Electricity delivered to the grid by the project
Source of data to be used:	Electricity meter reading at project boundary
Value of data applied for the purpose of calculating expected emission reductions in section B.5	198,960
Description of measurement methods and procedures to be applied:	The readings of electricity meter will be hourly measured and monthly recorded. Data will be archived for 2 years following the end of the crediting period by means of electronic and paper backup.

QA/QC procedures to be applied:	The electricity output from each turbine will be monitored and recorded at the on-site control centre using a computer system. The project operator is responsible for recording this set of data. Electricity sales invoices will also be obtained for double check.
Any comment:	Electricity supplied by the project activity to the grid. Double check by receipt of sales.

3.4 Description of the monitoring plan

Implementation of the monitoring plan

The monitoring plan will be executed and implemented by the monitoring principal who is appointed by the project owner. The local power grid company should cooperate in the check of data.The operational and management structure for monitoring the Project's emission reductions has been outlined in the figure 4.

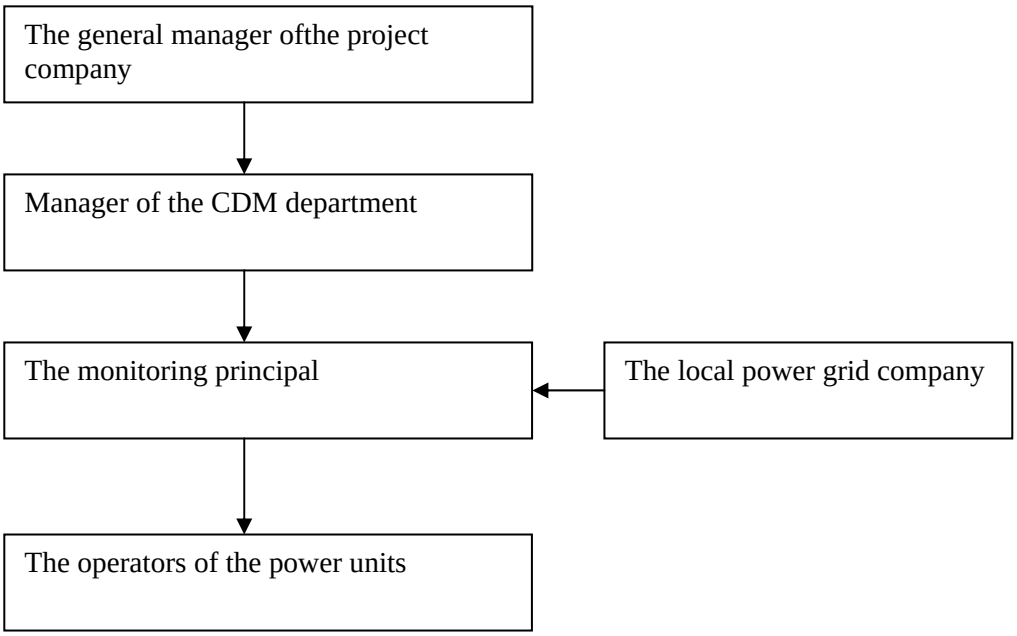

Figure 5. Management structure for monitoring the emission reduction

The monitoring principal will arrange the turbine operators to collect and pack up the data, and be responsible for contact with the local power grid company to double check the data.

Monitoring meters and installation

The monitoring equipments in this monitoring plan are equipments to measure the electricity output to the grid, such as the pass ammeter. These equipments should be automatic systems complying with the national standards and technical requirements. The pass ammeter should meet the standard of national I type measurement reaching 0.5S of the precision and the license of Grid-connected Electric Equipments of Guangdong Province. The ammeters are produced by Hunan Weisheng Company and Shenzhen Kelu Electrical Company. The project site will install two series of measurement and monitoring equipments, one as the main equipment and the other as standby.

