

Monitoring Report

**Xiaoshan Power Plant's NG Power Generation Project of
Zhejiang Southeast Electric Power Co., Ltd.**

(CDM Registration Reference No.1343)

Version 02

Monitoring Periods: 1st Period: 28 June 2007 to 25 March 2008

Date of Report: September 16, 2008

1. Introduction

The purpose of this monitoring report is to calculate the emission reductions achieved by the Xiaoshan Power Plant's NG Power Generation Project of Zhejiang Southeast Electric Power Co., Ltd. (the "Project", or the "proposed project") in the period covered by this report, and to serve as the basis for the verification of these reductions.

The present monitoring periods is chosen from 28 June 2007 (the date of the project connect to the Grid) to 25 March 2008 (before the starting date of the first crediting period).

2. General Description of the Project

2.1 Project background

The Project has been registered as CDM project by the UNFCCC on 26 March 2008 under reference number 1343, which is under the Category 1: Energy Industries (renewable / non renewable sources) as per list of Sectoral Scopes.

Approved baseline methodology AM0029, "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas", has been applied for the Project activity.

The proposed project is located in Xiaoshan District, Hangzhou City, Zhejiang Province of China, and it is built as a grid-connected electricity generation plant using natural gas (NG) as fuel and without other auxiliary fuels.

The proposed project installed two sets of gas-steam combined cycle for power generation units with the total rated output of 806 MW. The generated electricity will be sold into the Zhejiang Grid, a sub-grid of an independent regional grid- East China Grid (ECG).

The Project using natural gas as a fuel to generate clean power, and will achieve greenhouse gas (GHG) emission reductions by avoiding CO₂ emission from the business-as-usual scenario electricity generation of those coal-fired power plants connected into the ECG. Moreover, the Project will assist China in stimulating and accelerating the commercialization of NGCC technologies and markets.

2.2 Technology employed by the Project

The selected technology for the Project is from the Germany manufacturer of Siemens V94.3A system, which includes following main equipments:

- Siemens make V94.3A type gas turbine;
- Heat recovery steam generator – NG-V94.3A-R, supplied by Hangzhou Heat Recovery Boiler Plant;
- Steam turbine, supplied by Siemens, H30-25-25,E30-25-2-1×10;
- Electricity generator (capacity 403MW), THDF108/53, supplied by Siemens.

3 Monitoring Methodology and Plan

3.1 Methodology

The approved monitoring methodology AM0029 (version 01, 19 May 2006) "Grid Connected Electricity Generation Plants using Non-Renewable and Less GHG Intensive Fuel" is used for the Project.

The Project owner would establish the CDM administration group to ensure the monitoring plan implement efficiently.

3.2 Calculations of Emission Reductions

The Project emissions reduction was calculated according to the approved methodology AM0029. The procedures used for calculating these emissions are described below:

Project emission

The Project activity is on-site combustion of natural gas to generate electricity and without auxiliary fuels in project operation. The CO₂ emissions from electricity generation (PE_y) are calculated as follows:

$$PE_y = \sum_f FC_{f,y} \times COEF_{f,y} \quad (1)$$

Where:

FC_{f, y}: is the total volume of natural gas combusted in the Project plant in year(s) 'y'

COEF_{f, y}: is the CO₂ emission coefficient (tCO₂/m₃ or similar) in year(s) for natural gas and is obtained as:

$$COEF_{f,y} = \sum NCV_y \times EF_{CO_2,f,y} \times OXID_f \quad (2)$$

Where:

NCV_{f, y}: is the net calorific value (energy content) per volume unit of natural gas in year 'y' (GJ/m³) as determined from the fuel supplier;

EF_{CO₂, f, y}: is the CO₂ emission factor per unit of energy of natural gas in year 'y' (tCO₂/GJ) as determined from the fuel supplier, wherever possible, otherwise from local or national data;

OXID_f: is the oxidation factor of natural gas.

Baseline emission calculation

Baseline emissions are calculated by multiplying the electricity generated in the project plant (EG_{PJ,y}) with a baseline CO₂ emission factor (EF_{BL,CO₂,y}), as follows:

$$BE_y = EG_{PJ,y} \times EF_{BL,CO_2,y} \quad (3)$$

Which EG_{PJ,y} is electricity generation in the project plant during the year in MWh.

According to the methodology AM0029, the Baseline emission factor is chosen as the minimum of the following three options:

Option 1: The build margin, calculated according to ACM0002; and

Option 2: The combined margin, calculated according to ACM0002, using a 50/50 OM/BM weight.

Option 3: The emission factor of the technology (and fuel) identified as the most likely baseline scenario under "Identification of the baseline scenario" above, and calculated as follows:

$$EF_{BL,CO_2,y}(tco2 / Mwh) = \frac{COEF_{BL}}{\eta_{BL}} \times 3.6GJ / MWh \quad (4)$$

COEF_{BL} = the fuel emission coefficient (tCO₂e/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used;

η_{BL} = the energy efficiency of the technology, as estimated in the baseline scenario analysis.

Option 1 & Option 2:

Due to the fact that the data required to calculate the emission factor for the year y is usually only available 18 months after the end of the year y, so in this monitoring report, emission factor of the year 2007 proceeding the previous year 2005 will be used according to the "Tool to

calculate the emission factor for an electricity system". Based on the same reason, the emission factor of the year 2008 proceeding the previous year 2006 will be used in this monitoring report.

It applies the public available data information provided by the Chinese DNA to calculate $EF_{OM,y}$ and $EF_{BM,y}$ of the ECG.

Option 1: Calculate the Build Margin Emission Factor ($EF_{BM,y}$)

The build margin emission factor of the ECG was calculated according the data of year 2005 and year 2006 is as following (More information about BM_{2007} and BM_{2008} calculation please refers to Annex 1):

Option1	Baseline CO ₂ emission factor (tCO ₂ e/MWh)
BM_{2007}	0.8672
BM_{2008}	0.8154

Option 2: Calculate the Combined Margin Emission Factor ($EF_{CM,y}$)

Step a. Calculate the Operating Margin Emission Factor ($EF_{OM,y}$)

The operation margin emission factor of the ECG was calculated according the data of year 2005 and year 2006 is as following (More information about $EF_{OM,2007}$ and $EF_{OM,2008}$ calculation please refers to Annex 2):

Operating Margin Emission Factor (tCO ₂ e/MWh)	
$EF_{OM,2007}$	0.9421
$EF_{OM,2008}$	0.9540

Step b. Calculate the Combined Margin Emission Factor ($EF_{CM,y}$)

The Combined Margin Emission Factor ($EF_{CM,y}$) was calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$), where the weights w_{OM} and w_{BM} are 50% (i.e., $w_{OM} = w_{BM} = 0.5$).

Operating Margin Emission Factor (tCO ₂ e/MWh)	
$EF_{CM,2007}$	0.9046
$EF_{CM,2008}$	0.8847

Option 3: The emission factor of the technology (and fuel) identified as the most likely baseline scenario, and calculated as follows:

$$EF_{BL,CO_2,y}(tCO_2 / Mwh) = \frac{COEF_{BL}}{\eta_{BL}} \times 3.6GJ / MWh$$

Where,

$COEF_{BL}$ = the fuel emission coefficient (tCO₂e/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used; in this report, the $COEF_{BL}$ is IPCC defaults, about 25.8tC/TJ.

η_{BL} = the energy efficiency of the technology, as estimated in the baseline scenario analysis above.

Base on the registered PDD of the proposed project, the most likely baseline scenario is to build

a new 600MW sub-critical coal-fired power plant.

