CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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GD Power & Shenzhou PV 10MW Bundled Solar PV Power Project
Version: 05.1
Date: 08/08/2012

Date	Version	Comments
10/10/2011	01	GSP
03/02/2012	02	Updated following DOE on-site validation and findings log
13/03/2012	03	Updated
26/03/2012	04	Updated following DOE findings log
01/04/2012	05	Updated following DOE findings log
08/08/2012	05.1	Updated following DOE's TR comments

A.2. Description of the small-scale project activity:

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GD Power & Shenzhou PV 10MW Bundled Solar PV Power Project (hereafter as "the proposed project") consists of two small-scale renewable solar PV projects: Inner Mongolia Alashan 5MWp PV Power Project (hereafter referred to as "GD Project") and Inner Mongolia Shenzhou Photovoltaic Power Co., Ltd 5MWp Photovoltaic Power Plant (hereafter referred to as "Shenzhou Project"). GD Project is located in Barunbieli Town, Alashan Zuoqi, Alashan League, Inner Mongolia Autonomous Region. It is developed by GD Power Inner Mongolia New Energy Development Co., Ltd. Shenzhou Project is located in Jinshan Development District, Tumed Zuoqi, Hohhot City, Inner Mongolia Autonomous Region. It is developed by Inner Mongolia Shenzhou Photovoltaic Power Co., Ltd.

GD Project consists of 5*1MWp photovoltaic cells. The total installed capacity of GD Project is 5MWp with polysilicon silicon photovoltaic cells installed and the net grid-connected electricity generation of 7,549MWh[1] will be exported to the Yaoba 110kV substation. The annual equivalent utilization hour is 1,509h, thus the plant load factor of GD Project determined as 17.2% (average power generation/installed capacity/max operation hour in one year = 7,549MWh/5MW/8,760h).

The total installed capacity of Shenzhou Project is 5MWp with monocrystal silicon and polysilicon photovoltaic cells installed. On the average, the project activity is expected to supply 7,548MWh[2] electricity to the Lianhua 110kV substation. The annual equivalent utilization hour is 1,509h, thus the plant load factor of Shenzhou Project determined as 17.2% (average power generation/installed capacity/max operation hour in one year = 7,548MWh/5MW/8,760h).

[1] Average electricity generation of GD Project over 25 years, in consideration of 20% attenuation during the whole lifetime.

[2] Average electricity generation of Shenzhou Project over 25 years, in consideration of 20% attenuation during the whole lifetime.

All the electricity generated will be transmitted to North China Power Grid (NCPG). The installation of the bundled project will generation of electricity by using renewable solar PV power to the NCPG and replacing equivalent electricity generated by fossil fuel fired power plants connected to the NCPG, and therefore reducing Greenhouse Gas emissions. The expected annual net electricity delivered to the grid by the proposed bundled project activity is 16,149MWh[3] and the estimated annual emission reductions are 15,033 tCO_2e during the first period.

Prior to the implementation of the proposed bundled project, the electricity generated by the project activity would have been generated by operation of existing power plants and new addition of power capacity connected to the NCPG.

The baseline scenario as identified in the Section B.4 of the PDD, which is the same as the scenario existing prior to the implementation of the proposed project activity.

Contribution of the project activity to sustainable development

The project contributes to sustainable development in the following ways:

- The project activity will displace the power generation of fossil fuel power plants, reducing CO_2, SO_x and NO_x emissions significantly, thus mitigating the air pollution and its adverse impacts on human health.
- Improvement of the fossil fuel dominated fuel mix of the electricity generation in the power grid by providing clean and renewable energy source, and help to energy supply security.
- Promote application and diffusion of the innovative/creative solar PV technology in China through the demonstrative practice of the project activity.
- Create employment opportunities for the local community during the construction and operation period.

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (Host)	GD Power Inner Mongolia New Energy Development Co., Ltd	NO
Japan (Buyer)	Carbon Capital Management, Inc.	NO
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required		

A.4. Technical description of the small-scale project activity:

[3] The annual average electricity generation of GD Project over the first crediting period is 8,090MWh, and that of Shenzhou Project over the first crediting period is 8059MWh. Thus the annual average electricity generation of bundled project during the first crediting period is 16,149MWh (8,090MWh+8,059MWh).

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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People's Republic of China

A.4.1.2. Region/State/Province etc.:

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Inner Mongolia Autonomous Region

A.4.1.3. City/Town/Community etc:

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GD Project: Barunbieli Town, Alashan Zuoqi, Alashan League
Shenzhou Project: Jinshan Development District, Tumed Zuoqi, Hohhot City

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity(ies):

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The two photovoltaic projects respectively lies in Alashan League and Hohhot City, both sited at Inner Mongolia Autonomous Region P.R.China, in which:

GD Project is located in Barunbieli Town, which lies in the east of Alashan League. The exact geographic location of is the latitude of 38°39′00″N and the longitude of 105°37′43″E. Shenzhou project is located at Jinshan Development District, Tumed Zuoqi, Hohhot City, which exact geographic location of the power plant is the latitude of 40°45′39″N and the longitude of 111°27′18″E.

Figure 1 and Figure 2 show the geographical location of the bundled project.

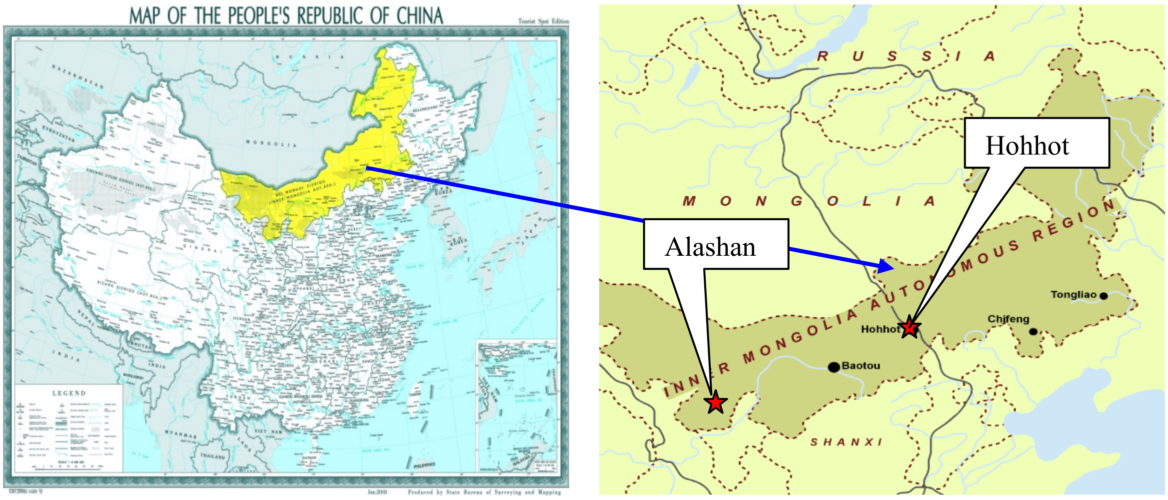

Figure 1. Geographical location of Inner Mongolia Autonomous Region

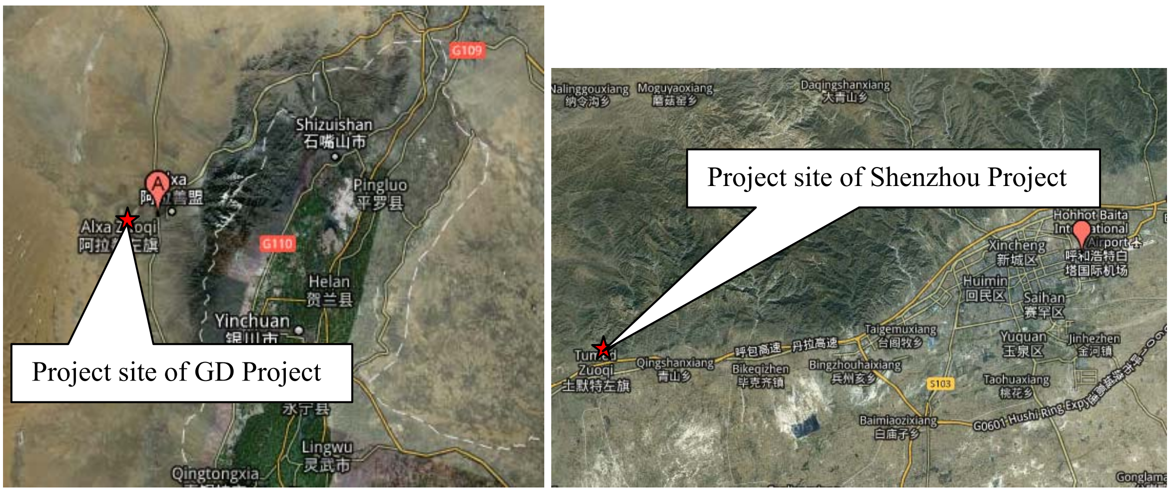

Figure 2. Geographical location of bundled project activity

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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According to the simplified modalities and procedures for small-scale CDM project activities the bundled project activity falls under the following type and category.

Project type: Type I
Category: AMS-I.D Grid connected renewable electricity generation

Technology of the small-scale project activity

The photovoltaic generating Plant consists of PV array, power conditioning system, boost transformer and electricity grid connecting system.

In the absence of the bundled project, equivalent amount of annual power output to the project will be generated and supplied by NCPG which the project is connected to. This is the same with the baseline scenario of the bundled project. It is expected that the bundled project as a renewable energy source will generate emission reductions by avoiding CO_2 emissions from the same amount of electricity generation from NCPG, which is mainly composed of traditional thermal power plants.

The PV array inverts a photovoltaic power to a direct current electricity power. The power conditioning system inverts a direct current to an alternating current. The boost transformer sends a generated voltage to the grid (NCPG). The schematic diagram of PV station is showed in Figure 3.

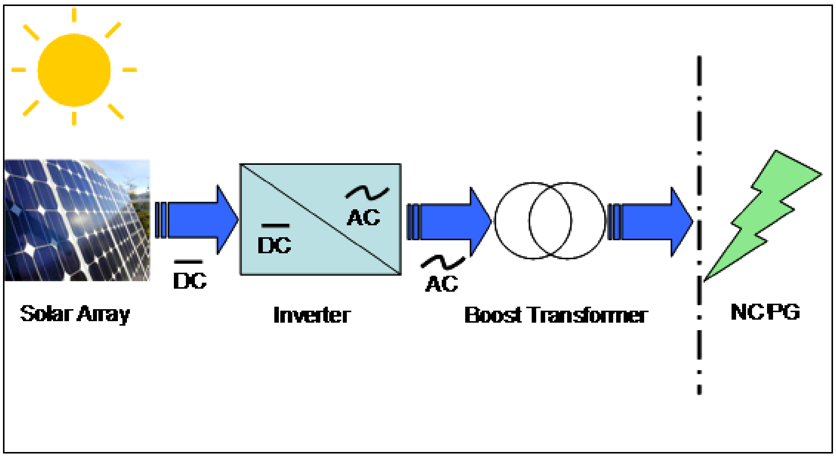

Figure 3. Schematic Diagram of PV Station

1. Modules

GD project consists of 5*1MWp polysilicon cells, 10*500kW inverter and fixed solar support installed. The inclination of all modules will be set to 38°.