The institute authorized by Electric Science Institute of Guangdong Province Power Grid

Company will calibrate the equipments after its installation and put seals on the surface of the equipments.
Afterwards, Guangdong Province Electric Science Institute will do on-site calibration of the monitoring equipments every year. Guangdong Province Electric Science Institute has the Certificate issued by General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China.

Collection, packing up and storage of the data

The automatic measurement system will automatically read, transmit and copy all the data which are the original data for monitoring. The monitoring principal will arrange the unit operators to collect the electricity data monthly. At the end of each month, the monitoring data measured in the whole month will be copied into a CD and also printed out. The monitoring principal also needs to save the copies of electricity sales slip which the project owner provides for the power grid and the balance receipts which the local power grid provides for the project owner in order to check the data. The final electricity connected to the grid should be added and gathered each year. The electrical and paper documents of data should be kept in the whole crediting period and two years after of the crediting period.

4 GHG Emission Reductions:

4.1 **Explanation of methodological choice:**

The calculation of the GHG emission reductions by the proposed project is followed the baseline methodology ACM0002 (Ver06). The project electricity system of the proposed project is defined as the CSPG.

4.2 **Quantifying GHG emissions and/or removals for the baseline scenario:**

Firstly emission factors of Operating Margin ($EF_{OM,y}$) and Build Margin ($EF_{BM,y}$) were calculated. Then, the baseline emission factor (EF_y). All the calculation is in compliance with requirement of the baseline methodology ACM0002 (Ver06). The details are listed in the following steps.

Step 1: Calculation the Operating Margin emission factor ($EF_{OM,y}$)

According to The Methodology, four alternatives could be used to calculate the OM:
a) Simple OM
b) Simple adjusted OM, or
c) Dispatch Data Analysis OM, or
d) Average OM.

For the Project, the simple Operating Margin emission factor was chosen based on the following two reasons:
1. In China, the State Grid Corporation run the interregional dispatch system and each regional grid corporation run the intraregional dispatch system. The dispatch information is regarded as business secrets and not available to the public.
2. For the most recent 5 years (2000-2004), the low-cost/must run resources constitute less than 50% of total: 34.23%, 33.72%, 32.98%, 30.59% and 29.71% for 2000, 2001, 2002, 2003 and 2004 (the proportions are calculated by statistic data from China Electric Power Yearbook 2001, 2002, 2003, 2004 and 2005).

As a result, the simple OM method can be used.

The Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (1)$$

Where $F_{i,j,y}$ is the amount of fuel *i* consumed (ton for solid and liquid fuel, m^3 for gas fuel) by relevant power sources *j* in years *y*,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.
$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2/t for solid and liquid fuel, tCO_2/m^3 for gas fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in years *y*, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*. In the China Electric Power Year Book and other data resources, only generation data is available. The generation from source *j* can be translated into electricity delivered to the grid by source *j* by the following formulation:

$$GEN_{j,\ y} = G_{j,\ y} \times (1-e_{j,y}) \quad (2)$$

Where $G_{j,y}$ is the amount of generation (in MWh) by source *j* in year *y*; $e_{j,y}$ is the rate of plant self consumption of source *j* in year *y*.

The CO_2 emission coefficient of fuel type *i* $COEF_i$ is obtained as

$$COEF_i = NCV_i \times EF_{CO_2,i} \times OXID_i * 44/12 \quad (3)$$

Where:
NCV_i is the net calorific value per ton or m^3 of a fuel *i* (TJ/tce, TJ/m^3).
$OXID_i$ is the oxidation factor of the fuel *i*.
$EF_{CO2,i}$ is the Carbon emission factor per TJ of fuel type *i* (tC/TJ).

The Simple OM emission factor is calculated as electricity-to-the-grid weighted average in the China Southern Power Grid during the most recent 3-year (2002-2004), and will be fixed in the first crediting period. The detailed calculation data is in the Annex 3. The Operation Margin emission factor ($EF_{OM,y}$) of which the proposed project will serve is **0.9998tCO_2/MWh.**

Step2: Calculation the Build Margin emission factor ($EF_{BM,y}$)

The BM is calculated as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m,y}}{\sum_{m} GEN_{m,y}} \quad (4)$$

Where

$F_{i,m,y}$ is the amount of fuel *i* (tce) consumed by plant *m* in year *y*.