According to the Baseline Emission Factor of China Grids issued by Chinese DNA, for the 600MW sub-critical coal-fired power plant, the most efficiency level of the best technology commercially available in the year of 2005 is 343.33gce/kWh, while the corresponding efficiency of the power supply is 35.83%.

For the year of 2006, in China the efficiency level of the 600MW sub-critical coal-fired power plant is 37.28% (corresponding the fuel consumption is 329.94 gce/kWh).

Based on these data available, the $EF_{BL,CO_2,y}$ is calculated as follows:

Operating Margin Emission Factor (tCO ₂ e/MWh)	
$EF_{BL,CO_2,2007}$	0.9506
$EF_{BL,CO_2,2008}$	0.9135

The baseline CO₂ emission factor was calculated according the options mentioned above is as following:

Option	Baseline CO ₂ Emission Factor (tCO ₂ e/MWh)	
	For the Year of 2007	For the Year of 2008
Option 1	0.8672	0.8154
Option 2	0.9046	0.8847
Option 3	0.9506	0.9135

According to AM0029, the Project shall use the lowest $EF_{BL, CO_2, y}$ among these three Options, thus the Option 1 is selected as the $EF_{BL,CO_2,y}$ with the lowest volume of 0.8672 tCO₂e/MWh for the year of 2007; and 0.8154 CO₂e/MWh for the year of 2008.

Leakage

Leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the Project boundary. This includes mainly fugitive CH₄ emissions and CO₂ emissions from associated fuel combustion and flaring. In the methodology AM0029, the leakage emission was calculated as follows:

$$LE_y = LE_{CH_4,y} + LE_{LNG,CO_2,y} \quad (5)$$

Where:

LE_y : Leakage emissions during the year y in tCO₂e

$LE_{CH_4, y}$: Leakage emissions due to fugitive upstream CH₄ emissions in the year y in t CO₂e

$LE_{LNG, CO_2, y}$: Leakage emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y in t CO₂e

In this report, only take fugitive upstream CH₄ emissions ($LE_{CH_4, y}$: Leakage) into account due to this project used NG as fuel, i.e. $LE_y = LE_{CH_4,y}$.

According to AM0029, for the purpose of estimating fugitive CH₄ emissions, the Project participants should multiply the quantity of natural gas consumed by the Project in year y with an

emission factor for fugitive CH₄ emissions (EF_{NG, upstream, CH₄}) from natural gas consumption and subtract the emissions occurring from fossil fuels used in the absence of the Project activity, as follows:

$$LE_{CH_4,y} = (FC_y \times NCV_y \times EF_{NG,upstream,CH_4} - EG_{PJ,y} \times EF_{BL,upstream,CH_4}) \times GWP_{CH_4} \quad (6)$$

FC_y : Quantity of natural gas combusted in the Project plant during the year y in m³;

$NCV_{NG,y}$: Average net calorific value of the natural gas combusted during the year y in GJ/m³;

$EF_{NG,upstream,y}$: Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, and, in the case of LNG, liquefaction, transportation, re-gasification and compression into a transmission or distribution system, in t CH₄ per GJ fuel supplied to final consumers;

$EG_{PJ,y}$: Electricity generation in the Project plant during the year in MWh;

GWP_{CH_4} : Global warming potential of methane valid for the relevant commitment period

$EF_{BL,upstream,CH_4}$: Emission factor for upstream fugitive methane emissions occurring in the absence of the Project activity in t CH₄ per MWh electricity generation in the Project plant, as defined below;

The emission factor for upstream fugitive CH₄ emissions occurring in the absence of the Project activity ($EF_{BL,upstream,CH_4}$) should be calculated consistent with the baseline emission factor (EF_{BL,CO_2}) used in step 2, so the $EF_{BL,upstream,CH_4}$ in this PDD was calculated as follows:

$$EF_{BL,upstream,CH_4} = \frac{\sum_j FF_{j,k} \times EF_{k,upstream,CH_4}}{\sum_j EG_j} \quad (7)$$

Where:

j: Plants included in the build margin;

$FF_{j,k}$: Quantity of fuel type k (a coal or oil type) combusted in power plant j included in the build margin;

$EF_{k,upstream,CH_4}$: Emission factor for upstream fugitive methane emissions from production of the fuel type k (a coal or oil type) in t CH₄ per MJ fuel produced;

EG_j : Electricity generation in the plant j included in the build margin in MWh/a.

Based on the calculation method of BM in Annex 1, the formula (7) could be converted to:

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{fossil,upstream,CH_4}$$

$$EF_{fossil,upstream,CH_4} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv}$$

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times (\lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv})$$

The above formula can be simplified as follows, and it is more conservative,

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times \lambda_{Coal} \times EF_{Coal,Adv}$$

$$EF_{Coal,Adv} = SCC \times \frac{NCV_{standard,coal}}{NCV_{Rawcoal}} \times EF_{coal,upstream,CH4}$$

Where:

CAP_{Total} is the total change in installed capacity of the Grid (MW), for more information please refers to Annex1;

$CAP_{Thermal}$ is the incremental capacity of fuel-fired power of the Grid (MW), for more information please refers to Annex1;

$EF_{Coal, Adv}$, $EF_{Oil, Adv}$ and $EF_{Gas, Adv}$ is emission factor of coal, oil, gas-fired power with the most efficiency level of the best technology commercially available in China was selected, for more information please refers to Annex1;

λ_{Coal} , λ_{Oil} and λ_{Gas} are the proportions of the corresponding CO₂ emissions of the solid fuel, liquid fuel and gas fuel to the total emission, for more information please refers to Annex1;

$EF_{coal,upstream,CH4}$: Emission factor for upstream fugitive methane emissions from production of the fuel type k (a coal or oil type) in t CH₄ per MJ fuel produced; Its values is 13.4tCH₄/kt based on the underground coal production in table 2 of AM0029;

SCC, the standard coal consumption of the best technology commercially available of coal-fired power generation within the grid boundary (gce/kWh), for more information please refers to Annex1.

$NCV_{standard\ coal}$, the net caloric value of the standard coal, 7000kcal/kg;

$NCV_{raw\ coal}$, the net caloric value of the raw coal, 5000kcal/kg (Data source: China Energy Statistic Yearbook)

3.3 Parameters being monitored

For the proposed project, the following parameters are being monitored on continuous:

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Net amount of electricity generated delivered to the grid by the Project
Source of data to be used:	Reading of the Meters installed in the plant and in substation.
Description of measurement methods and procedures to be applied:	Power exported to the grid and imported from the grid is measured continuously and recorded the readings daily. A monthly record ($EG_{PJ,m}$) will be prepared by the project owner at beginning of the month, and sent to the grid company for cross-check. Commercial receipts for electricity sold will also be kept for cross check.
QA/QC procedures to be applied:	Meters will be remained for regular maintenance and testing services for an ensured accuracy (0.2s). All the calibration tests records will be maintained for DOE's verification.