Shenzhou project has installed 650 kWp tracking system besides fixed solar support, which includes homotaxial tracking system and biaxial tracking system. The inclination of fixed solar module and homotaxial tracking axis is 38° and 10° respectively.

The total capacity of the bundled project is 10MWp.

The key technical indicators of the photovoltaic cells used in the proposed project activity are listed in Table 1 and Table 2.

Table 1. Main technical parameters of photovoltaic cells of GD Project

Parameters	**Unit**	**STP230-20/wd**	**GDM-230PE03**	**GDM-235PE03**	**GDM-225PE03**
Peak power	Wp	230	230±3%	235+3%	225+3%
Open-circuit voltage	V	36.8	37	30.1	36.9
Short-circuit current	A	8.25	8.26	8.31	8.20
Maximum voltage	V	29.8	29.8	37.1	29.4
Maximum current	A	7.72	7.72	7.81	7.66
Operating temperature	℃	45±2	47±2	47±2	47±2
Dimension	mm	1665L×991W×50H	1640L×992W×50H	1640L×992W×50H	1640L×992W×50H
Lifetime	yrs	25			

Table 2. Main technical parameters of photovoltaic cells of Shenzhou Project

PV module type	Actual power	Dimension	Open circuit voltage	Rated voltage	Short circuit current	Rated current	Lifetime
	Wp	mm (L×W×H)	V	V	A	A	yrs
S-145D	155	1165×990×46	25.1	20.5	8.46	7.56	25
S-165D	165	1316×992×46.5	28.5	23	8.03	7.17	
	155		28.3	22.6	7.63	6.86	
	165	1318×994×46	28.5	23	8.03	7.17	
	160		28.4	22.8	7.83	7.02	
	155		28.3	22.6	7.63	6.86	
	145		28.1	22.2	7.33	6.54	
	135		27.6	21.8	6.94	6.19	
S-165D-A	165	1575×826×46	43.5	35	5.25	4.71	
	155		42.5	34	5.1	4.56	
	145		41.5	33	4.9	4.39	
	135		40	32	4.7	4.22	
S-180C	185	1575×826×46	45.5	36.5	5.68	5.07	
	180		45	36	5.5	5	
	175		45	36	5.44	4.86	
	170		44.4	35.5	5.27	4.79	
	165		43.8	35	5.23	4.71	
S-280D	280	1956×992×46	44.8	35.8	8.33	7.82	

2. <u>Inverters</u>

Inverter is an electrical device that converts direct current (DC) to alternating current (AC).

GD Project will be installed with 10 sets of inverters with capacity 500kW and Shenzhou Project is will be installed with 50 sets of inverters of capacity 100kW/50kW.
The parameters of inverters used in the proposed project are listed in Table 3 and Table 4.

Table 3. Main technical parameters of inverters of GD Project

Parameters	Unit	SG500KTL
Rated capacity	kW	500
Max input power	kWp	550
Max input voltage	V	900
MPPT input voltage range	V	450～820
Max input current (DC)	A	1200
Output frequency and range	HZ	47-51.5HZ/57-61.5HZ
Max efficiency	%	98.7
Load factor		>0.9
Dimension	mm	2800×2180×850
Cooling Mode		Air-cooled

Table 4. Main technical parameters of inverters of Shenzhou Project

Parameters	Unit	SG50K3	SG100K3	SG250K3	SG500KTL
Rated capacity	kW	50	110	250	500
Max input power	kWp	55	100	275	550
Max input voltage	V	880	880	900	880
MPPT input voltage range	V	450～820	450～820	450～820	450～820
Max input current (DC)	A	130	250	600	1200
Output frequency and range	HZ	47-51.5HZ/57-61.5HZ	47-51.5HZ/57-61.5HZ	47-51.5HZ/57-61.5HZ	47-51.5HZ/
Max efficiency	%	95.5	97.0	97.3	98.7
Load factor		>0.99(under rated capacity)	>0.99(under rated capacity)	>0.95	>0.99(under rated capacity)
Dimension	mm	820×1964×646	1015×1969×775	1800×2180×850	2800×2180×850
Cooling Mode		Air-cooled	Air-cooled	Air-cooled	Air-cooled

Parameters	Unit	SSL0500
Rated capacity	kW	500
Max input power	kWp	550
MPPT input voltage range	V	300～850
Max input current (DC)	A	1200
Output frequency and range	HZ	50/60±4.5
Max efficiency	%	98.3
Load factor		>0.99
Dimension	mm	1200×2000×1000
Cooling Mode		Air-cooled

Domestic technology is employed by the proposed project and no technology transfer involved.

Electricity delivered to NCPG by GD Project will be monitored with meters installed in GD Plant and inlet of Yaoba Substation, Please find detail connection information in section B.7.2.

Electricity delivered to NCPG by Shenzhou Project will be monitored with meter(s) installed on the inlet point of Lianhua Substation. Please find detail connection information in section B.7.2.

The measurement precision of the meter(s) employed by the bundled project will be at least 0.5s.

A.4.3. Estimated amount of emission reductions over the chosen crediting period:

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The proposed bundled project activity applies the renewable crediting period (7 years*3) and the estimation of the emission reductions during the first crediting period is shown in Table below. The annually average emission reductions are estimated as 15,033t CO_2e per year.

Years	Annual estimation of emission reductions in tones of CO2e
01/09/2012[4] ~ 31/12/2012	5,197
01/01/2013 ~ 31/12/2013	15,456
01/01/2014 ~ 31/12/2014	15,296
01/01/2015 ~ 31/12/2015	15,138
01/01/2016 ~ 31/12/2016	14,980

[4] The starting date of monitoring period changes to Sep, 1st, 2012, due to the delay of expected date of PDD submitting for registration.

01/01/2017 ~ 31/12/2017	14,822
01/01/2018 ~ 31/12/2018	14,665
01/01/2019 ~ 31/08/2019	9,680
Total estimated reductions (tonnes of CO2e)	**105,234**
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**15,033**

A.4.4. Public funding of the small-scale project activity:

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No public funding from Annex I parties to Kyoto Protocol are involved in the proposed project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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According to Appendix C of the *simplified modalities and procedures for small-scale CDM project activities*, the proposed project is not a part of any larger scale project or program nor a de-bundled component of a larger project activity, since the project participants further confirm that they have not registered any small-scale CDM activities or applied to register another small CDM project activity within 1km of the project boundary, neither in the same project category and technology/measure, nor registered within the previous two years.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

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Methodologies:
AMS-I.D Grid connected renewable electricity generation -Version 17
http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X

References:
Tool to calculate the emission factor for an electricity system-Version 2.2.1
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf

Guidelines on the Demonstration of Additionality of Small-Scale Project Activities-Version 09.0.0

http://cdm.unfccc.int/Reference/Guidclarif/meth/methSSC_guid05.pdf

B.2 Justification of the choice of the project category:

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The project activity is in line with the applicability conditions of AMS I.D, Ver.17 as follow:

No.	As per the methodology	As per the project activity
1	This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: a) Supply electricity to a national or a regional grid; b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	YES. The proposed bundled project comprises renewable energy generation units, *i.e.* solar photovoltaic power system that supply power to NCPG that would have otherwise been supplied by fossil fuel fired generating unit connected to NCPG.
2	2. This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition1; (c) involve a retrofit2 of (an) existing plant(s); or (d) involve a replacement3 of (an) existing plant(s).	YES. The proposed bundled project is a green field solar PV power plant at desert where there was no renewable energy power plant operating prior to the implementation of the project activity.
3	Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir. • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emission section, is greater than $4W/m^2$. • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emission	N/A. The proposed bundled project is a solar PV power plant.

	section, is greater than 4W/m^2.	
4	If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	YES. The proposed bundled project is new solar PV power plants with total capacity of 10MW, which is less than 15MW.
5	Combined heat and power (co-generation) systems are not eligible under this category.	N/A. The proposed bundled project is a solar PV based power plant only, and no heat will be generated in this system.
6	In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	N/A. The proposed bundled project is a green field solar PV power plant.
7	In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	N/A. The proposed bundled project doesn't involve retrofitting or modifying an existing facility for renewable energy generation.

B.3. Description of the project boundary:

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According to paragraph 9 of AMS-I.D. V17, the bundled project boundary is the solar power stations and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

The electricity displaced by the proposed project activity should be a part of the NCPG, which is composed of Beijing Power Grid, Tianjin Power Grid, Hebei Power Grid, Shanxi Power Grid, Shandong Power Grid and Inner Mongolia Power Grid.

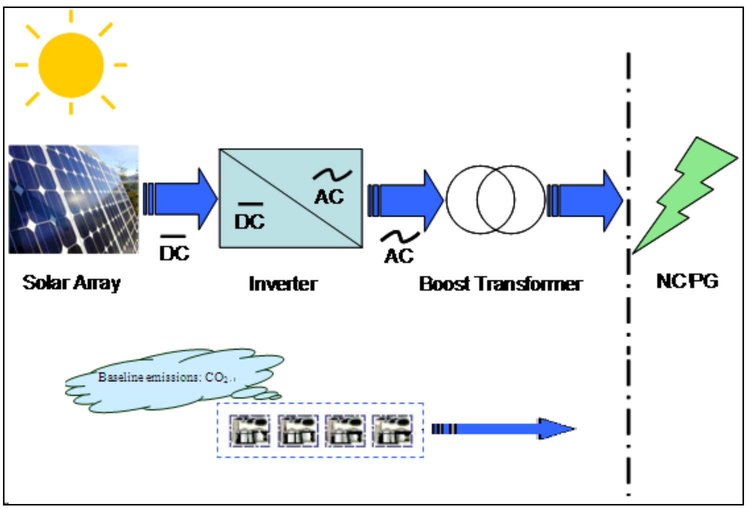

Figure 4. Project Boundary of GD/Shenzhou Project

B.4. Description of baseline and its development:

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According to the methodology AMS I.D (Version 17), for the bundled project that is installation of two new grid-connected renewable power plants/units, the baseline scenario is the electricity delivered to the grid by the project activity would otherwise have been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

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Guidelines on the Demonstration of Additionality of Small-Scale Project Activities (Version09) is followed to determine the proposed bundled project's additionality.