$COEF_{i,m,y}$ is the CO_2 emission coefficient (tCO_2/tce) of fuel *i*, taking into account the carbon content of the fuels used by plant *m* and the percent oxidation of the fuel in year *y*.

$GEN_{m,y}$ is the electricity (MWh) delivered to the grid by plant *m*, equals to generation minus plant self consumption:

$$GEN_{m,y}=G_{m,y} \times (1-e_m), \quad (5)$$

Where,

$G_{m,y}$ is the electricity generation by plant *m* in year *y*;

e_m is the rate of plant self consumption.

There are two options for the calculation of the Build Margin emission factor $EF_{BM,y}$ in the ACM0002. Due to the data limitation, it is hard to acquire data at newly-built power plant level. Therefore, Option 1 is chosen for the proposed project: Calculate the $EF_{BM,y}$ *ex ante* based on the most recent information available on plants already built for sample *m* at the time of PDD submission. The sample group *m* consists of either

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

According to the latest CDM EB guideline, the BM calculation is as follows:

1. Since no data available at power plant level, the above samples are composed by the installed capacity increment by fuel type.

2. Find the starting year t_0 which meets the following in equation:

$$\sum_i CAP_{i,t-t_0} \geq 20\% \times \sum_i CAP_{i,t} \quad (6)$$

Where:

t is the most recent year in which data are available;

$CAP_{i,t-t0}$ is the installed capacity increment of fuel type i during the starting year t_0 to the current year t;

$CAP_{i,t}$ is the installed capacity of fuel type i in the current year t.

Based on the statistic data, the installed capacity increment in the China Southern Power Grid during 2002-2004 is 16.46GW, accounting for 20.97% of the installed capacity in 2004. In addition, the installed capacity increment is obviously larger than the total installed capacity of 5 power plants. Therefore, it is feasible to calculate the Build Margin emission factor $EF_{BM,y}$ based on the data of the China Southern Power Grid during 2002-2004.

3. The emission factors of hydro power, nuclear power and other type of installed capacity increment are conservatively valued at 0. The emission factor of each thermal power type i (EF_i) is calculated by the following formula:

$$EF_i = 3.6/ EE_{i,adv} /1000* COEF_i \quad (7)$$

Where:

$EE_{i,adv}$ (%) is the electricity delivery efficiency of best technology commercially available by fuel type i; and

$COEF_i$ (tCO_2/MWh) is the CO_2 emission coefficient of fuel type *i*, and is obtained by the above Formula (3).

4. The Build Margin emission factor $EF_{BM,y}$ is the calculated as the proportions of different types of installed capacity increment in the total installed capacity increment multiplying the emission factor of the fuel type. The details are in Annex 3.

The Build Margin emission factor ($EF_{BM,y}$) of the China Southern Power Grid which the proposed project will serve is **0.5658** tCO_2/MWh.

Step3: Calculation the baseline emission factor (EF_y)

According to the baseline methodology (ACM0002), the baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$),:

$$EF_y = \omega_{OM} \times EF_{OM,y} + \omega_{BM} \times EF_{BM,y} \quad (7)$$

where the weights ω_{OM} and ω_{BM} are 0.75 and 0.25 by the default.

The baseline emission factor is: $EF_y = 0.75 * EF_{OM,y} + 0.25 * EF_{BM,y}$ = 0.8913tCO2/MWh.