Data / Parameter:	FC_{ty}
Data unit:	m ³
Description:	The total volume of nature gas consumed by the proposed project.
Source of data to be used:	Fuel flow meter readings
Description of measurement methods and procedures to be applied:	The natural gas consumed by the proposed project will be monitored continuously and recorded the readings daily, and a weekly record will be prepared by the project owner and the gas supplier. Commercial receipts for natural gas purchased will be kept for cross check.
QA/QC procedures to be applied:	Natural gas supply metering to the project will be subject to regular (in

applied:	accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy (uncertainty: 0.16%). All the calibration tests records will be maintained for DOE's verification.
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Data / Parameter:	NCV _{f,y}
Data unit:	GJ/m ³
Description:	Net calorific value of nature gas which was consumed by the proposed project.
Source of data to be used:	Fuel supplier
Description of measurement methods and procedures to be applied:	The calorific value of the gas would be provided by the supplier according to fuel purchase agreement, and will be recorded by the Project owner.
QA/QC procedures to be applied:	

Data / Parameter:	COEF _{f,y}
Data unit:	tCO ₂ /m ³
Description:	CO ₂ emission coefficient.
Source of data to be used:	Calculated under the proposed project activity.
Description of measurement methods and procedures to be applied:	Calculated based on the standard procedures mentioned in the methodology
QA/QC procedures to be applied:	-

Data / Parameter:	EF _{co2,f,y}
Data unit:	tCO ₂ /GJ
Description:	Emission factor for natural gas.
Source of data to be used:	Local/Regional/Global (IPCC)
Description of measurement methods and procedures to be applied:	Local/Regional/Global (IPCC)
QA/QC procedures to be applied:	-

Data / Parameter:	OXID _{f,y}
Data unit:	-
Description:	Oxidation factor
Source of data to be used:	Use IPCC current default
Description of measurement methods and procedures to be applied:	IPCC guidelines
QA/QC procedures to be applied:	-

3.4 Roles and responsibilities

The Project owner would establish the CDM administration group to ensure the monitoring plan implement efficiently.

A CDM Group has been formed for the Project Activity for monitoring and verification of all the monitoring parameters as per the guidelines formulated by the management of the Company and as per PDD. Qualified and trained people are monitoring the parameters and emission reductions.

4 Monitoring Data

4.1 Monitoring data of the EG_{PJ,y}

Period	Electricity Supplied to the Grid (MWh)	Electricity Imported from the Grid (MWh)	Net Electricity Supplied to the Grid (MWh)
28/06/2007~30/06/2007	19.8	54.12	-34.32
01/07/2007~31/07/2007	600.60	460.68	139.92
01/08/2007~31/08/2007	0.00	538.56	-538.56
01/09/2007~30/09/2007	41,784.60	484.44	41,300.16
01/10/2007~31/10/2007	82,123.80	353.76	81,770.04
01/11/2007~30/11/2007	20,928.60	340.56	20,588.04
01/12/2007~31/12/2007	5,834.40	328.68	5,505.72
Subtotal	151,291.80	2,560.80	148,731.00
01/01/2008~31/01/2008	0	335.28	-335.28
01/02/2008~29/02/2008	8,910.00	498.96	8,411.04
01/03/2008~25/03/2008	13,200.00	605.88	12,594.12
Subtotal	22,110.00	1,440.12	20,669.88
Total	173,401.80	4,000.92	169,400.88

4.2 Monitoring data NG consumed by the Project

Monitoring Period	Volume of nature gas consumed by the proposed project (m ³)	Weight Average Gross Calorific Value of nature gas (kcal/m ³)	Weight Average Net Calorific Value of nature gas (MJ/m ³)
28/06/2007~31/07/2007	649,657	8,729	32.87
01/08/2007~31/08/2007	157,879	8,783	33.07
01/09/2007~30/09/2007	12,287,577	8,745	32.93
01/10/2007~31/10/2007	17,022,549	8,734	32.89
01/11/2007~30/11/2007	4,781,083	8,757	32.98
01/12/2007~31/12/2007	1,511,153	8,909	33.55
Subtotal	36,409,898	8,748	32.94
01/01/2008~31/01/2008	0	0	0
01/02/2008~29/02/2008	2,464,659	8,779	33.06
01/03/2008~25/03/2008	5,199,054	8,753	32.96
Subtotal	7,663,713	8,761	32.99
Total	44,073,611	8,750	32.95

5 Calculation of Emission Reductions

The Project emissions reduction was calculated according to the approved methodology AM0029. The procedures used for calculating these emissions are described below:

5.1 Project emission

Based on the above values, the project emission calculation was described as follows:

	FC m ³	NCV MJ/m ³	EF _C tC/TJ	EF _{CO2} tCO ₂ /TJ	OXID	PE
28/06/2007~31/07/2007	649,657	32.87	15.3	56.1	1	1,198
01/08/2007~31/08/2007	157,879	33.07	15.3	56.1	1	293
01/09/2007~30/09/2007	12,287,577	32.93	15.3	56.1	1	22,701
01/10/2007~31/10/2007	17,022,549	32.89	15.3	56.1	1	31,406
01/11/2007~30/11/2007	4,781,083	32.98	15.3	56.1	1	8,845
01/12/2007~31/12/2007	1,511,153	33.55	15.3	56.1	1	2,844
Subtotal	36,409,898	32.94	15.3	56.1	1	67,286
01/01/2008~31/01/2008	0	0	-	-	-	-
01/02/2008~29/02/2008	2,464,659	33.06	15.3	56.1	1	4,571
01/03/2008~25/03/2008	5,199,054	32.96	15.3	56.1	1	9,613
Subtotal	7,663,713	32.99	15.3	56.1	1	14,184
Total	44,073,611	32.95	15.3	56.1	1	81,470

5.2 Baseline emission calculation

Baseline emissions are calculated by multiplying the electricity generated in the project plant ($EG_{PJ,y}$) with a baseline CO₂ emission factor ($EF_{BL,CO2,y}$), as follows:

$$BE_y = EG_{PJ,y} \times EF_{BL,CO2,y}$$

Which $EG_{PJ,y}$ is electricity generation in the project plant during the year in MWh.

Based on the above analysis, the Project shall use for $EF_{BL, CO2, 2005}$ and $EF_{BL, CO2, 2006}$ to calculate the baseline emission for the year 2007 and the year 2008. The calculation of the baseline emission is described as follows:

	EG MWh	EF _{BL, CO2, y} (tCO ₂ e/MWh)	BE tCO ₂
28/06/2007~31/07/2007	0	0.8672	-
01/08/2007~31/08/2007	-439.56	0.8672	-381
01/09/2007~30/09/2007	41,306.76	0.8672	35,821
01/10/2007~31/10/2007	81,770.04	0.8672	70,911
01/11/2007~30/11/2007	20,588.04	0.8672	17,854
01/12/2007~31/12/2007	5,505.72	0.8672	4,775
Subtotal	148,731.00	0.8672	128,980
01/01/2008~31/01/2008	-335.28	0.8154	-273

01/02/2008~29/02/2008	8,411.04	0.8154	6,858
01/03/2008~25/03/2008	12,594.12	0.8154	10,269
Subtotal	20,669.88	0.8154	16,854
Total	169,400.88	-	145,834

5.3 Leakage

For the proposed project, the leakage calculation is described as follows:

	FC m ³	NCV MJ/m ³	$EF_{NG,upstream,CH_4}$ (tCH ₄ /PJ)	EG MWh
Subtotal for the year of 2007	36,409,898	32.94	296	148,731.00
Subtotal for the year of 2008	7,663,713	32.99	296	20,669.88
Total	44,073,611	32.95	296	169,400.88

	$EF_{BL,upstream,CH_4}$ (tCH ₄ /MWh)	GWP_{CH_4} (tCO ₂ /tCH ₄)	LE tCO ₂
Subtotal for the year of 2007	0.0057	21	-10,561
Subtotal for the year of 2008	0.0055	21	-795
Total	-	-	-11,356

According to the AM0029, when the total net leakage effects are negative, the Project should assume $LE_y = 0$.