CDM consideration

As a solar photovoltaic bundled project, the project owner confronted with lots of material barriers. In March, 2010, the Feasibility Study Report (FSR) of GD Project has concluded that the GD Project would not be financially viable because the IRR is considerably lower than the benchmark IRR. It suggested that the CDM revenue has been one of the potential approaches to improve the economic attraction of GD Project. Therefore, On August 2nd, 2010, prior to the start of GD Project, the potential incentive from CDM had been considered seriously by the Board Meeting with the aim of obtaining additional revenue from selling CERs so as to make the project financially viable. On Jan 19th and May 5th of 2011, the prior consideration of CDM of GD project notification were accepted by China's DNA and UNFCCC respectively and the time of notification are both within the six months after the project starting.

The milestones are listed in Table 5 to illustrate the timeline of the GD Project.

Table 5 Timeline and relevant evidences of GD Project

Time	Activities
03/2010	Completion of Feasibility Study Report (FSR)
06/04/2010	Approval of EIA
22/07/2010	Approval of FSR by Inner Mongolia Autonomous Region DRC
02/08/2010	Investment Board Meetings, with CDM support
02/11/2010	CDM Letter of Intension signed
10/11/2010	EPC contract signed *(starting date of GD Project)*
18/11/2010	Start construction
19/01/2011	Prior Consideration of CDM Notification accepted by China DNA
15/03/2011	CDM consulting contract signed
05/05/2011	Prior Consideration of CDM Notification accepted by UNFCCC secretariat
09/09/2011	ERPA signed

On May 17th and May 9th of 2010, the prior consideration of CDM of Shenzhou Project notification were accepted by China's DNA and UNFCCC respectively and the time of notification are both within the six months after the project starting.

The milestones are listed in Table 6 to illustrate the timeline of the Shenzhou Project.

Table 6 Timeline and relevant evidences of Shenzhou Project

Time	Activities
10/09/2008	Approval of EIA
03/2009	Completion of Feasibility Study Report (FSR)
13/07/2009	Approval of FSR by Inner Mongolia Autonomous Region DRC
25/07/2009	Investment Board Meetings, with CDM support
08/11/2009	CDM consulting contract signed
25/11/2009	Photovoltaic module purchase contract signed *(Staring date of Shenzhou Project)*
08/02/2010	Civil Construction Contract signed
01/04/2010	Start construction
09/05/2010	Prior Consideration of CDM Notification accepted by UNFCCC secretariat
17/05/2010	Prior Consideration of CDM Notification accepted by China DNA
20/11/2010	CDM Letter of Intension signed
15/05/2011	Authorized Agreement on CDM development with GD Project Owner signed
09/09/2011	ERPA signed

The additionality for the bundled project has been demonstrated as per Guidelines on the Demonstration of Additionality of Small-Scale Project Activities, version 09, EB 68 annex 27.
As per the Guideline the positive list of grid-connected renewable electricity generation technologies that are automatically defined as additional, without further documentation of barriers, consists of the following grid-connected renewable electricity generation technologies of installed capacity up to 15 MW:
(a) Solar technologies (photovoltaic and solar thermal electricity generation);
(b) Off-shore wind technologies;
(c) Marine technologies (wave, tidal);
(d) Building-integrated wind turbines or household rooftop wind turbines of a size up to 100 kW.

Since the project activity is 10MW solar photovoltaic grid connected renewable electricity generation technologies and it satisfies second condition of Guideline, the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The emission reductions conducted by the proposed bundled project will based on the approval methodologies AMS-I.D (version 17). The calculation including:

a) Baseline emissions
b) Project emissions
c) Leakage
d) Emission reductions

a) Baseline emissions

According to methodology AMS-I.D. (version 17), the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$, expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_y = EG_{BL,y} \times EF_{CO_2,grid,y} \quad (1)$$

Where:

BE_y	Baseline Emissions in year *y*; tCO_2
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{CO_2,grid,y}$	CO_2 emission factor of the grid in year y (t CO2/MWh)

$$EG_{BL,y} = EG_{output,y} - EG_{input,y} \quad (2)$$

$EG_{output,y}$	Quantity of electricity supplied to the grid by the Project in year y (MWh)
$EG_{input,y}$	Quantity of electricity purchased from the grid by the Project in year y (MWh)

The emission factor of the grid can be calculated in a transparent and conservative manner according to AMS-I.D. as follows:

a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the *'Tool to calculate the emission factor for an electricity system'*. OR
b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Method (a) is applied to calculate the emission factor of the grid according to the step-wise approach presented by "*Tool to calculate the emission factor for an electricity system (version 2.2.1)*" as follows:
o
Step 1 - Identify the relevant electricity systems
Step 2 - Choose whether to include off-grid power plants in the project electricity system (optional)
Step 3 - Select a method to determine the operating margin (OM)
Step 4 - Calculate the operating margin emission factor according to the selected method
Step 5 - Calculate the build margin emission factor (BM)
Step 6 - Calculate the combined margin (CM) emissions factor

Step 1: Identify the relevant electricity systems

According to *"Tool to calculate the emission factor for an electricity system"*, the data published by the DNA of China is selected. Therefore, in accordance to the latest delineation published by DNA of China on 20 Dec 2010, North China Power Grid (NCPG) is identified as the electricity system, from which would provide electricity in baseline scenario. The spatial extent of the NCPG comprises all the power plants connected physically to the North China Power Grid, which includes Beijing City, Tianjin City, Hebei Province, Shanxi Province, Shandong Province and Inner Mongolia Autonomous Region (*the proposed project location province*) Power Grid.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Option I is chosen**:** Only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

Any of the four methods can be used, however, the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. Among the total electricity generations of the North China Power Grid which the Project is connected into, the amount of low-cost/must run resources accounts for about 0.70% in 2004, 0.67% in 2005, 0.75% in 2006, 0.92% in 2007, and 1.27% in 2008; the average is0.86%[5], all less than 50%. Thus, the method (a) Simple OM can be used to calculate the baseline emission factor of operating margin ($EF_{OM,y}$) for the project.

For the simple OM, the emissions factor is selected to be calculated using either of the data vintages between any of: *Ex ante* option or *Ex post*. For this PDD *Ex ante* option is selected, which is a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

Step 4: Calculate the operating margin emission factor according to the selected method

In accordance with the "*Tool to calculate the emission factor for an electricity system*" , the simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated by one of the following options:

- Based on the net electricity generation and a CO_2 emission factor of each power unit (Option A), or
- Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (option B)

[5] China Electric Power Yearbook, 2005-2009 editions

According to the "Tool", Option B can only be used if:
(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation

However, due to the necessary data, including the fuel consumption and net electricity generation of each power plant, is not available in China, and the other two requirements are also satisfied, Option B is adopted.

As per Option B, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost / must-run power plants / units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:
Data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system can be identified; thus, Option B is employed to calculate OM.

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \qquad (3)$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (kJ / mass or volume unit)
$EF_{CO_2,i,y}$	CO_2 emission factor of fossil fuel type i in year y ($kgCO_2$/GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year y (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year y
y	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)

For this approach (simple OM) to calculate the operating margin, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants / units, and including electricity imports to the grid. Electricity imports should be treated as one power plant source.

The simple OM emission factor ($EF_{grid,OMsimple,y}$) is calculated with reference to the *Notification on Determining Baseline Emission Factor of China's Grid* issued by Chinese DNA (http://cdm.ccchina.gov.cn), (see Annex 3 for details).

$EF_{grid,OMsimple,y}$ is 0.9914 tCO_2e/MWh.

Step 5. Calculate the build margin (BM) emission factor

According to *Tool to Calculate the Emission Factor for an Electricity System* (version 02.2.1), project participants shall choose between one of the following two options to calculate the build margin emission factor ($EF_{grid,BM,y}$).

Option 1. For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group m at the time of PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2. For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the Project or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emission factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

Option 1 is adopted by the bundled project.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

The sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh);

(c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEG_{SET-sample-CDM}$, in MWh) ;

If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET-sample-CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample-CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample-CDM->10yrs}$).

It is suggested the set of power units that comprises the larger annual generation should be used.

Considering data availability, CDM EB accepts the following deviation in application of methodology[6]:
1) Use of capacity additions during the last several years for estimating the build margin emission factor for grid electricity.
2) Use of weights estimated using installed capacity in place of annual electricity generation.

And it is suggested to use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

Therefore for the bundled project: First, calculate the share of different power generation technology in recent capacity additions. Second, calculate the weight for capacity additions of each power generation technology. And finally calculate the emission factor using the efficiency level of the best technology commercially available in China.

According to *Tool to Calculate the Emission Factor for an Electricity System* (version 02.2.1), the build margin emission factor ($EF_{grid,BM,y}$) is the generation-weighted average emission factor of power units m, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (4)$$

6 Http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ.

Where:

$EF_{grid,BM,y}$ is the build margin emission factor in year y (tCO_2e/MWh);

$EF_{EL,m,y}$ is the CO_2 emission factor of power unit m in year y (tCO_2e/MWh);

$EG_{m,y}$ is the net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh);

m is the power units included in the build margin;

y is the most recent historical year for which electricity generation data are available.

$EF_{EL,m,y}$ is calculated according to Option A2 of Step 4(a) (Simple OM) in *Tool to Calculate the Emission Factor for an Electricity System* (version 02.2.1).

As the data of installed capacity cannot be separated into coal fired, oil fired and gas fired currently, the build margin emission factor is calculated by the following steps and formulae:

Step a. Calculate the power generation emissions of solid fuel, liquid fuel and gas fuel and each share in the total emissions based on *Energy Balance Table* of the most recent year.

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}} \quad (5)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}} \quad (6)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}} \quad (7)$$

Where:

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by province j in year(s) y;

$NCV_{i,y}$ is the net calorific value (energy content) of fuel i in year y (GJ/mass or volume unit);

$EF_{CO2,i,j,y}$ is the emission factor of fuel i in year y (tCO_2e/GJ);

COAL, OIL and GAS are footnote group for solid fuels, liquid fuels and gas fuels.

Step b. Calculate the emission factor for thermal power of the grid based on the result of Step a and the efficiency level of the best technology commercially available in China.

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (8)$$

$$EF_{Coal,Adv,y} = FC_{adv,coal} \times NCV_{coal,y} \times EF_{CO2,coal,y} \quad (8\text{-a})$$

$$EF_{oil,Adv,y} = FC_{adv,oil} \times NCV_{oil,y} \times EF_{CO2,oil,y} \quad (8\text{-b})$$

$$EF_{gas,Adv,y} = FC_{adv,gas} \times NCV_{gas,y} \times EF_{CO2,gas,y} \quad (8\text{-c})$$

Where $EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are emission factor proxies of efficiency level of the best coal fired, oil fired and gas fired power generation technology commercially available in China.

Step c. Calculate the build margin emission factor of the grid based on the result of Step b and the share of thermal power of recent 20% capacity additions.