According to the descriptions and formulas above, the combined baseline emission factor of the China Southern Power Grid is: $\boldsymbol{EF_y}$**=0.8913t$\boldsymbol{CO_2}$/MWh.**

According to the Feasibility Study Report of the proposed project, the estimated annual electricity generation delivered to the power grid will be: $\boldsymbol{EG_y}$**=198,960MWh.**
The annual emissions of baseline scenario are: $\boldsymbol{BE_y}$**=**$\boldsymbol{EG_y}$**×**$\boldsymbol{EF_y}$**=177,333t$\boldsymbol{CO_2}$.**

4.3 Quantifying GHG emissions and/or removals for the project:

According to the baseline methodology ACM0002, the GHG emission of the proposed project within the project boundary is zero, i.e. PE_y=0.

According to the baseline methodology ACM0002, the leakage of the proposed project is not considered, i.e. L_y=0.
Therefore, the proposed project activity emissions are zero, i.e. E.1+E.2=PE_y+L_y=0.e.

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

The annual emission reductions of the proposed project during the first crediting period are estimated to be:
$ER_y=BE_y-PE_y= BE_y$ **=177,333tCO_2.**

5 Environmental Impact:

The Environmental Assessment Report of the project was completed by South China Institute of Environmental Sciences.SEPA in July, 2006.

According to the *Feasibility Study Report* and the *Environmental Impact Assessment Forum*, the environmental impacts possibly caused by the Project and the guard measures adopted by the Project Developer are analyzed as follows:

The waste water released during the construction period will be mainly living waste water which will be treated and released to meet the environmental standards. The impacts on the sound environment and air quality are short-term during the construction period. After the completion of the construction, the impacts will disappear naturally, and will not have large effect on the local environment.

The electromagnetism of wind power plant operation will be relatively low, and will have little impact on the neighbourhood environment. There will be no air pollutant emissions during the operation period of the project. There will be a little amount of living waste water released during the operation period of the project, which will be treated and released to meet the environmental standards. The noise source during the operation period of the project will be mainly from the running of the wind power unit. The noise level will meet the environmental standards. The location of the project is far from nature reserves and residents. The communications and bird migration will not be interfered.

In conclusion, being as a typical type of clean renewable energy, the project has no significant impacts on local environment and will greatly contribute to achievement of sustainable development objective and promote local environmental protection.

The Environmental Assessment Report of the proposed project has been approved by the Environmental Protection Agency of Jieyang City on August 8, 2006.

6 Stakeholders comments:

Brief description how comments by local stakeholders have been invited and compiled

- Source of local government comments: The Certificate of the Land Use by Huilai Shibeishan 100MW Wind Farm approved by the People's Government of Huilai County.
- Source of local environmental protection department comments: The Environmental Protection Comments approved by the Environmental Protection Bureau of Huilai County.
- Source of local public comments: On 01 Sep 2004, the project owner held a public comment meeting in the meeting room of Green Delta Vacation Hotel in Huilai County. Before the meeting, the county government help the project owner to inform and invite local residents to attend the meeting. After being acknowledged the meeting information, totally 16 public representatives attended the meeting, 8 from Jinghai Town of Huilai County, and the other 8 from Qianzhan Town of Huilai County.

Summary of the comments received

No opposite comment was received. The summary of the comments is as follows:

Comments from the local government: According to the regulations for the portfolio agreements, approve the land in Shibeishan and the surrounding 16km^2 for the construction of the wind farm.

Comments from the local environmental protection department: The project is located in foothill areas, there are few residents, and the wind energy is clean energy which will have little impacts on the local environment. Approve the construction of the project.

Comments from villager representatives: The construction of the wind farm will help to improve the local transportation condition and raise the fame of Huilai County. The villagers expect that the economic compensation standard could be reasonably raised, the local career opportunity could be enlarged, and some local welfare could be subsidized.

Report on how due account was taken of any comments received

Since there is no negative comment received, it's no need to make adjustment on design, construction and operation of the project.