5.4 Summary of the calculation of emission reductions

Period	Project activity emissions (tonnes of CO ₂ e)	Baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of overall emission reductions (tonnes of CO ₂ e)
Subtotal for the year of 2007	67,286	128,980	0	61,694
Subtotal for the year of 2008	14,184	16,854	0	2,670
Total	81,470	145,834	0	64,364

Annex 1

BASELINE INFORMATION

It applies the public available data information provided by the Chinese DNA to calculate $EF_{BM,y}$ of the ECG. (Regional Grid Baseline Emission Factors at: <http://cdm.ccchina.gov.cn/web/index.asp>)

Option 1: Calculate the Build Margin Emission Factor ($EF_{BM,y}$)

According to the consolidated baseline methodology ACM0002 using equations (1) calculates the Build Margin Emission Factor ($EF_{BM,y}$):

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \quad (1)$$

Where:

$F_{i,m,y}$ is the total amount of fuel i (in a mass or volume unit) consumed by all the sample power sources m in year(s) y , m refers to the sample power plants serving the grid, excluding those low-operating cost and must-run power plants, and including imports to the grid.

$COEF_{i,m,y}$ is the total amount the CO₂ emission coefficient of fuel i (tCO₂/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by sample power sources m and the oxidation rate of the fuel in year(s) y , and $GEN_{m,y}$ is the power output (MWh) supplied to the grid by the sources m .

Further, according to *Option 1* and *Option 2* for the sample group m defined by the ACM0002, the *Option 2* is selected to be used for this PDD, which defined the Build Margin emission factor $EF_{BM,y}$ is to be updated annually **ex-post** for the year in which actual project generation and associated emissions reductions occur. The selection of *Option 2* is made mainly because it is very difficult to obtain the data of the five existing power plants built most recently or the power plants capacity additions in the power sector that comprise 20% of the system generation (in MWh) built most recently in the PRC as these data are considered as confidential business information kept by the plants owners.

In this PDD, as required, the related public available data published by DNA¹ would be used for estimation of the $EF_{BM,y}$, and the calculations are as follows:

Step a: Calculate the proportions of the corresponding CO₂ emissions of the solid fuel, liquid fuel and gas fuel to the total emission by the energy information available of the last year;

$$\lambda_{Coal} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad (2)$$

¹ Data Source: the Baseline Emission Factors of the Regional Grids in the PRC, issued by the Chinese DNA (<http://cdm.ccchina.gov.cn/web/index.asp>)

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad (3)$$

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad (4)$$

Where:

$F_{i,j,y}$ is the fuel (tce) consumed by the province j in the year y ;

$COEF_{i,j,y}$ is the CO₂ emission coefficient of fuel i (tCO₂/tce), taking into account the carbon content and the percent oxidation of the fuel in year y ;

$COAL$, OIL and GAS are the footnotes of the solid fuel, liquid fuel and gas fuel respectively.

For the year of 2005, λ_{Coal} , λ_{Oil} and λ_{Gas} of ECG are 0.9671, 0.024; 0.009 respectively (see TableA2 for details).

For the year of 2006, λ_{Coal} , λ_{Oil} and λ_{Gas} of ECG are 0.9678, 0.0108; 0.0214 respectively (see TableA8 for details).

Step b: Calculate the fuel-fired emission factors ($EF_{Thermal}$) of the grids based on the emissions of the best technology commercially viable.

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \quad (5)$$

Where:

$EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ is emission factor of coal, oil, gas-fired power with the most efficiency level of the best technology commercially available in China was selected (see TableA2 and Table A for details).

Step c: Calculate $EF_{BM,y}$ of the grid based on equation (6):

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (6)$$

Where:

CAP_{Total} is the total change in installed capacity of the Grid, MW;

$CAP_{Thermal}$ is the incremental capacity of fuel-fired power of the Grid, MW.

Based on the data information cited above, the build margin emission factor ($EF_{BM,2005}$) of the ECG is 0.8672tCO₂e/MWh and ($EF_{BM,2006}$) of the ECG is 0.8514tCO₂e/MWh (see TableA7 and Table A14 for details).

Data for $EF_{BM,2005}$ calculation

Table A1. The Oxidation Factor, Emission Factors and Average Low Calorific Value of the Fuel

Fuel	Low Calorific Value	Emission Factors tc/TJ	Oxidation Factor
Raw Coal	20,908 kJ/kg	25.80	1
Cleaned Coal	26,344 kJ/kg	25.80	1
Other Washed Coal	8,363 kJ/kg	25.80	1
Coke	28,435 kJ/kg	25.80	1
Crude Oil	41,816 kJ/kg	20.00	1
Gasoline	43,070 kJ/kg	18.90	1
Coal oil	43,070 kJ/kg	19.60	1
Diesel Oil	42,652 kJ/kg	20.20	1
Fuel oil	41,816 kJ/kg	21.10	1
Other Petroleum Products	38,369 kJ/kg	20.00	1
Natural gas	38,931 kJ/m ³	15.30	1
Coke oven gas	16,726 kJ/m ³	12.10	1
Other coal gas	5,227 kJ/m ³	12.10	1
LPG	50,179 kJ/kg	17.20	1
Refinery gas	46,055 kJ/kg	15.70	1

According to the statistical analysis of newly-built fuel-fired power plants in the 10th Five-Year Plan (2000-2005) a by State Electricity Regulatory Commission of China, for the coal-fired power plant, the most efficiency level of the best technology commercially available in China was selected as 600MW. The fuel consumption is 343.33gce/kWh, while the corresponding efficiency of the power supply is 35.82%.

The best technology commercially with the most efficiency level applied in the combined cycle power plant (including gas power plant and oil power plant) is selected as 200MW level, (equals to the technology of 9E unit from GE). According to the data in 2004, the fuel consumption of the combined cycle power plant with the actual most efficiency level of the best technology commercially is 258gce/kWh, while the corresponding efficiency of the power supply is 47.67%.

The emission factors of coal-fired power, oil-fired power and gas-fired power respectively with the most efficiency level of the best technology commercially was described in Table A2

Table A2. The Emission Factor of Coal, Oil, Gas-Fired Power Plant

Variable		Efficiency of Power Supply A	Emission Factor of the Fuel (tc/TJ) B	Oxidation Factor C	Emission Factor (tCO ₂ /MWh) D=3.6/A/1000*B*C*44/12
Coal-fired power plant	EF _{Coal, Adv}	35.82%	25.80	1	0.95
Gas-fired power plant	EF _{Gas, Adv}	47.67%	15.30	1	0.42
Oil-fired power plant	EF _{Oil, Adv}	47.67%	21.10	1	0.58

Table A3. Emission of CO₂ in ECG in 2005

Fuel	Unit	Shanghai A	Zhejiang B	Jiangsu C	Anhui D	Fujian E	Total F=A+...+E	Calorific Value G	Emission Factor of the Fuel (tc/TJ) H	Oxidation Factor I	Emission of CO ₂
Raw coal	10 ⁴ t	2,847.31	4,801.52	9,888.06	3,082.90	2,107.69	22,727.48	25.80	100.00	20,908.00	449,526,099.64
Cleaned coal	10 ⁴ t						0.00	25.80	100.00	26,344.00	0.00
Other washed Coal	10 ⁴ t					0.00	0.00	25.80	100.00	8,363.00	0.00
Coke	10 ⁴ t		0.03				0.03	25.80	100.00	28,435.00	806.99
Subtotal											449,526,906.63
Crude oil	10 ⁴ t	0.00	27.01	0.00	0.00	0.00	27.01	20.00	100.00	41,816.00	828,263.45
Gasoline	10 ⁴ t							18.90			0.00
Kerosene	10 ⁴ t							19.60			0.00
Diesel	10 ⁴ t	1.25	4.52	16.00		1.67	23.44	20.20	100.00	42,652.00	740,491.04
Fuel oil	10 ⁴ t	59.39	153.22	13.22		7.45	233.28	21.10	100.00	41,816.00	7,546,991.82
Other Petroleum Products	10 ⁴ t	21.00	34.80	8.38			64.18	20.00	100.00	38,369.00	1,805,849.77
Subtotal											10,921,596.09
Coke oven gas	10 ⁸ m ³	1.68		1.38	1.71		4.77	12.10	100.00	16,726.00	353,970.67
Other coal gas	10 ⁸ m ³	83.72	0.06	24.97	30.00		138.75	12.10	100.00	5,227.00	3,217,675.86
Liquefied Petroleum	10 ⁴ t	0.00	0.00	0.00	0.00		0.00	17.20	100.00	50,179.00	0.00
Refinery gas	10 ⁴ t	0.57	0.00	0.83			1.40	15.70	100.00	46,055.00	37,117.26
Natural gas	10 ⁸ m ³	1.09	0.62	1.85			3.56	15.30	100.00	38,931.00	777,514.36
Subtotal											4,386,278.15
Total											464,834,780.86