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total.y}} \times EF_{Thermal,y} \qquad (9)$$

Where:

$CAP_{Total,y}$ is total capacity additions that are close to and exceed 20% of existing capacity;

$CAP_{Thermal,y}$ is capacity additions of thermal power.

The data on installed capacity for calculating the build margin emission factor ($EF_{grid,BM,y}$) are obtained from *China Electric Power Yearbook 2007/2008/2009*. The data on different fuel consumptions for power generation and the net calorific values of the fuels are obtained from *China Energy Statistical Yearbook 2009*. The emission factors of the fuels employed and carbon oxidation rate are obtained from Table 1.3 and Table 1.4 on page 1.21-1.24 of Chapter 1, Volume 2 of *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. The lower values of the 95% confidence intervals in Table 1.4 are used for the emission factors of the fuels employed.

The BM emission factor ($EF_{grid,BM,y}$) is calculated with reference to the *Notification on Determining Baseline Emission Factor of China's Grid* issued by Chinese DNA (http://cdm.ccchina.gov.cn), (see Annex 3 for details).

Following the equations above, $EF_{grid,BM,y}$ is calculated as follows. Data used in these calculations are provided in Annex 3.

$EF_{grid,BM,y}$ = 0.7495 tCO_2e/MWh

Step 6. Calculate the combined margin emission factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \qquad (10)$$

Where:

$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emission factor (%)
w_{BM}	Weighting of build margin emission factor (%)

According to the *"Tool to calculate the emission factor for an electricity system"*, the default values of the proposed project are w_{OM} =0.75, w_{BM} =0.25 in the first crediting period.

The result of calculation for $EF_{grid,CM,y}$ is given in Table 12.

Table 12. NCPG $EF_{grid,CM,y}$

$EF_{grid,OM,y}$	0.9914	tCO_2/MWh
$EF_{grid,BM,y}$	0.7495	tCO_2/MWh
$EF_{grid,CM,y}$	**0.9309**	**tCO_2/MWh**

b) Project emissions

The bundled project activity generates electricity by utilizing solar power. Therefore, the project emission is zero according to AMS-I.D..

c) Leakage

The leakage of the bundled project is zero according to the AMS-I.D..

d) Emission reductions

The emission reductions ER_y of the bundled project activity during a given year y is the difference between baseline emission (BE_y), project emissions (PE_y) and emission due to leakage (LE_y), as follows:

$$ER_y = BE_y - PE_y - LE_y$$

B.6.2. Data and parameters that are available at validation:

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Data / Parameter:	$FC_{i,j,y} / F_{i,j,y}$
Data unit:	Tonne or m^3
Description:	Amount of fossil fuel type *i* consumed by power plant/unit *j* in year *y*
Source of data used:	China Energy Statistical Yearbook 2007, 2008 and 2009
Value applied:	Please refer to Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually	According to the latest version of Tool to Calculate the Emission Factor for an Electricity System, the proposed project uses the national values from "China Energy Statistical Yearbook", the data selection is reasonable and effective.

applied :	
Any comment:	-

Data / Parameter:	$NCV_{i,y}$
Data unit:	MJ / mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	China Energy Statistical Yearbook 2009
Value applied:	Please refer to Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the latest version of Tool to Calculate the Emission Factor for an Electricity System, the proposed project uses the national values from "China Energy Statistical Yearbook 2009", the data selection is reasonable and effective.
Any comment:	-

Data / Parameter:	$OXID_i$
Data unit:	%
Description:	Oxidation rate of the fuel *i*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	Please refer to Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	-

Data / Parameter:	$EF_{CO_2,i,j,y}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	Please refer to Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	-

Data / Parameter:	$EG_{m,y}$ / EG_y
Data unit:	MWh
Description:	Net electricity generated by power plant/unit m (or in the project electricity system in case of EG_y) in year y

Source of data used:	China Electric Power Yearbook 2007, 2008 and 2009
Value applied:	Please refer to Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the latest version of Tool to Calculate the Emission Factor for an Electricity System, the proposed project uses the national values from "China Electric Power Yearbook"
Any comment:	-

Data / Parameter:	$CAP_{j,y}$
Data unit:	MW
Description:	Installed capacity of source *j* in year *y* in the NCPG
Source of data used:	China Electric Power Yearbook 2007, 2008 and 2009
Value applied:	Please refer to Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the latest version of Tool to Calculate the Emission Factor for an Electricity System, the proposed project uses the national values from "China Electric Power Yearbook"
Any comment:	-

Data / Parameter:	$EF_{coal,adv,y}$, $EF_{oil,adv,y}$ and $EF_{gas,adv,y}$
Data unit:	%
Description:	Efficiency level of best technologies commercially available in China
Source of data used:	China's DNA : Notification on Determining Baseline Emission Factors of China Power Grid 2010 URL: http://cdm.ccchina.gov.cn
Value applied:	Best efficiency for coal plant is 39.08% Best efficiency for oil plant is 51.46% Best efficiency for gas plant is 51.46%
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best and most recent data available, and use the same data publication as the calculation of the emission factors published by the Chinese authorities.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

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Following the aforementioned formulae, the baseline emissions, project emissions and the emission reductions that the project would yield are calculated, with the results being summarized in the following.

a) Baseline emissions

GD Project:

$$BE_{y,GD} = EG_{BL,y,GD} \times EF_{CO_2,grid,y}$$

The parameters contained in the above equation and their values are listed in the following tables

$EG_{BL,y,GD}$

Year	Amounts(MWh)
01/09/2012 ~ 31/12/2012	2,781.1
01/01/2013 ~ 31/12/2013	8,291.9
01/01/2014 ~ 31/12/2014	8,215.2
01/01/2015 ~ 31/12/2015	8,139.2
01/01/2016 ~ 31/12/2016	8,063.8
01/01/2017 ~ 31/12/2017	7,989.2
01/01/2018 ~ 31/12/2018	7,915.3
01/01/2019 ~ 31/08/2019	5,236.1

$EF_{CO2,grid,y}$	0.9309 tCO_2/MWh

Therefore, the baseline emissions of GD Project are:

$BE_{y,GD}$

Year	Amounts(tCO_2e)
01/09/2012 ~ 31/12/2012	2,589
01/01/2013 ~ 31/12/2013	7,719
01/01/2014 ~ 31/12/2014	7,648
01/01/2015 ~ 31/12/2015	7,577
01/01/2016 ~ 31/12/2016	7,507
01/01/2017 ~ 31/12/2017	7,437
01/01/2018 ~ 31/12/2018	7,368
01/01/2019 ~ 31/08/2019	4,874

Shenzhou Project:

$$BE_{y,SZ} = EG_{BL,y,SZ} \times EF_{CO_2,grid,y}$$

The parameters contained in the above equation and their values are listed in the following tables

$EG_{BL,y,SZ}$

Year	Amounts(MWh)

	01/09/2012 ~ 31/12/2012 | 2,801.9 01/01/2013 ~ 31/12/2013 | 8,311.2 01/01/2014 ~ 31/12/2014 | 8,216.7 01/01/2015 ~ 31/12/2015 | 8,122.2 01/01/2016 ~ 31/12/2016 | 8,027.7 01/01/2017 ~ 31/12/2017 | 7,933.2 01/01/2018 ~ 31/12/2018 | 7,838.7 01/01/2019 ~ 31/08/2019 | 5,162.1
$EF_{CO2,grid,y}$	0.9309 tCO_2/MWh

Therefore, the baseline emissions of Shenzhou Project are:

$BE_{y,SZ}$

Year	Amounts(tCO_2e)
01/09/2012 ~ 31/12/2012	2,608
01/01/2013 ~ 31/12/2013	7,737
01/01/2014 ~ 31/12/2014	7,649
01/01/2015 ~ 31/12/2015	7,561
01/01/2016 ~ 31/12/2016	7,473
01/01/2017 ~ 31/12/2017	7,385
01/01/2018 ~ 31/12/2018	7,297
01/01/2019 ~ 31/08/2019	4,805

b) Project emissions

Project emissions of the proposed bundled project are zero.

c) Leakage

Leakage emissions are zero.

d) Emission reductions

As described in section B6.1, the emission reductions ER_y of the project activity during a given year *y* is the difference between baseline emission (BE_y), project emissions (PE_y) and emission due to leakage (LE_y), as follows

GD Project:

$$ER_{y,GD} = BE_{y,GD} - PE_{y,GD} - LE_{y,GD}$$

Therefore, the emission reductions are:

$ER_{y,GD}$	Year	Amounts(tCO_2e)
	01/09/2012 ~ 31/12/2012	2,589
	01/01/2013 ~ 31/12/2013	7,719
	01/01/2014 ~ 31/12/2014	7,648
	01/01/2015 ~ 31/12/2015	7,577
	01/01/2016 ~ 31/12/2016	7,507
	01/01/2017 ~ 31/12/2017	7,437
	01/01/2018 ~ 31/12/2018	7,368
	01/01/2019 ~ 31/08/2019	4,874

Shenzhou Project:

$$ER_{y,SZ} = BE_{y,SZ} - PE_{y,SZ} - LE_{y,SZ}$$

$ER_{y,SZ}$	Year	Amounts(tCO_2e)
	01/09/2012 ~ 31/12/2012	2,608
	01/01/2013 ~ 31/12/2013	7,737
	01/01/2014 ~ 31/12/2014	7,649
	01/01/2015 ~ 31/12/2015	7,561
	01/01/2016 ~ 31/12/2016	7,473
	01/01/2017 ~ 31/12/2017	7,385
	01/01/2018 ~ 31/12/2018	7,297
	01/01/2019 ~ 31/08/2019	4,805

B.6.4 Summary of the ex-ante estimation of emission reductions:

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The proposed bundled project activity applies the renewable crediting period (7 years* 3) and the annually average emission reductions during the first crediting period are estimated as 15,033t CO_2e per year.