7 Schedule:

Chronological plan for the date of the project can be find in the table below:

Date	milestone
November.2003	Feasibility Study Report(FSR)
January. 29 th 2004	Approval of FSR
Feb. 2004	Decision for development of CDM
Feb. 2004	Date of financial closure completed
Aug. 4th 2004	Date of construction
Sep 28th 2005	Operation date of the project
March. 31th 2006	Decision for VER development instead of CDM
March. 31th 2006	Starting date of the first crediting period
Sep. 1th 2008	Validation and verification of the Project by the DOE

8 Ownership:

8.1 Proof of Title:

The approval of EIA and FSR are evidences for legislative right. Besides, the purchasing contract for turbine generator set and ERPA for the project between project participates are to proof the ownership of the main equipment and process generating the reductions, respectively. The mentioned documents above will be provided to Registry Operator.

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

The project has request for CDM registration and will be registration on September 17st,2008. So the crediting period of CDM is from 17 September, 2008 to 16 September, 2015. The crediting period of VER is from 31 March,2006 to 30 March,2016.

ANNEX 1

BASELINE INFORMATION

Data recommended in the *Notification on Determining Baseline Emission Factors of China power Grid*（issued by Chinese DNA）for CSPG are adopted for the Project.

Table A1~A3 show the thermal power generation supplied to CSPG in 2002, 2003 and 2004.

Table 1. Data of the China Southern Power Grid in 2002

	Installed capacity (10^4kW)					Power generation (10^8kWh)					Thermal power plant self use rate (%)
	Total	Hydro power	Thermal power	Nuclear power	Other	Total	Hydro power	Thermal power	Nuclear power	Other	
Total	6168.02	2292.1	3596.92	279	0	2892.75	830.93	1851.68	208.77	0	--
Guangdong	3587.99	777.53	2523.78	279		1610.08	169.13	1230.81	208.77		5.58
Guangxi	751.95	436.33	315.62			317.03	186.34	130.69			8.31
Guizhou	706.86	242.61	464.25			427.43	95.12	332.31			7.9
Yunnan	876.91	583.63	293.27			408.49	250.62	157.87			8.21

Source: China Electric Power Yearbook 2003, China Electric Power Press, 2003

Table 2. Data of the China Southern Power Grid in 2003

	Installed capacity (10^4kW)					Power generation (10^8kWh)					Thermal power plant self use rate (%)
	Total	Hydro power	Thermal power	Nuclear power	Other	Total	Hydro power	Thermal power	Nuclear power	Other	
Total	6971.68	2540.93	4044.41	378	8.34	3351.4	832.71	2227.8	289.3	1.59	--
Guangdong	3920.2	810.72	2723.14	378	8.34	1895.77	171.36	1433.51	289.3	1.59	5.5
Guangxi	771.53	452.52	319.01			363.67	192.88	170.79			8.43

Guizhou	1017.95	371.37	646.58			513.14	80.19	432.95			7.4
Yunnan	1010	654.32	355.68			458.91	268.37	190.55			8.01

Source: China Electric Power Yearbook 2004, China Electric Power Press, 2004

Table 3. Data of the China Southern Power Grid in 2004

	Installed capacity (10^4kW)					Power generation (10^8kWh)					Thermal power plant self use rate (%)
	Sum	Hydro power	Thermal power	Nuclear power	Other	Sum	Hydro power	Thermal power	Nuclear power	Other	
Sum	7814.39	2762.08	4665.97	378	8.34	3762.77	840.72	2635.74	284.81	1.49	--
Guangdong	4262.1	858.46	3017.29	378	8.34	2121.33	141.13	1693.89	284.81	1.49	5.42
Guangxi	941.5	504.04	437.81			373.72	172.29	201.43			8.33
Guizhou	1221.9	441.72	780.18			629.24	132.04	497.2			7.06
Yunnan	1136.55	705.86	430.69			536.72	293.5	243.22			7.56