Data Source: The China Energy Statistical Yearbook 2005

Based on TableA13 and formula (6),(7) and (8), $\lambda_{Coal}=96.71\%$, $\lambda_{Oil}=2.35\%$, $\lambda_{Gas}=0.94\%$ 。

$$So EF_{Thermal} = \lambda_{Coal} \times EF_{Coal, Adv} + \lambda_{Oil} \times EF_{Oil, Adv} + \lambda_{Gas} \times EF_{Gas, Adv} = 0.9372$$

Table A4. The Installed Capacity of ECG in 2005

	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total
Fuel-fired power	MW	13,113.50	42,506.40	27,688.10	11,423.20	9,345.40	104,076.60
Hydropower	MW	0.00	142.60	6,952.10	749.80	8,224.90	16,069.40
Nucleus power	MW	0.00	0.00	3,066.00	0.00	0.00	3,066.00
Wind power and others	MW	253.30	58.80	37.20	0.00	52.00	401.30
Total	MW	13,366.80	42,707.80	37,743.40	12,173.00	17,622.30	123,613.30

Data source: China Electric Power Yearbook 2006

Table A5. The Installed Capacity of ECG in 2004

	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total
Fuel-fired power	MW	12,014.90	28,289.50	21,439.80	9,364.50	8,315.40	79,424.10
Hydropower	MW	0.00	126.50	6,418.40	692.80	7,180.10	14,417.80
Nucleus power	MW	0.00	0.00	3,056.00	0.00	0.00	3,056.00
Wind power and others	MW	3.40	17.50	39.70	0.00	12.00	72.60
Total	MW	12,018.30	28,433.50	30,953.90	10,057.30	15,507.50	96,970.50

Data source: China Electric Power Yearbook 2005

Table A6. The Installed Capacity of ECG in 2003

	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total
Fuel-fired power	MW	11,092.60	22,245.00	15,321.20	9,284.90	7,092.80	65,036.50
Hydropower	MW	0.00	137.80	6,054.50	649.10	6,761.10	13,602.50
Nucleus power	MW	0.00	0.00	2,406.00	0.00	0.00	2,406.00
Wind power and others	MW	0.00	0.00	39.70	0.00	12.00	51.70
Total	MW	11,092.60	22,382.80	23,821.40	9,934.00	13,865.90	81,096.70

Data source: China Electric Power Yearbook 2004

Table A7. Change in Installed Capacity of ECG in 2004~2005

Year	2003 A	2004 B	2005 C	Change in Installed Capacity from 2004 to 2005 D=C-B	The Proportion of the Total Change Capacity
Fuel-fired power(MW)	65,036.50	79,424.10	104,076.60	24,652.50	93%
Hydropower(MW)	13,602.50	14,417.80	16,069.40	1,651.60	6%
Nucleus power	2,406.00	3,056.00	3,066.00	10.00	0%
Wind power (MW)	51.70	72.60	401.30	328.70	1%
Total(MW)	81,096.70	96,970.50	123,613.30	26,642.80	1.00
Share in total installed capacity of 2005	66%	78%	100%		

$$EF_{BM,y}=0.9372 \times 93\% = 0.8672 \text{ tCO}_2/\text{MWh}$$

Data for $EF_{BM,2006}$ calculation

Table A8. The Oxidation Factor, Emission Factors and Average Low Calorific Value of the Fuel

Fuel	Low Calorific Value	Emission Factors tc/TJ	Oxidation Factor
Raw Coal	20,908 kJ/kg	25.80	1
Cleaned Coal	26,344 kJ/kg	25.80	1
Other Washed Coal	8,363 kJ/kg	25.80	1
Moulded coal	20,908 kJ/kg	26.60	1
Coke	28,435 kJ/kg	29.20	1
Crude Oil	41,816 kJ/kg	20.00	1
gasoline	43,070 kJ/kg	18.90	1
Coal oil	43,070 kJ/kg	19.60	1
Diesel Oil	42,652 kJ/kg	20.20	1
Fuel oil	41,816 kJ/kg	21.10	1
Other Petroleum Products	38,369 kJ/kg	20.00	1
Natural gas	38,931 kJ/m ³	15.30	1
Coke oven gas	16,726 kJ/m ³	12.10	1
Other coal gas	5,227 kJ/m ³	12.10	1
LPG	50,179 kJ/kg	17.20	1
Refinery gas	46,055 kJ/kg	15.70	1

According to the statistical analysis of newly-built fuel-fired power plants in the 10th Five-Year Plan (2000-2005) a by State Electricity Regulatory Commission of China, for the coal-fired power plant, the most efficiency level of the best technology commercially available in China was selected as 600MW. The fuel consumption is 329.94 gce/kWh, while the corresponding efficiency of the power supply is 37.28%.

The best technology commercially with the most efficiency level applied in the combined cycle power plant (including gas power plant and oil power plant) is selected as 200MW level, (equals to the technology of 9E unit from GE). According to the data in 2006, the fuel consumption of the combined cycle power plant with the actual most efficiency level of the best technology commercially is 252 gce/kWh, while the corresponding efficiency of the power supply is 48.81%.

The emission factors of coal-fired power, oil-fired power and gas-fired power respectively with the most efficiency level of the best technology commercially was described in Table A9.

Variable		Efficiency of Power Supply A	Emission Factor of the Fuel (tc/TJ) B	Oxidation Factor C	Emission Factor (tCO ₂ /MWh) D=3.6/A/1000*B*C*44/12
Coal-fired power plant	EF _{Coal,Adv}	37.28%	25.8	1	0.9135
Gas-fired power plant	EF _{Gas,Adv}	48.81%	15.3	1	0.4138
Oil-fired power plant	EF _{Oil,Adv}	48.81%	21.1	1	0.5706