Table 13 Ex-ante estimation of emission reductions due to GD Project

Years	Estimation of baseline emissions ($BE_{y,GD}$) tCO_2e	Estimation of project activity emissions ($PE_{y,GD}$) tCO_2e	Estimation of leakage emissions ($LE_{y,GD}$) tCO_2e	Estimation of emission reductions ($ER_{y,GD}$) tCO_2e
01/09/2012 ~ 31/12/2012	2,589	0	0	2,589
01/01/2013 ~ 31/12/2013	7,719	0	0	7,719
01/01/2014 ~ 31/12/2014	7,648	0	0	7,648
01/01/2015 ~ 31/12/2015	7,577	0	0	7,577
01/01/2016 ~ 31/12/2016	7,507	0	0	7,507
01/01/2017 ~ 31/12/2017	7,437	0	0	7,437
01/01/2018 ~ 31/12/2018	7,368	0	0	7,368
01/01/2019 ~ 31/08/2019	4,874	0	0	4,874
Total (tonnes of CO_2e)	**52,718**	0	0	**52,718**

Table 14. Ex-ante estimation of emission reductions due to Shenzhou Project

Years	Estimation of baseline emissions ($BE_{y,SZ}$) tCO_2e	Estimation of project activity emissions ($PE_{y,SZ}$) tCO_2e	Estimation of leakage emissions ($LE_{y,SZ}$) tCO_2e	Estimation of emission reductions($ER_{y,SZ}$) tCO_2e
01/09/2012 ~ 31/12/2012	2,608	0	0	2,608
01/01/2013 ~ 31/12/2013	7,737	0	0	7,737
01/01/2014 ~ 31/12/2014	7,649	0	0	7,649
01/01/2015 ~ 31/12/2015	7,561	0	0	7,561
01/01/2016 ~ 31/12/2016	7,473	0	0	7,473
01/01/2017 ~ 31/12/2017	7,385	0	0	7,385
01/01/2018 ~ 31/12/2018	7,297	0	0	7,297
01/01/2019 ~ 31/08/2019	4,805	0	0	4,805
Total (tonnes of CO_2e)	**52,515**	0	0	**52,515**

Table 15. Ex-ante estimation of emission reductions due to the proposed bundled project

Years	Emission reduction of GD Project ($ER_{y,GD}$) tCO_2e	Emission reduction of Shenzhou Project ($ER_{y,SZ}$) tCO_2e	Estimation of emission reductions (ER_y) tCO_2e
01/09/2012 ~ 31/12/2012	2,589	2,608	5,197
01/01/2013 ~ 31/12/2013	7,719	7,737	15,456
01/01/2014 ~ 31/12/2014	7,648	7,649	15,296
01/01/2015 ~ 31/12/2015	7,577	7,561	15,138

01/01/2016 ~ 31/12/2016	7,507	7,473	14,980
01/01/2017 ~ 31/12/2017	7,437	7,385	14,822
01/01/2018 ~ 31/12/2018	7,368	7,297	14,665
01/01/2019 ~ 31/08/2019	4,874	4,805	9,680
Total (tonnes of CO_2e)	52,718	52,515	**105,234**
Annual average over the first crediting period (tonnes of CO_2e)	7,531	7,502	**15,033**

B.7 Application of a monitoring methodology and description of the monitoring plan:

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B.7.1 Data and parameters monitored:

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Data / Parameter:	$EG_{facility,y,GD}$
Data unit:	MWh/year
Description:	Net quantity of electricity supplied to the grid by the GD Project in year *y*
Source of data to be used:	On-site measurement by energy meter(s)
Value of data	Year / Amount(MWh): 01/09/2012 ~ 31/12/2012: 2,781.1 01/01/2013 ~ 31/12/2013: 8,291.9 01/01/2014 ~ 31/12/2014: 8,215.2 01/01/2015 ~ 31/12/2015: 8,139.2 01/01/2016 ~ 31/12/2016: 8,063.8 01/01/2017 ~ 31/12/2017: 7,989.2 01/01/2018 ~ 31/12/2018: 7,915.3 01/01/2019 ~ 31/08/2019: 5,236.1
Description of measurement methods and procedures to be applied:	$EG_{facility,y,GD} = EG_{output,y,GD} - EG_{input,y,GD}$
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{output,y,GD}$
Data unit:	MWh/year
Description:	Quantity of electricity supplied to the grid by the GD Project in year *y*

Source of data to be used:	On-site measurement by energy meter(s)
Value of data	N.A
Description of measurement methods and procedures to be applied:	$EG_{output,y,GD} = EG_{GEN,y,GD} - EG_{AUX,y,GD}$
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{GEN,y,GD}$
Data unit:	MWh/year
Description:	Quantity of electricity generated by GD Project in year *y*
Source of data to be used:	On-site measurement by energy meter(s)
Value of data	N.A
Description of measurement methods and procedures to be applied:	Monitored continuously, measured hourly and recorded monthly by the meter installed at the outlet of solar PV power generation equipments of GD Project.
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{AUX,y,GD}$
Data unit:	MWh/year
Description:	Quantity of electricity consumed by the auxiliary equipments in year *y*
Source of data to be used:	On-site measurement by energy meter(s)
Value of data	N.A.
Description of measurement methods and procedures to be applied:	Monitored continuously, measured hourly and recorded monthly by the meter installed at the inlet of the auxiliary equipments of GD Project.
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{input,y,GD}$
Data unit:	MWh
Description:	Amount of electricity purchased from the grid by GD Project in year *y*
Source of data to be used:	Assumed as zero in the PDD. Actual data will be obtained through on-site measurement.

Value of data	0
Description of measurement methods and procedures to be applied:	Monitored continuously, measured hourly and recorded monthly by the meter installed at the inlet of Yaoba110kV Substation.
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and calibration and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{facility,y,SZ}$
Data unit:	MWh/year
Description:	Net quantity of electricity supplied to the grid by the Shenzhou Project in year *y*
Source of data to be used:	On-site measurement by energy meter(s)
Value of data	Year / Amounts(MWh): 01/09/2012 ~ 31/12/2012: 2,801.9 01/01/2013 ~ 31/12/2013: 8,311.2 01/01/2014 ~ 31/12/2014: 8,216.7 01/01/2015 ~ 31/12/2015: 8,122.2 01/01/2016 ~ 31/12/2016: 8,027.7 01/01/2017 ~ 31/12/2017: 7,933.2 01/01/2018 ~ 31/12/2018: 7,838.7 01/01/2019 ~ 31/08/2019: 5,162.1
Description of measurement methods and procedures to be applied:	$EG_{facility,y,SZ} = EG_{output,y,SZ} - EG_{input,y,SZ}$
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{output,y,SZ}$
Data unit:	MWh/year
Description:	Quantity of electricity supplied to the grid by the Shenzhou Project in year *y*
Source of data to be used:	On-site measurement by energy meter(s)
Value of data	N.A.
Description of measurement methods and procedures to be applied:	Monitored continuously, measured hourly and recorded monthly by the meter installed at the inlet of Lianhua110kV Substation.

QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and testing to ensure accuracy.
Any comment:	-

Data / Parameter:	$EG_{input,y,SZ}$
Data unit:	MWh
Description:	Amount of electricity purchased from the grid by Shenzhou Project in year *y*
Source of data to be used:	Assumed as zero in the PDD. Actual data will be obtained through on-site measurement.
Value of data	0
Description of measurement methods and procedures to be applied:	Monitored continuously, measured hourly and recorded monthly by the meter installed at the inlet of Lianhua110kV Substation.
QA/QC procedures to be applied:	Meter(s) will be subject to regular maintenance and calibration and testing to ensure accuracy.
Any comment:	-

B.7.2 Description of the monitoring plan:

>>

This section details the steps taken to monitor on a regular basis the GHG emissions reductions from the bundled project.

The monitoring plan specifies the necessary methods and procedures to measure and record the variables and factors required by the applicable monitoring methodologies as tabulated in detail in above section B.7.1.

The project owner will be responsible for all monitoring activities, assuring that all activities are fully consistent with the monitoring plan.

The project owner will build a reliable monitoring system, including:

a) Monitoring System Organization Structure
b) Main Monitoring Data
c) Recording & Calibration QA/QC
d) In case of Emergency

a) Monitoring System Organization Structure

A CDM management team will be formed to manage all the CDM related business in the Project Activity. The General Manager of the Project Entity will be in charge of the overall management of the monitoring plan. The configuration of the CDM team is described in Figure 7.

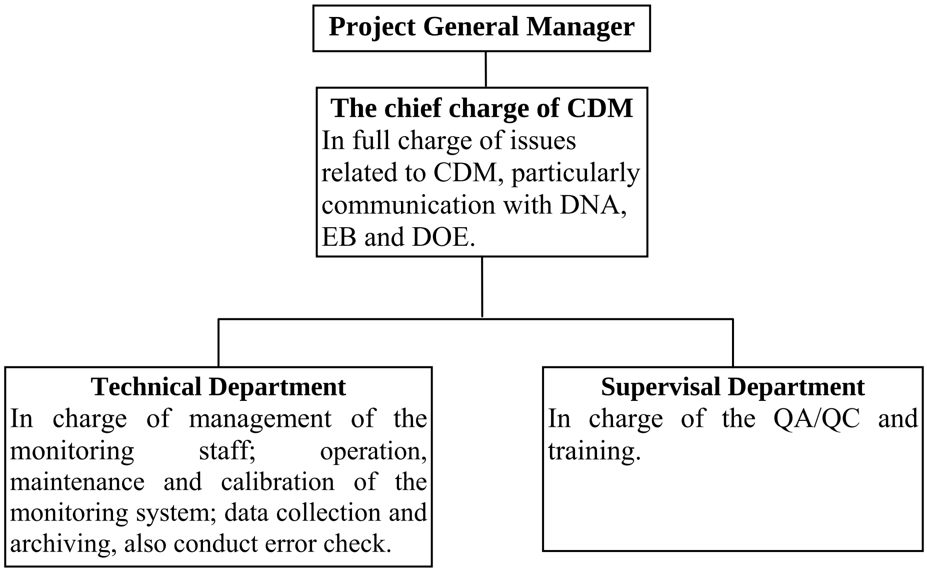

Figure 7. Configuration of the CDM Management Team

Both GD and Shenzhou Project apply the same configuration of the CDM management team. For all staff involved in the CDM project, a training plan will be developed to provide them with the skills necessary to conduct their work in a safe manner and ensure the successful operation of the project activity.

The CDM manager should ensure that only trained and skilled staff will work in the CDM project. Depending on task designation, the staff should attain a comprehensive knowledge with regard to the general and technical aspects of the project, as well as the basic understanding of CDM.

b) Main Monitoring Data

GD Project:

Electricity supplied to the grid by GD Project ($EG_{output,y,GD}$) cannot be monitored by the gate meter (M3) because GD Project shares one gate meter with another project – GD Phase II 10 MW Project. Therefore, the electricity supplied to the grid by GD Project ($EG_{output,y,GD}$) during the year y will be calculated by electricity generated by GD Project ($EG_{GEN,y,GD}$) and electricity consumed by the auxiliary equipments ($EG_{AUX,y,GD}$), as the equation below:

$$EG_{output,y,GD} = EG_{GEN,y,GD} - EG_{AUX,y,GD}$$

Electricity generated by GD Project ($EG_{GEN,y,GD}$) during the year y will be monitored continuously, measured hourly and recorded monthly by meter M1 installed at the outlet of solar PV power generation equipments of GD Project.

Electricity consumed by the auxiliary equipments ($EG_{AUX,y,GD}$) during the year y will be monitored continuously, measured hourly and recorded monthly by meter M2 installed at the inlet of the auxiliary equipments of GD Project, which measures the amount of electricity consumed by the solar plant itself.