Source: China Electric Power Yearbook 2005, China Electric Power Press, 2005

1. Calculating the simple OM emission factor of the China Southern Power Grid:

Table 4. Calculate the OM of Southern China Grid in 2002

Fuel Type	Unit	NCV	Unit for NCV	EF (tCO_2/TJ)	OXID	Guangdong	Guangxi	Guizhou	Yunnan	CO2 Emission
		A		B	C	D	E	F	G	J=(D+E+F+G)* A*B*C
Raw Coal	Mt	20908	MJ/t	94.6	1	41.2106	7.1135	14.3068	11.4439	146512309.88
Clean Coal	Mt	26344	MJ/t	94.6	1					0.00
Other washed	Mt	8363	MJ/t	94.6	1			0.3526	0.1358	386392.68
Coke	Mt	28435	MJ/t	107	1				0.0644	195939.90
Crude Oil	Mt	41816	MJ/t	73.3	1	0.058				177776.54

Gasoline	Mt	43070	MJ/t	69.3	1	0.0001				298.48
Diesel	Mt	42652	MJ/t	74.1	1	0.7307	0.0067		0.005	2346365.00
Fuel Oil	Mt	41816	MJ/t	77.4	1	7.0141	0.002			22708017.39
LPG	Mt	50179	MJ/t	63.1	1	0.0009				2849.67
Refinery Gas	Mt	46055	MJ/t	57.6	1	0.0142				37669.31
Other petroleum products	Mt	41816	MJ/t	73.3	1	0.0791				242450.42
Natural Gas	Mm^3	38931	kJ/m^3	56.1	1					0.00
Coke Oven Gas	Mm^3	17354	kJ/m^3	44.4	1					0.00
Other Coal Gas	Mm^3	5227	kJ/m^3	44.4	1	0.63				146209.64
Total		***a***								**172756278.91**
Generation	GWh	***b***				123081	13069	32559	16396	185105
Self Consumption rate		***c***				5.58%	8.31%	7.90%	8.21%	
Electricity delivered to Grid	GWh	***d=b*(1-c)***				116213	11983	29987	15050	173233

The Calculation of OM:
a : The total emissions of SCPG: **172756278.91 tCO_2**
d: The electricity delivered to SCPG by thermal power plants: 173233 **GWh**
OM=a/d*10^{-3}=0.9972

Data Sources:
China Energy Statistical Yearbook 2000-2002, China Statistics Press, 2003.
China Electric Power Yearbook 2003, China Electric Power Press, 2003
2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2 Energy.

Table 5. Calculate the OM of Southern China Grid in 2003

Fuel Type	Unit	NCV	Unit for NCV	EF (tCO_2/TJ)	OXID	Guangdong	Guangxi	Guizhou	Yunnan	CO2 Emission
		A		B	C	D	E	F	G	J=(D+E+F+G) *A*B*C
Raw Coal	Mt	20908	MJ/t	94.6	1	44.9179	8.3184	21.6911	14.0527	175993455.05
Clean Coal	Mt	26344	MJ/t	94.6	1	0.0005				1246.07
Other washed	Mt	8363	MJ/t	94.6	1			0.3638	0.2037	448971.84
Coke	Mt	28435	MJ/t	107	1				0.005	15212.73
Crude Oil	Mt	41816	MJ/t	73.3	1	0.0685				209960.23
Gasoline	Mt	43070	MJ/t	69.3	1	0.0002				596.95
Diesel	Mt	42652	MJ/t	74.1	1	0.319			0.0076	1032223.61
Fuel Oil	Mt	41816	MJ/t	77.4	1	6.2722	0.003			20310051.27
LPG	Mt	50179	MJ/t	63.1	1					0.00
Refinery Gas	Mt	46055	MJ/t	57.6	1	0.0285				75603.89
Other petroleum products	Mt	41816	MJ/t	73.3	1	0.1135				347890.30
Natural Gas	Mm^3	38931	kJ/m^3	56.1	1					0.00
Coke Oven Gas	Mm^3	17354	kJ/m^3	44.4	1				0.004	3082.07
Other Coal Gas	Mm^3	16970	kJ/m^3	44.4	1	0.321			1.127	1091021.66
Total		***a***								**199529315.67**
Generation	GWh	***b***				141738	17028	43273	19390	221429
Self Consumption rate		***c***				5.50%	8.43%	7.40%	8.01%	
Electricity delivered to Grid	GWh	***d=b*(1-c)***				133942	15593	40071	17837	207443

The Calculation of OM: ***a*** : The total emissions of SCPG: **199529315.67 tCO_2** ***d***: The electricity delivered to SCPG by thermal power plants: 207443 **GWh** **$OM=a/d*10^{-3}=0.9619$**
Data Sources: China Energy Statistical Yearbook 2004, China Statistics Press, 2005. China Electric Power Yearbook 2004, China Electric Power Press, 2004 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2 Energy.