Fuel	Unit	Shanghai A	Zhejiang B	Jiangsu C	Anhui D	Fujian E	Total F=A+...+E	Calorific Value G	Emission Factor of the Fuel (tc/TJ) H	Oxidation Factor I	Emission of CO ₂
Raw coal	10 ⁴ t	2,744.45	6,065	10,945.4	3,455.2	2,369.63	25,579.7	20908	25.8	1	505,940,068
Cleaned coal	10 ⁴ t	0	0	0	0	0	0	26344	25.8	1	0
Other washed	10 ⁴ t	0	0	150.54	23.06	0	173.6	8363	25.8	1	1,373,419
Moulded coal	10 ⁴ t	0	0	0			0	20908	26.6	1	0
Coke	10 ⁴ t	0	39.07	0	0	0	39.07	28435	29.2	1	1,189,463
Subtotal											508,502,949
Crude oil	10 ⁴ t	0	20.3	0	0	0	20.3	41816	20	1	622,501
Gasoline	10 ⁴ t	0	0	0	0	0	0	43070	18.9	1	0
kerosene	10 ⁴ t	0	0	0	0	0	0	43070	19.6	1	0
Diesel	10 ⁴ t	2.13	4.11	3.7	1.21	1.11	12.26	42652	20.2	1	387,305
Fuel oil	10 ⁴ t	44.51	71.98	3.77	0.02	4.5	124.78	41816	21.1	1	4,036,838
Other Petroleum Products	10 ⁴ t	18.82	0	3.57	0	0	22.39	38369	20	1	629,993
Subtotal											5,676,637
Coke oven gas	10 ⁷ ₃ m	32	91.8	135	0	0	258.8	38931	15.3	1	5,652,267
Other coal gas	10 ⁷ ₃ m	17.1	2.3	31.3	7.1	0	57.8	16726	12.1	1	428,920
Liquefied Petroleum	10 ⁷ ₃ m	846.4	32.8	1065.4	251.2	0	2,195.8	5227	12.1	1	5,092,160
Refinery gas	10 ⁴ t	0	0	0	0	0	0	50179	17.2	1	0
Natural gas	10 ⁴ t	0.29	0	0.4	2.95	0	3.64	46055	15.7	1	96,505
Subtotal											11,269,853
Total											525,449,440

Based on tableA10 and formula (3),(4) and (5), $\lambda_{Coal}=96.78\%$, $\lambda_{Oil}=1.08\%$, $\lambda_{Gas}=2.14\%$.

$$\text{So } EF_{Thermal} = \lambda_{Coal} \times EF_{Coal, Adv} + \lambda_{Oil} \times EF_{Oil, Adv} + \lambda_{Gas} \times EF_{Gas, Adv} = 0.8991$$

Table A11. The Installed Capacity of ECG in 2006

	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total
Fuel-fired power	MW	14,526	51,776	35,391	14,134	13,001	128,828
Hydropower	MW	0	136	8,369	1,001	8,957	18,463
Nucleus power	MW	0	0	3,066	0	0	3,066
Wind power and others	MW	253	162	43	0	89	547
Total	MW	14,550	51,927	46,863	15,135	22,047	150,522

Data source: China Electric Power Yearbook 2007

Table A12. The Installed Capacity of ECG in 2005

	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total
Fuel-fired power	MW	13,113.50	42,506.40	27,688.10	11,423.20	9,345.40	104,076.60
Hydropower	MW	0.00	142.60	6,952.10	749.80	8,224.90	16,069.40
Nucleus power	MW	0.00	0.00	3,066.00	0.00	0.00	3,066.00
Wind power and others	MW	253.30	58.80	37.20	0.00	52.00	401.30
Total	MW	13,366.80	42,707.80	37,743.40	12,173.00	17,622.30	123,613.30

Data source: China Electric Power Yearbook 2006

Table A13. The Installed Capacity of ECG in 2004

	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total
Fuel-fired power	MW	12,014.90	28,289.50	21,439.80	9,364.50	8,315.40	79,424.10
Hydropower	MW	0.00	126.50	6,418.40	692.80	7,180.10	14,417.80
Nucleus power	MW	0.00	0.00	3,056.00	0.00	0.00	3,056.00
Wind power and others	MW	3.40	17.50	39.70	0.00	12.00	72.60
Total	MW	12,018.30	28,433.50	30,953.90	10,057.30	15,507.50	96,970.50

Data source: China Electric Power Yearbook 2005

Table A14. Change in Installed Capacity of ECG in 2004~2006

Year	2004 A	2005 B	2006 C	Change in Installed Capacity from 2005 to 2006 D=C-A	The Proportion of the Total Change Capacity
Fuel-fired power(MW)	79,424.10	104,076.60	128,828	24,751.4	90.70%
Hydropower(MW)	14,417.80	16,069.40	18,463	2,393.6	8.77%
Nucleus power	3,056.00	3,066.00	3,066	0	0.00%
Wind powewr (MW)	72.60	401.30	547	145.7	0.53%
Total(MW)	96,970.50	123,613.30	150,904	27,290.7	100.00%
Share in total installed capacity of 2005	64.26%	81.92%	100%		

$$EF_{BM,y}=0.8991 \times 90.70\% = 0.8154 \text{ tCO}_2/\text{MWh}$$

Annex 2

BASELINE INFORMATION-----Calculation of the Combined Margin Emission Factor

It applies the public available data information provided by the Chinese DNA to calculate $EF_{BM,y}$ of the ECG. (Regional Grid Baseline Emission Factors at: <http://cdm.ccchina.gov.cn/web/index.asp>)

Option 2: Calculate the Combined Margin Emission Factor ($EF_{CM,y}$)

Step a. Calculate the Operating Margin Emission Factor ($EF_{OM,y}$)

Out of four options for the OM, the Simple Operating Margin Emission Factor (S-OM) is selected for the two reasons as follows.

- 1) Detailed hourly dispatch data is not publicly available, given that, up to date, the Chinese Grid Company who runs the power dispatch centers does not make such information available to the public.
- 2) From historical data that are public available, the ratio of electricity generated by hydro power plants against the total electricity generated in the East China Grid over the past five years is following: 11.49%, 11.86%, 10.96%, 9.77%, and 11.65%, 11.44% for 2001, 2002, 2003, 2004, 2005 and 2006. Therefore, the ECG generation system is dominated by coal-fired power, using the average of the five most recent years it can be shown that low-cost/must run hydro resources constitute less than 50% of total grid generation in the ECG.

For further clarification purpose, the two reasons cited above are also in accordance with the Methodology as stated:

The Simple OM method (a) can only be used where 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 normals for hydroelectricity production.

The simple OM thus is selected to be used for the calculation of OM.

Simple OM

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO₂/MWh) of all generating sources serving the system, excluding low-operating cost and must-run power plants. The formula of $EF_{OM,simple,y}$ calculation is

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}}$$

Where:

$F_{i,j,y}$ is the total amount of fuel i (in a mass or volume unit) consumed by all the relevant power sources j in year(s) y , j refers to the power sources serving the grid, excluding those low-operating cost and must-run power plants, and including imports to the grid.

$COEF_{i,j,y}$ is the CO₂ emission coefficient of fuel i (tCO₂/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the oxidation rate of the fuel in year(s) y , and $GEN_{j,y}$ is the electricity output (MWh) supplied to the grid by the sources j .

The CO₂ emission coefficient $COEF_{i,y}$ is then obtained from above equation as

$$COEF_i = NCV_i \cdot EF_{CO_2,i} \cdot OXID_i \quad (13)$$

Where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i .

$OXID_i$ is the oxidation factor of the fuel (see page 1.29 in the 2006 Revised IPCC Guidelines for Default Values).

$EF_{CO_2,i}$ is the CO₂ emission factor per unit of energy of the fuel i .

The Simple OM Emission Factor ($EF_{OM,y}$) of the proposed project is calculated based on the electricity generation mix of the ECG, excluding low-operating cost and must-run power plants, such as hydropower, wind power etc. The data on installed capacity and electricity generation of different power generation sources are taken from the *China Electric Power Yearbook* (published annually, 2004, 2005, 2006 and 2007 editions). The data on different fuel consumptions for power generation in the ECG are taken from the *China Energy Statistical Yearbook* (year 2004, 2005, 2006 and 2007 editions).

Based on the data information mentioned above, the Simple OM Emission Factor ($EF_{OM,y}$) of the ECG for the year of 2007 is calculated as 0.9421tCO₂e/MWh and 0.9540tCO₂e/MWh for the year of 2008. (see TableB1 to Table B20 for details).

Step b. Calculate the baseline emission factor EF_y

The Combined Margin Emission Factor (EF_y) was calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$), where the weights w_{OM} and w_{BM} are 50% (i.e., $w_{OM} = w_{BM} = 0.5$).