Electricity import from the grid ($EG_{input,y,GD}$)

The total electricity import from the grid by GD Project ($EG_{input,y,GD}$) during the year y is the electricity purchased from the grid through Yaoba Substation, which will be monitored by meter M3. The total electricity import from the grid by GD Project may include electricity import by GD Phase II 10 MW Project. However, individual electricity import by GD project will not be calculated for conservative.

$EG_{input,y,GD}$ will be monitored continuously, measured hourly and recorded monthly by the meter M3 installed at the inlet of Yaoba 110kV Substation.

The net electricity supplied to the grid by GD Project during the year y ($EG_{facility,y,GD}$) is the difference between $EG_{output,y,GD}$ and $EG_{input,y,GD}$,

$EG_{BL,y,GD} = EG_{facility,y,GD}$

$EG_{facility,y,GD} = EG_{output,y,GD} - EG_{input,y,GD} = EG_{GEN,y,GD} - EG_{AUX,y,GD} - EG_{input,y,GD}$

The Figure 8 below demonstrates the monitoring points of GD project.

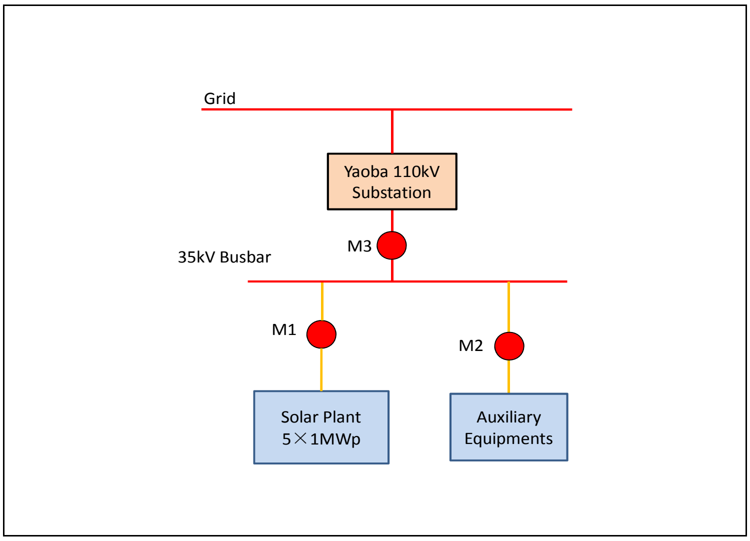

Figure 8 Monitoring diagram of GD Project

<u>Shenzhou Project:</u>

Net quantity of electricity supplied to the grid by Shenzhou Project ($EG_{facility,y,SZ}$)

$EG_{BL,y,SZ} = EG_{facility,y,SZ}$

The net quantity of electricity supplied to the grid by the Shenzhou Project ($EG_{facility,y,SZ}$) during the year will be monitored continuously, measured hourly and recorded monthly by meter M1. The electricity M1 is installed at the inlet point of Lianhua 110kV substation, which is a bidirectional meter which monitors the amount of electricity supplied to the grid and electricity imported from the grid by Shenzhou Project. The electricity meter M1 will record the $EG_{output,y,SZ}$ and $EG_{input,y,SZ}$.

$EG_{facility,y,SZ} = EG_{output,y,SZ} - EG_{input,y,SZ}$

The Figure 9 below demonstrates the monitoring points of Shenzhou project.

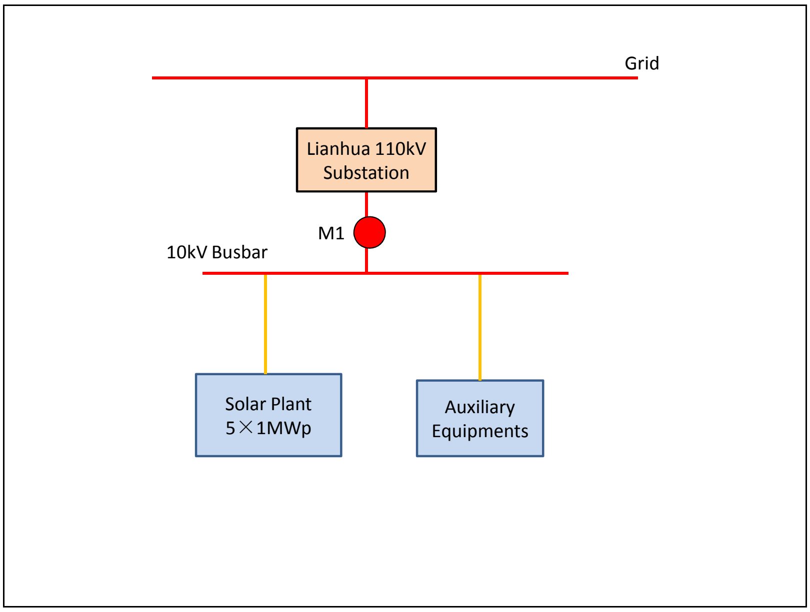

Figure 9 Monitoring diagram of Shenzhou Project

c) Recording & Calibration

The meters of GD and Shenzhou Project will be installed by respective project developer. Records of the meter (type, manufacture, model and calibration documentation) will be retained in the quality control system.

Further, the energy meters will be subject to periodical maintenance and calibration according to relevant national or industry standards. The measurement precision of the meters employed by the bundled project will be at least 0.5s. The meter(s) of the bundled project will be calibrated once per year. All the records should be documented and maintained by the bundled project owner for DOE's verification.

The GD and Shenzhou operators will take charge of data supervision respectively, including data collection, checking and archiving. Readings of all meters on site will be documented in paper worksheets. Additionally, all data collected will be recorded in electronic files and backups will be made regularly.

d) QA/QC

The bundled project entity will operate the project in accordance with the monitoring manual established by the relevant responsible persons. Periodic checks shall be conducted according to the relevant national standard. To assure the reliability the record and measurement results, the bundled project entity would implement measures in case of the following situations occur:

1) Any abnormal circumstances identified
2) Meter failure
3) Meter is repaired or replaced due to faults and calibration.

The operators on duty will dispose the situation in accordance with the monitoring manual, the professional workers will maintain the equipment and check the monitoring meters to assure data recorded is right.

e) In case of Emergency

In case of emergencies, the bundled project entity will claim emission reduction following the below processes：

1) In the event that a meter has lost calibration over the allowable error limit then this shall be corrected at the earliest opportunity and re-calibrated.

2) In the case that a meter is in calibration or out of work, the data will be monitored and measured by backup meter or determined according to a conservative scheme agreed by project owner and power supply company.

3) The head of the GD and Shenzhou power plant will both sign a statement declaring the emergency situation to have ended and normal operations to have resumed.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

The application of the baseline study and monitoring methodology of the Project was completed on 08/08/2012 by KOE Environmental Business, Inc.(Japan)
The persons/entity (ies) involved in baseline and monitoring study are:

Linda Zhang E-mail：zlx@cncdm.cn
Tracy Li Email: lm@cncdm.cn

KOE Environmental Business, Inc.(Japan)
Tel: +86 010 5830 1721
Fax: +86 010 5830 2353
Website: http://www.cncdm.cn

The entity is not project participants listed in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

10/11/2010 (the date when EPC Contract signed of GD Project)
25/11/2009 (the date when Equipment Purchase Contract signed of Shenzhou Project)

C.1.2. Expected operational lifetime of the project activity:

>>

25 yrs (GD Project)
25 yrs (Shenzhou Project)

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

01/09/2012

C.2.1.2. Length of the first crediting period:

>>

7 yrs

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Not applicable

C.2.2.2. Length:

>>

Not applicable

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

The Environmental Impact Assessment (EIA) report of GD Project was completed by Inner Mongolia Lvjie Environmental Protection Co., Ltd and approved by Environmental Protection Administration of Inner Mongolia Antonomous Region on Apr. 6th, 2010 (Document No.: NHB[2010]71). The Environmental Impact Assessment (EIA) report of Shenzhou Project was completed by State Environmental Protection Administration Nanjing Environmental Science Research Institute and approved by Environmental Protection Administration of Inner Mongolia Antonomous Region on Sep. 10th, 2008 (Document No.: NHS (B) [2008]242). In both EIA reports, the potential environmental impacts of the GD and Shenzhou project on the water and air quality as well as habitants' life etc are assessed. The main conclusion of the EIA reports is summarized as Table 16.

Table 16. Main conclusion of the EIA reports of GD and Shenzhou Project

Item	GD Project	Shenzhou Project
Air quality	During civil construction period, the construction will cause dust emission which will be greatly mitigated through the following measures: 1) Watering will be implemented timely on the construction site and transport roads. 2) The construction materials on the vehicles will be sealed by tarpaulins during transportation. 3) Strengthened management of material field, road hardening and building cement field will minimize dust emissions and secondary dust. After put into operation, the project will not produce exhaust gas pollution.	Due to the dry and windy climate in the solar PV power plant area, the construction will cause dust emission during civil construction period. Thus, the dust emission will be greatly mitigated through the following measures: 1) Watering will be implemented timely on the construction site and transport roads. 2) The vehicles will enter the construction site at low speed and the construction materials on the vehicles will be sealed by tarpaulins. 3) Strengthened management of material field, road hardening and building cement field will minimize dust emissions and secondary dust. After put into operation, the project will not produce exhaust gas pollution.
Water quality	The wastewater discharged during civil construction mainly includes construction sewage, machinery equipment washing water and domestic sewage, etc. All of the sewage will be discharged into drainage pipe network in the industrial park to prevent polluting the surrounding environment. After put into operation, the project will not produce exhaust gas pollution. After commissioning, the sewage mainly results from the workers' life. The sewage will be discharged into drainage	The waste water discharged during civil construction mainly includes construction sewage, machinery equipment washing water and domestic sewage, etc. All of the sewage will be discharged into the temporary sewage treatment plant to prevent polluting the surrounding environment. After commissioning the sewage mainly results from the workers' life. The amount of the sewage is small and doesn't contain specific pollution factors. The sewage will be collected and transported to sewage treatment

	pipe network and have no negative effect on the regional water environment.	plant in the development zone.
Noise	The noise during civil construction will originate from operating equipment and transportation vehicles. To reduce the impacts of noise, the construction time and interval will be controlled strictly. Moreover, the surrounding areas of the project site are all wastelands and there are no residents around. Thus, the construction noise will cause no effects on the surrounding environment as long as the construction is implemented reasonably. There is no noise during operation.	The noise during civil construction will originate from operating equipment and transportation vehicles. To reduce the impacts of noise, the construction time and interval will be controlled strictly. Moreover,the surrounding areas of the project site are all wastelands and there are no residents around. Thus, the construction noise will cause no effects on the surrounding environment as long as the construction is implemented reasonably. The noise during operation is mainly resulted from the operating equipment in the power plant. The impacts of the noise will decrease with the distance addition and hardly cause negative impacts on the surrounding environment.
Solid waste	During the civil construction period, the soil waste mainly results from construction rubbish and domestic refuse from workers. All the solid waste will be collected by the sanitation department for disposal. The municipal soil waste during operation will be collected by the sanitation sector for disposal.	During the civil construction period, the soil waste mainly results from construction rubbish and domestic refuse from workers. All the solid waste will be transported to designated sites for storage and disposal. The soil waste during operation mainly originates from the workers at the plant. The amount is small. All the rubbish will be transported to landfill site by the sanitation department regularly for disposal.
Ecological environment	During construction period, the foundation excavation, ground leveling and vehicle rolling will damage the surface vegetation and will cause temporary negative impact on the ecological environment. Therefore, the construction will be controlled strictly to mitigate the destruction on the surrounding ecological environment. After the completion of the civil construction, the land greening will be carried out in the plant site so as to improve the regional ecological environment.	During construction period, the foundation excavation, ground levelling and vehicle rolling will damage the surface vegetation and will cause negative impact on the ecological environment. Therefore, the construction will be deployed in sub area and sub section. Besides, covering and enclosure measures will be adopted with the temporary storage yard to prevent the soil and water loss resulting from strong wind and rain and mitigate the destruction on the surrounding ecological environment. After the completion of the civil construction, the land greening will be carried out in the plant site to improve the regional ecological environment.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