Table 6. Calculate the OM of Southern China Grid in 2004

Fuel Type	Unit	NCV	Unit for NCV	EF (tCO_2/TJ)	OXID	Guangdong	Guangxi	Guizhou	Yunnan	CO2 Emission
		A		B	C	D	E	F	G	J=(D+E+F+G)*A*B*C
Raw Coal	Mt	20908	MJ/t	94.6	1	60.1770	13.05	26.4392	17.5128	231767969.13
Clean Coal	Mt	26344	MJ/t	94.6	1	0.0021				5233.50
Other washed	Mt	8363	MJ/t	94.6	1					0.00
Coke	Mt	28435	MJ/t	107	1					0.00
Crude Oil	Mt	41816	MJ/t	73.3	1	0.1689				517697.55
Gasoline	Mt	43070	MJ/t	69.3	1					0.00
Diesel	Mt	42652	MJ/t	74.1	1	0.4888			0.0183	1602696.24
Fuel Oil	Mt	41816	MJ/t	77.4	1	9.5771				30996843.45
LPG	Mt	50179	MJ/t	63.1	1					0.00
Refinery Gas	Mt	46055	MJ/t	57.6	1	0.286				758691.65
Other petroleum products	Mt	41816	MJ/t	73.3	1	0.166				508808.72
Natural Gas	Mm^3	38931	kJ/m^3	56.1	1	0.048				104833.40
Coke Oven Gas	Mm^3	17354	kJ/m^3	44.4	1					0.00

Other Coal Gas	Mm^3	16970	kJ/m^3	44.4	1	0.258				194394.74
Total		***a***								**266457168.38**
Generation	GWh	***b***				169300	20143	49679	24322	263444
Self Consumption rate		***c***				5.42%	8.33%	7.06%	7.56%	
Electricity delivered to Grid	GWh	***d=b*(1-c)***				160124	18465	46172	22483	247244
The Calculation of OM: ***a*** : The total emissions of SCPG: **266457168.38 tCO_2** ***d***: The electricity delivered to SCPG by thermal power plants: 247244 **GWh** **OM=a/d*10^{-3}=1.0777**										
Data Sources: China Energy Statistical Yearbook 2004, China Statistics Press, 2006. China Electric Power Yearbook 2005, China Electric Power Press, 2005 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2 Energy.										

Table 7. Calculate the Simple OM (3 year generation weighted average)

	Year 2002	Year 2003	Year 2004	Sum
Emissions inside SCPG (tCO_2)	172756278.91	199529315.67	266457168.38	--
Emissions from Mid China Power Grid (tCO_2)	0	0	0	--
Electricity delivered inside SCPG (GWh)	173233	207443	247244	--
Electricity delivered by Mid China Power Grid (GWh)	0	11	10951	--
Total emissions (tCO_2)	172756278.91	199529315.67	266457168.38	638742762.96
Total electricity delivered (GWh)		207454	258195	638882
$EF_{OM,y}$ (tCO_2/MWh)	--	--	--	0.9998

2. Calculating the BM emission factor of the China Southern Power Grid:

Table 11. Installed Capacity of the China Southern Power Grid in 2004

	Guangdong	Guangxi	Yunnan	Guizhou	Total
	A	B	C	D	G=A+B+C+D
Coal-fired Capacity (MW)	18625	4378.1	4306.9	7801.8	35111.8
Oil-fired Capacity (MW)	11427	0	0	0	11427
Hydro Capacity (MW)	8584.6	7560.4	7058.6	4417.2	27620.8
Nuclear Capacity (MW)	3780	0	0	0	3780
Other Capacity (MW)	204.3				204.3
Total Capacity (MW)	42620.9	11938.5	11365.5	12219	78143.9