Data for $EF_{OM,2007}$ calculation

TableB1. Fossil Fuel-fired Power Generation of ECG in 2003

Regions	Electricity Generation (MWh)	Rate of Electricity Consumption (%)	Electricity Supply to Grid (MWh)
Shanghai	69,444,000	5.14	65,874,578
Jiangsu	133,277,000	5.9	125,413,657
Zhejiang	83,089,000	5.31	78,676,974
Anhui	54,156,000	6.06	50,874,146
Fujian	42,146,000	5.07	40,009,198
Total			360,848,554

Data source: China Electric Power Yearbook 2004

Table B2. Power Import of ECG in 2003

Power Import from CCG		13,756,040
	Emission Factor of CO ₂ (tCO ₂ /MWh)	0.7973
	Total Emission of CO ₂ in CCG (tCO ₂)	276,366,760
	Total Power Supply of CCG (MWh)	346,613,868
Power Import from Yangcheng Power Plant		10,705,870
	Emission Factor of CO ₂ for Yangcheng Power Plant	0.9498
	Fuel Consumption of Yangcheng Power Plant	343gce/kwh

Data source: <http://cdm.ccchina.gov.cn/web/index.asp>

Table B3. Calculate the Operating Margin Emission Factor of ECG in 2003

Fuel	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total	Emission Factors ² tC/TJ	Oxidation Factor ³ %	Average Low Calorific Value MJ/t, km ³	Emission of CO ₂ tCO _{2e}
Raw Coal	10 ⁴ t	2,618	6,417.74	3,442.4	2,669.67	1,754	16,901.81	25.8	100	20,908	334,300,359.1
Cleaned Coal	10 ⁴ t						0	25.8	100	26,344	0
Other Washed Coal	10 ⁴ t						0	25.8	100	8,363	0
Coke	10 ⁴ t						0	25.8	100	28,435	0
Coke Oven Gas	10 ⁸ m ³	1.99	0.06				2.05	12.1	100	16,726	152,125.7577
Other Gas	10 ⁸ m ³	66.34					66.34	12.1	100	5,227	1538454.90
Crude Oil	10 ⁴ t						0	20	100	41,816	0
Gasoline	10 ⁴ t							18.89	100	43,070	0.00
Diesel Oil	10 ⁴ t	1.26	14.71	13.99			29.96	20.2	100	42,652	946,463.8034
Fuel Oil	10 ⁴ t	95.49	0.76	174.48		18.89	289.62	21.1	100	41,816	9,369,683.521
PLG	10 ⁴ t	0.49	0.96				1.45	17.2	100	50,179	45887
Refinery Gas	10 ⁸ m ³						0	15.3	100	38,931	0
Other Coking Products	10 ⁴ t	18.91	5.3	15.04			39.25	20	100	38,369	1,104,387.717
Other Petroleum Products	10 ⁴ t						0	25.8	100	28,435	0
Other Energy	10 ⁴ tce	5.68		7.08			12.76	0	0	0	0
Subtotal											347457361
CO ₂ emission caused by power import from CCG											17,252,566
Total CO ₂ emission											368,586,282
Total power supply of ECG											385,310,464
OM											0.9566

Data source: China Energy statistical Yearbook 2004

² Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook³ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

Table B4. Fuel-Fired Power Generation of ECG in 2004

Regions	Electricity Generation (MWh)	Rate of Electricity Consumption (%)	Electricity Supply to Grid (MWh)
Shanghai	71,127,000	5.22	67,414,171
Jiangsu	163,545,000	5.93	153,846,782
Zhejiang	95,255,000	5.68	89,844,516
Anhui	59,875,000	6.03	56,264,538
Fujian	50,490,000	6.07	47,425,257
Total			414,795,263

Data source: China Electric Power Yearbook 2005

Table B5 Power Import of ECG in 2004

Power Import from CCG		26,933,850
	Emission Factor of CO ₂ (tCO ₂ /MWh)	0.826390
	Total Emission of CO ₂ in CCG (tCO ₂)	345,647,254
	Total Power Supply of CCG (MWh)	418,261,666
Power Import from Yangcheng Power Plant		11,649,610
	Emission Factor of CO ₂ for Yangcheng Power Plant	0.9442
	Fuel Consumption of Yangcheng Power Plant	341gce/kwh

Data source: <http://cdm.ccchina.gov.cn/web/index.asp>

Table B6. Calculate the Operating Margin Emission Factor of ECG in 2004

Fuel	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total	Emission Factors ⁴ tc/TJ	Oxidation Factor ⁵ %	Average Low Calorific Value MJ/t, km ³	Emission of CO ₂ tCO ₂ e
Raw Coal	10 ⁴ t	2,779.6	7,601.9	4,008.9	2906.2	2183.7	19,480.3	25.8	100	20,908	385,300,230.3
Cleaned Coal	10 ⁴ t						0	25.8	100	26,344	0
Other Washed Coal	10 ⁴ t		5.46			4.63	10.09	25.8	100	8,363	79,826.00582
Coke	10 ⁴ t						0	25.8	100	28,435	0.00
Coke Oven Gas	10 ⁸ m ³	2.59					2.59	12.1	100	16,726	192,197.9085
Other Gas	10 ⁸ m ³	72.46					72.46	12.1	100	5,227	1680380.49
Crude Oil	10 ⁴ t						0	20	100	41,816	0
Diesel Oil	10 ⁴ t	2.69	27.17	6.23			36.09	20.2	100	42,652	1,140,116.11
Fuel Oil	10 ⁴ t	58.52	55.07	202.89		23.26	339.74	21.1	100	41,816	10,991,147.99
PLG	10 ⁴ t						0	17.2	100	50,179	0
Refinery Gas	10 ⁴ t	0.77	0.55				1.32	15.7	100	46,055	34,996.2734
Nature Gas	10 ⁸ m ³		0.14				0.14	15.3	100	38,931	30,576.4074
Other Petroleum Products	10 ⁴ t	21.22	1.37	24.89			47.48	20	100	38,369	1,335,957.421
Other Coking Products	10 ⁴ t						0	25.8	100	28,435	0
Other Energy	10 ⁴ tce	6.43		15.48			21.91	0	0	0	0
Subtotal										400,785,428.93	
CO ₂ emission caused by power import from CCG										32,592,178	
CO ₂ emission caused by power import from Yangcheng										12,337,539	
Total CO ₂ emission										434,043,338,	
Total power supply of ECG										453,378,722.6	
OM										0.9574	

Data source: China Energy statistical Yearbook 2005

⁴ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook⁵ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

Table B7. Fuel-Fired Power Generation of ECG in 2005

Regions	Electricity Generation (MWh)	Rate of Electricity Consumption (%)	Electricity Supply to Grid (MWh)
Shanghai	74,606,000	5.05	70,838,397
Jiangsu	211,429,000	5.96	198,827,832
Zhejiang	108,110,000	5.59	102,066,651
Anhui	62,918,000	5.9	59,205,838
Fujian	48,600,000	4.57	46,378,980
Total			477,317,698

Data source: China Electric Power Yearbook 2006

Table B8. Power Import of ECG in 2005

Power Import from CCG		160,410,000
	Emission Factor of CO ₂ (tCO ₂ /MWh)	0.7712
	Total Emission of CO ₂ in CCG (tCO ₂)	359,859,371
	Total Power Supply of CCG (MWh)	286,203,305
Power Import from Yangcheng Power Plant		77,244,000
	Emission Factor of CO ₂ for Yangcheng Power Plant	0.9387
	Fuel Consumption of Yangcheng Power Plant	339gce/kwh