As discussed in above section, the environmental impacts of the proposed bundled project are not considered significant by the competent authorities of the host Party. Utilizing solar energy through photovoltaic for electricity generation is an effective approach to reduce local environmental pollution as well as to provide clean energy.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The project owners of GD Project and Shenzhou Project respectively carried out a questionnaire survey on the workers and local residents to collect comments if any about the project activity (GD Project in October 2010 and Shenzhou Project in November 2009), and the notice had been published for collecting comments from local residents. Comments received from the survey are summarized as follows.

The questionnaire mainly concerns issues as follows:
1) The brief introduction of the project;
2) Basic information of the local people surveyed;
3) Knowing about the project;
4) Whether support the construction of the project;
5) The positive and negative impact caused by the construction and operation of the project.

E.2. Summary of the comments received:

>>

Totally 2*50 questionnaires returned out of 2*50 with 100% response rate. The basic structure of the respondents is illustrated in Table 17 and Table 18.

Table 18. GD Project Statistics on the basic conditions of people surveyed

Structure of gender			Structure of educational background			Structure of age		
gender	**population**	**share**	**Educational background**	**population**	**share**	**age**	**population**	**share**
Male	36	72%	Junior college and below	10	20%	20~30	12	24%
Female	14	28%	Senior high school and above	40	80%	31~40	21	42%
						41~60	17	34%

Table 19. Shenzhou Project Statistics on the basic conditions of people surveyed

Structure of gender			Structure of educational background			Structure of age		
gender	**population**	**share**	**Educational background**	**population**	**share**	**age**	**population**	**share**
Male	35	70%	Junior college and below	10	20%	20~30	13	26%
Female	15	30%	Senior high school and above	40	80%	31~40	19	38%
						41~60	18	36%

As shown in Table 18 and Table 19, people surveyed are representative of the public in terms of gender, age and educational background. Therefore their attitudes towards the project can be a comprehensive reflection of the attitudes of the local residents possibly affected by the project.

Among the 50 respondents, the statistics of ***GD Project*** is as follow:

49 respondents (accounting for 98%) have a clear understanding of the basic information of the GD Project. 43 respondents (accounting for 96%) hold a supportive attitude towards the GD Project, which was considered to alleviate environmental pollution (68%), increase income (38%), decrease electricity purchase price (10%) and provide employment opportunity (60%).

48 respondents (accounting for 96%) considered that there is no negative environment effect and 2 respondents (accounting for 4%) supposed it was necessary to take into account noise of the GD Project

Among the 50 respondents, the statistics of ***Shenzhou Project*** is as follow:

50 respondents (accounting for 100%) have a clear understanding of the basic information of the Shenzhou Project. All the respondents (accounting for 100%) hold a supportive attitude towards the Shenzhou Project, which was considered to alleviate environmental pollution (94%), increase income (76%), decrease electricity purchase price (18%) and provide employment opportunity (82%).

48 respondents (accounting for 96%) considered that there is no negative environment effect and 2 respondents (accounting for 6%) supposed it may result in land occupation inShenzhou Project

The survey shows that most of the residents at both the project sites consider that construction of the projects will benefit the local economic development, but they still have some concerns about the noise possibly caused by the projects. The project owners has given adequate consideration to light pollution control and taken appropriate measures.

E.3. Report on how due account was taken of any comments received:

>>

The project owner has taken full consideration of relevant comments and suggestions from stakeholders in the process of project construction. People and local government are all very supportive of the Project therefore it is not necessary to modify the Project due to the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Mobile:	-
Direct FAX:	-
Direct tel:	-
Personal E-Mail:	-

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds from Annex 1 country are involved in the proposed project.

Annex 3

BASELINE INFORMATION

The baseline information for calculation of OM, BM and CM emission factor of the North China Power Grid is shown in the Report on Determination of Baseline Grid Emission Factor by China DNA NDRC at http://cdm.ccchina.gov.cn. The concrete process is shown in the following tables.

Table A1 Fuel consumption and emission of the North China Power Grid in 2006

Fuels	Units	Bei jing	Tian jin	He bei	Shanxi	Inner Mongolia	Shan dong	Total	Carbon Content (tC/TJ)	OXID (%)	Emission factor ($kgCO_2$/TJ)	NCV ($MJ/t,m^3$)	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K	L=G×J×K/100000 (quality unit) L=G×J×K/10000 (volume unit)
Raw coal	10^4 ton	796.63	1639.2	6867.9	6968.88	8404.05	10930.66	**35607.41**	25.8	100	87,300	20,908	649,930,803
Washed coal	10^4 ton						39.77	**39.77**	25.8	100	87,300	26,344	914,643
Other washed coal	10^4 ton	6.36		214.13	371.14	61.77	544.6	**1198**	25.8	100	87,300	8,363	8,746,477
Moulded Coal	10^4 ton	7.97					27.77	**35.74**	26.6	100	87,300	20,908	652,351
Coke	10^4 ton						3.23	**3.23**	29.2	100	95,700	28,435	87,896
Coke oven gas	10^8 m^3	0.38	0.63	5.8	22.32	0.64	5.79	**35.56**	12.1	100	37,300	16,726	2,218,517
Other gas	10^8 m^3	20.66	6.58	69.72	13.79	22.76	7.22	**140.73**	12.1	100	37,300	5,227	2,743,772
Crude oil	10^4 ton					0.74		**0.74**	20	100	71,100	41,816	22,001
Gasoline	10^4 ton			0.01				**0.01**	18.9	100	67,500	43,070	291
Diesel	10^4 ton	0.21		3.01		0.07	6.32	**9.61**	20.2	100	72,600	42,652	297,577
Fuel oil	10^4 ton	6.38		0.08			4.1	**10.56**	21.1	100	75,500	41,816	333,391
LPG	10^4 ton						0.01	**0.01**	17.2	100	61,600	50,179	309
Refinery gas	10^4 ton			2.43			2.32	**4.75**	15.7	100	48,200	46,055	105,443
Natural gas	10^8 m^3	3.41	0.73		0.53			**4.67**	15.3	100	54,300	38,931	987,216
Other petroleum	10^4 ton						0.28	**0.28**	20	100	75,500	41,816	8,454
Other coking products	10^4 ton							**0**	25.8	100	95,700	28,435	0
Other energy	10^4 ton	6.83		47.11	230.76	12.51	132.29	**429.5**	0	0	0	0	0
Total													**667,049,139**
Data source: *China Energy Statistical Yearbook 2007*													

Table A2 The fuel fired electricity generation and calculation of emission factor of the North China Power Grid in 2006

Province	The fuel fired electricity generation(MWh)	The rate of electricity self-consumption(%)	The fuel fired electricity connected to the grid(MWh)	Electricity importation from Northeast China Power Grid (MWh)	2,618,060
Beijing	20,705,000	7.51	19,150,055	Emission factor of the Northeast China Power Grid (tCO_2e/MWh)	**1.14972**
Tianjin	35,924,000	6.86	33,459,614	Electricity importation from Central China Power Grid (MWh)	**497,060**
Hebei	143,888,000	6.63	134,348,226	Emission factor of the Central China Power Grid (tCO_2e/MWh)	**1.12157**
Shanxi	150,250,000	7.45	139,056,375		
Inner Mongolia	139,593,000	7.58	129,011,851	Total CO_2 emission(tCO_2e)	**670,616,651**
Shandong	230,922,000	7.12	214,480,354	The total fuel fired electricity connected to the grid(MWh)	**672,621,593**
The Total			**669,506,473**	$EF_{simple,OM,2006}$ (tCO_2e /MWh)	**0.99702**
Data Source: *China Energy Statistical Yearbook 2007; China Electric Power Yearbook 2007*					

Table A3 Calculation of simple OM emission factor of the North China Power Grid in 2007

Fuels	Units	Bei jing	Tian jin	He bei	Shanxi	Inner Mongolia	Shan dong	Total	Carbon Content (tC/TJ)	OXID (%)	Emission factor ($kgCO_2/TJ$)	NCV ($MJ/t,m^3$)	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K	L=G×J×K/100000 (quality unit) L=G×J×K/10000 (volume unit)
Raw coal	10^4 ton	816.17	1753.9	7716.1	7510.06	10434.25	11884.8	**40115.43**	25.8	100	87,300	20,908	732,214,267
Washed coal	10^4 ton						18.43	**18.43**	25.8	100	87,300	26,344	423,859
Other washed coal	10^4 ton	5.76		156.89	478.81	48.57	756.84	**1446.87**	25.8	100	87,300	8,363	10,563,452
Moulded Coal	10^4 ton	7.93					42.86	**50.79**	26.6	100	87,300	20,908	927,054
Coke	10^4 ton			0.02			4.09	**4.11**	29.2	100	95,700	28,435	111,843
Coke oven gas	10^8 m^3	0.07	0.72	3.13	25.46	2.58	13.61	**45.57**	12.1	100	37,300	16,726	2,843,020
Other gas	10^8 m^3	11.8	7.6	88.38	72.8	28.17	29.64	**238.39**	12.1	100	37,300	5,227	4,647,821
Crude oil	10^4 ton							**0**	20	100	71,100	41,816	0
Gasoline	10^4 ton			0.01				**0.01**	18.9	100	67,500	43,070	291
Diesel	10^4 ton	0.33		2.35		0.62	5.08	**8.38**	20.2	100	72,600	42,652	259,490
Fuel oil	10^4 ton	4.74		0.18			2.35	**7.27**	21.1	100	75,500	41,816	229,522
LPG	10^4 ton							**0**	17.2	100	61,600	50,179	0
Refinery gas	10^4 ton	0.06		2.85			1.65	**4.56**	15.7	100	48,200	46,055	101,225
Natural gas	10^8 m^3	5.03	0.73		0.54	4.22	0.01	**10.53**	15.3	100	54,300	38,931	2,225,993
Other petroleum	10^4 ton	1.72						**1.72**	20	100	75,500	41,816	51,929
Other coking products	10^4 ton	4.74						**4.74**	25.8	100	95,700	28,435	128,986
Other energy	10^4 ton	11.94		77.25	360.26	30.75	163.48	**643.68**	0	0	0	0	0
Total													**754,728,750**
Data source: *China Energy Statistical Yearbook 2008*													