Sources: China Electric Power Yearbook 2005, China Electric Power Press, 2005

Table 12. Installed Capacity and generation of the China Southern Power Grid in 2003

	Guangdong	Guangxi	Yunnan	Guizhou	Total
	A	B	C	D	G=A+B+C+D
Coal-fired Capacity (MW)	17057.8	3184.7	3556.8	6465.8	30265.1
Oil-fired Capacity (MW)	10162.7	5.4	0	0	10168.1
Hydro Capacity (MW)	5707.2	4525.2	6543.2	3713.7	20489.3
Nuclear Capacity (MW)	3780	0	0	0	3780
Other Capacity (MW)	94.4				94.4
Total Capacity (MW)	36802.1	7715.3	10100	10179.5	64796.9

Sources: China Electric Power Yearbook 2004, China Electric Power Press, 2004

Table 13. Installed Capacity and generation of the China Southern Power Grid in 2002

	Guangdong	**Guangxi**	**Yunnan**	**Guizhou**	**Total**
	A	B	C	D	G=A+B+C+D
Coal-fired Capacity (MW)	15603.8	3156.2	4642.5	2932.7	26335.2
Oil-fired Capacity (MW)	9634	0	0	0	9634
Hydro Capacity (MW)	7775.3	4363.3	2426.1	5836.4	20401.1
Nuclear Capacity (MW)	2790	0	0	0	2790
Other Capacity (MW)	76.8				76.8
Total Capacity (MW)	35879.9	7519.5	7068.6	8769.1	59237.1

Sources: 1. China Electric Power Yearbook 2003, China Electric Power Press, 2003
2. http://disclosure.szse.cn/main/finalpage/2003-11-25/13089606.PDF

Table 14. Calculation of BM in the China Southern Power Grid

	Installed Capacity in year 2002 (MW)	Installed Capacity in year 2003 (MW)	Installed Capacity in year 2004 (MW)	Newly added capacity from 2002-2004 (**Build Margin**) (MW)	Weight of different generation technology
	A	B	C	D=C-A	
Coal-fired Capacity	26335.2	30265.1	35111.8	8776.6	53.56%
Oil-fired Capacity	9634	10168.1	11427	1793	10.94%
Gas-fired Capacity	0	0	0	0	0%
Hydro Capacity	22921	25409.3	27620.8	4699.8	28.68%
Nuclear Capacity	2790	3780	3780	990	6.04%
Other Capacity	76.8	94.4	204.3	127.5	0.78%

Total Capacity	61757.1	69716.9	78144	16386.9	100%
Percentage as installed capacity in 2004	79.03%	89.22%	100%		

Table 15. Calculation of BM emission factor in the China Southern Power Grid

	Electricity supply efficiency	Fuel emission factor (tc/TJ)	OXID	Emission Factor of electricity supply (tCO_2/MWh)	Weight	Weighed emission factor (tCO_2/MWh)
	A	B	C	D=3.6/A/1000*B*C*44/12	E	F=D*E
Coal-fired Capacity	36.53%	25.8	1	0.9323	53.56%	0.4993
Oil-fired Capacity	45.87%	21.1	1	0.6072	10.94%	0.0664
Gas-fired Capacity	45.87%	15.3	1	0.4403	0%	0
Hydro Capacity	--	0	--	0	28.68%	0
Nuclear Capacity	--	0	--	0	6.04%	0
Other Capacity	--	0	--	0	0.78%	0
Sum (EF_{BM})	--	--	--	--	100%	0.5658

Source: 2006 IPCC guidelines for National GHG Inventories Vol 2 Energy.
Chinese DNA, see also http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1051.pdf .