Table A4 The fuel fired electricity generation and calculation of emission factor of the North China Power Grid in 2007

Province	The fuel fired electricity generation(MWh)	The rate of electricity self-consumption(%)	The fuel fired electricity connected to the grid(MWh)	Electricity importation from Northeast China Power Grid (MWh)	1,789,750
Beijing	22,300,000	7.51	20,625,270	Emission factor of the Northeast China Power Grid (tCO_2e/MWh)	**1.08186**
Tianjin	39,900,000	6.53	37,294,530	Electricity importation from Central China Power Grid (MWh)	**803,000**
Hebei	163,300,000	6.67	152,407,890	Emission factor of the Central China Power Grid (tCO_2e/MWh)	**1.10197**
Shanxi	173,400,000	7.99	159,545,340	Total CO_2 emission(tCO_2e)	**757,549,895**
Inner Mongolia	180,100,000	7.77	166,106,230	The total fuel fired electricity connected to the grid(MWh)	**778,939,080**
Shandong	259,100,000	7.23	240,367,070	$EF_{simple,OM,2004}$（tCO_2e /MWh）	**0.97254**
The Total			**776,346,330**		

Data source: *China Electric Power Yearbook 2008*

Table A5 Calculation of simple OM emission factor of the North China Power Grid in 2008

Fuels	Units	Bei jing	Tian jin	He bei	Shanxi	Inner Mongolia	Shan dong	Total	Carbon Content (tC/TJ)	OXID (%)	Emission factor ($kgCO_2/TJ$)	NCV (MJ/t,m3)	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+B+C +D+E+F	H	I	J	K	L=G×J×K/100000 (quality unit) L=G×J×K/10000 (volume unit)
Raw coal	10^4 ton	755.75	1800.1	7353.3	7854.39	12607.82	12360.75	**42732.16**	25.8	100	87,300	20,908	779,976,613
Washed coal	10^4 ton						23.88	**23.88**	25.8	100	87,300	26,344	549,200
Other washed coal	10^4 ton	5.05		134.52	582.39	66.2	691.21	**1479.37**	25.8	100	87,300	8,363	10,800,731
Moulded	10^4 ton	5.66			32.49		45.38	**83.53**	26.6	100	87,300	20,908	1,524,647
Coke	10^4 ton			0.02			6.07	**6.09**	29.2	100	95,700	28,435	165,723
Coke oven gas	10^8 m^3	0.11	0.86	8.37	24.55	3.55	16.2	**53.64**	12.1	100	37,300	16,726	3,346,491
Other gas	10^8 m^3	10.4	9.08	187.54	36	34.32	29.76	**307.1**	12.1	100	37,300	5,227	5,987,440
Crude oil	10^4 ton					0.02		**0.02**	20	100	71,100	41,816	595
Gasoline	10^4 ton							**0**	18.9	100	67,500	43,070	0
Diesel	10^4 ton	0.15		3.08		0.35		**3.58**	20.2	100	72,600	42,652	110,856
Fuel oil	10^4 ton	2.56		0.25				**2.81**	21.1	100	75,500	41,816	88,715
LPG	10^4 ton							**0**	17.2	100	61,600	50,179	0
Refinery gas	10^4 ton	0.44		2.93				**3.37**	15.7	100	48,200	46,055	74,809
Natural gas	10^8 m^3	11.09	0.7		0.97	2.12		**14.88**	15.3	100	54,300	38,931	3,145,563
Other petroleum	10^4 ton	1.45						**1.45**	20	100	72,200	41,816	43,777
Other coking products	10^4 ton	7.97		7.61				**15.58**	25.8	100	95,700	28,435	423,968
Other energy	10^4 ton	4.9	2.34	61.02	466	63.72	141.71	**739.69**	0	0	0	0	0
Total													**806,239,126**
Data source: *China Energy Statistical Yearbook 2009*													

Table A6 The fuel fired electricity generation and calculation of emission factor of the North China Power Grid in 2008

Province	The fuel fired electricity generation(MWh)	The rate of electricity self-consumption(%)	The fuel fired electricity connected to the grid(MWh)		
Beijing	24,300,000	7.14	22,564,980	Electricity importation from Northeast China Power Grid (MWh)	**5,286,140**
Tianjin	39,700,000	7.05	36,901,150	Emission factor of the Northeast China Power Grid (tCO_2e/MWh)	**1.10489**
Hebei	158,000,000	6.9	147,098,000		
Shanxi	176,200,000	8.22	161,716,360	Total CO_2 emission(tCO_2e)	**812,079,707**
Inner Mongolia	200,800,000	7.96	184,816,320	The total fuel fired electricity connected to the grid(MWh)	**808,083,490**
Shandong	268,900,000	7.14	249,700,540	$EF_{simple,OM,2008}$ (tCO_2e /MWh)	**1.00495**
The Total			**802,797,350**		
Data source: *China Electric Power Yearbook 2009*					

TableA7 The three years generation weighted average emission factor of the North China Power Grid

Years	**2006**	**2007**	**2008**
Total CO_2 emission(tCO_2e)	670,616,651	757,549,895	812,079,707
The total fuel fired electricity connected to the grid(MWh)	672,621,593	778,939,080	808,083,490
OM=0.9914tCO_2e/MWh			

Table A8 Calculation the weight of CO_2 emissions from solid fuels, liquid fuels and gas fuels among the total emissions in North China Power Grid

Fuels	Units	Beijing	Tianjin	Hebei	Shanxi	Shandong	Inner Mongolia	Total	NCV (kJ/kg or m^3)	Emission factor	OXID (%)	CO_2 emissions (tCO_2e) **K=G×H×I×J /100,000**
		A	B	C	D	E	F	G=A+B+C +D+E+F	H	I	J	K
Raw coal	10^4t	755.75	1,800.12	7,353.33	7,854.39	12,360.75	12,607.82	42,732.16	20,908	87,300	1	779,976,613
Washed coal	10^4t	0	0	0	0	23.88	0	23.88	26,344	87,300	1	549,200
Other washed coal	10^4t	5.05	0	134.52	582.39	691.21	66.2	1,479.37	8,363	87,300	1	10,800,731
Mould coal	10^4t	5.66	0	0	32.49	45.38	0	83.53	20,908	87,300	1	1,524,647
Coke	10^4t	0	0	0.02	0	6.07	0	6.09	28,435	95,700	1	165,723
Other coking products	10^4t	7.97	0	7.61	0	0	0	15.58	28,435	95,700	1	423,968
Total of solid fuels												**793,440,881**
Crude oil	10^4t	0	0	0	0	0	0.02	0.02	41,816	71,100	1	595
Gasoline	10^4t	0	0	0	0	0	0	0	43,070	67,500	1	0
Diesel	10^4t	0.15	0	3.08	0	0	0.35	3.58	42,652	72,600	1	110,856
Fuel oil	10^4t	2.56	0	0.25	0	0	0	2.81	41,816	75,500	1	88,715
Other petroleum products	10^4t	1.45	0	0	0	0	0	1.45	41,816	72,200	1	43,777
Total of liquid fuels												**243,942**
Natural gas	10^8m^3	110.9	7	0	9.7	0	21.2	148.8	38,931	54,300	1	3,145,563
Coke oven gas	10^8m^3	1.1	8.6	83.7	245.5	162	35.5	536.4	16,726	37,300	1	3,346,491
Other gas	10^8m^3	104	90.8	1875.4	360	297.6	343.2	3,071	5,227	37,300	1	5,987,440
LPG	10^4t	0	0	0	0	0	0	0	50,179	61,600	1	0
Refinery gas	10^4t	0.44	0	2.93	0	0	0	3.37	46,055	48,200	1	74,809
Total of gas fuels												**12,554,302**
Total of all fuels												**806,239,126**

Data source: *China Energy Statistical Yearbook 2009*

Table A9 The emission factor of the most efficient commercial coal-fueled, oil-fueled and gas-fueled power plant

	Variable	Efficiency of electricity supply	Emission factor of the fuels(tC/TJ)	OXID	Emission factor (tCO_2e/MWh)
		A	B	C	D=3.6/A/10000*B*C
Coal-fueled power plant	$EF_{Coal,Adv}$	39.08	87,300	1	0.8042
Oil-fueled power plant	$EF_{Oil,Adv}$	51.46	75,500	1	0.5282
Gas-fueled power plant	$EF_{Oil,Adv}$	51.46	54,300	1	0.3799

TableA10 the weight of CO_2 emission from solid, liquid and gas fuels among the total emissions and the thermal emission factor of NCPG

$\lambda_{Coal,y}$	$\lambda_{Oil,y}$	$\lambda_{Gas,y}$	$EF_{EL,fossil,Adv,y}(tCO_2e/MWh)$ $(\lambda_{Coal,y} * EF_{Coal,Adv} + \lambda_{Oil,y} * EF_{Oil,Adv} + \lambda_{Gas,y} * EF_{Gas,Adv})$
98.41%	*0.03%*	*1.56%*	**0.7975**

Table A11 Calculation of BM emission factor of the North China Power Grid

	2006 installed capacity	***2007 installed capacity***	***2008 installed capacity***	***Newly added installed capacity between 2006 and 2008***	***Newly added installed capacity between 2007 and 2008***	***Weight in newly added installed capacity***
	A	*B*	*C*	*D=C-A*	*E=C-B*	*F*
Fossil fueled(MW)	*141,538*	*164,800*	*179,040*	*46,111*	*17,847*	*93.98%*
Hydro power(MW)	*4,004*	*4,510*	*5,260*	*520*	*9*	*1.06%*
Nuclear power(MW)	*0*	*0*	*0*	*0*	*0*	*0.00%*
Wind power(MW)	*937*	*1,719.2*	*3,370*	*2,433*	*1,651*	*4.96%*
Total(MW)	***146,479***	***171,029.2***	***187,660***	***49,064***	***19,508***	***100.00%***
Share in 2008 installed capacity				*26.15%*	*10.40%*	
BM=0.7975*93.98%=0.7495 tCO_2e/MWh						

$CM = 0.75 \times OM + 0.25 \times BM = 0.75 \times 0.9914 + 0.25 \times 0.7495 = 0.9309 tCO_2e/MWh$

Annex 4

MONITORING INFORMATION

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