Data source: <http://cdm.ccchina.gov.cn/web/index.asp>

Table B9. Calculate the Operating Margin Emission Factor of ECG in 2005

Fuel	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Total	Emission factors ⁶ tc/TJ	oxidation factor ⁷ %	Average low calorific Value MJ/t,km ³	Emission of CO ₂ tCO ₂ e
Raw Coal	10 ⁴ t	2847.31	9888.06	4801.52	3082.9	2107.69	22727.48	25.8	100	20908	449526099.64
Cleaned Coal	10 ⁴ t						0	25.8	100	26344	0.00
Other Washed Coal	10 ⁴ t						0	25.8	100	8363	0.00
Coke	10 ⁴ t			0.03			0.03	25.8	100	28435	806.99
Coke Oven Gas	10 ⁸ m ³	1.68	1.38		1.71		4.77	12.1	100	16726	353970.67
Other Gas	10 ⁸ m ³	83.72	24.97	0.06	30		138.75	12.1	100	5227	3217675.86
Crude Oil	10 ⁴ t			27.01			27.01	20	100	41816	828263.45
Diesel Oil	10 ⁴ t	1.25	16	4.52		1.67	23.44	20.2	100	42652	740491.04
Fuel Oil	10 ⁴ t	59.39	13.22	153.22		7.45	233.28	21.1	100	41816	7546991.82
PLG	10 ⁴ t						0	17.2	100	50179	0.00
Refinery Gas	10 ⁴ t	0.57	0.83				1.4	15.7	100	46055	37117.26
Nature Gas	10 ⁸ m ³	1.09	1.85	0.62			3.56	15.3	100	38931	777514.36
Other Petroleum Products	10 ⁴ t	21	8.38	34.8			64.18	20	100	38369	1805849.77
Other Coking Products	10 ⁴ t						0	25.8	100	28435	0.00
Other Energy	10 ⁴ tce	12.36		15.29			27.65	0	100	0	0.00
Subtotal											464,834,780.86
CO₂ emission caused by power import from CCG											208,009,959
CO₂ emission caused by power import from Yangcheng											82,288,008
Total CO₂ emission											661,046,505
Total power supply of ECG											714,971,698
OM											0.9246

Data source: China Energy statistical Yearbook 2006

⁶ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook⁷ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

Table B10. The Operating Margin Emission Factor of ECG in 2003~2005

Year	2003	2004	2005	OM
CO ₂ emission (tCO ₂ e)	368,586,282	434,043,338	661,046,505	0.9421
Fuel-fired power generation of ECG (MWh)	385,310,464	453,378,723	714,971,698	

Data source: Table A1-A9

Data for $EF_{OM,2008}$ calculation

Table B11. Fuel-Fired Power Generation of ECG in 2004

Regions	Electricity Generation (MWh)	Rate of Electricity Consumption (%)	Electricity Supply to Grid (MWh)
Shanghai	71,127,000	5.22	67,414,171
Jiangsu	163,545,000	5.93	153,846,782
Zhejiang	95,255,000	5.68	89,844,516
An'hui	59,875,000	6.03	56,264,538
Fujian	50,490,000	6.07	47,425,257
Total			414,795,263

Data source: China Electric Power Yearbook 2005

Table B12 Power Import of CCG in 2004

Power Import from CCG	26,933,850
Emission Factor of CO ₂ (tCO ₂ /MWh)	0.826390
Total Emission of CO ₂ in CCG (tCO ₂)	345,647,254
Total Power Supply of CCG (MWh)	418,261,666
Power Import from Yangcheng Power Plant	11,649,610
Emission Factor of CO ₂ for Yangcheng Powe Plant	0.9442
Fuel Consumption of Yangcheng Power Plant	341gce/kwh

Data source: <http://cdm.ccchina.gov.cn/web/index.asp>

Table B13. Calculate the Operating Margin Emission Factor of ECG in 2004

Fuel	Unit	Shanghai	Jiangsu	Zhejiang	An'hui	Fujian	Total	Emission Factors ⁸ tc/TJ	Oxidation Factor ⁹ %	Average Low Calorific Value MJ/t, km ³	Emission of CO ₂ tCO ₂ e
Raw Coal	10 ⁴ t	2,779.6	7,601.9	4,008.9	2906.2	2183.7	19,480.3	25.8	100	20,908	385,300,230.3
Cleaned Coal	10 ⁴ t						0	25.8	100	26,344	0
Other Washed Coal	10 ⁴ t		5.46			4.63	10.09	25.8	100	8,363	79,826.00582
Coke	10 ⁴ t						0	25.8	100	28,435	0.00
Coke Oven Gas	10 ⁸ m ³	2.59					2.59	12.1	100	16,726	192,197.9085
Other Gas	10 ⁸ m ³	72.46					72.46	12.1	100	5,227	1680380.49
Crude Oil	10 ⁴ t						0	20	100	41,816	0
Diesel Oil	10 ⁴ t	2.69	27.17	6.23			36.09	20.2	100	42,652	1,140,116.11
Fuel Oil	10 ⁴ t	58.52	55.07	202.89		23.26	339.74	21.1	100	41,816	10,991,147.99
PLG	10 ⁴ t						0	17.2	100	50,179	0
Refinery Gas	10 ⁴ t	0.77	0.55				1.32	15.7	100	46,055	34,996.2734
Nature Gas	10 ⁸ m ³		0.14				0.14	15.3	100	38,931	30,576.4074
Other Petroleum Products	10 ⁴ t	21.22	1.37	24.89			47.48	20	100	38,369	1,335,957.421
Other Coking Products	10 ⁴ t						0	25.8	100	28,435	0
Other Energy	10 ⁴ tce	6.43		15.48			21.91	0	0	0	0
Subtotal											400,785,428.93
CO ₂ emission caused by power import from CCG											32,592,178
CO ₂ emission caused by power import from Yangcheng											12,337,539
Total CO ₂ emission											434,043,338,
Total power supply of ECG											453,378,722.6
OM											0.9574

Data source: China Energy statistical Yearbook 2005

⁸ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook⁹ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

Table B14. Fuel-Fired Power Generation of ECG in 2005

Regions	Electricity Generation (MWh)	Rate of Electricity Consumption (%)	Electricity Supply to Grid (MWh)
Shanghai	74,606,000	5.05	70,838,397
Jiangsu	211,429,000	5.96	198,827,832
Zhejiang	108,110,000	5.59	102,066,651
An'hui	62,918,000	5.9	59,205,838
Fujian	48,600,000	4.57	46,378,980
Total			477,317,698

Data source: China Electric Power Yearbook 2006

Table B15. Power Import of CCG in 2005

Power Import from CCG	27,039,000
Emission Factor of CO ₂ (tCO ₂ /MWh)	0.7722
Power Import from Yangcheng Power Plant	11,282,000
Emission Factor of CO ₂ for Yangcheng Power Plant	1.1463

Data source: <http://cdm.ccchina.gov.cn/web/index.asp>

Table B16. Calculate the Operating Margin Emission Factor of ECG in 2005

Fuel	Unit	Shanghai	Jiangsu	Zhejiang	An'hui	Fujian	Total	Emission factors ¹⁰ tc/TJ	oxidation factor ¹¹ %	Average low calorific Value MJ/t,km ³	Emission of CO ₂ tCO ₂ e
Raw Coal	10 ⁴ t	2847.31	9888.06	4801.52	3082.9	2107.69	22727.48	25.8	100	20908	449526099.64
Cleaned Coal	10 ⁴ t						0	25.8	100	26344	0.00
Other Washed Coal	10 ⁴ t						0	25.8	100	8363	0.00
Coke	10 ⁴ t			0.03			0.03	29.2	100	28435	913.33
Coke Oven Gas	10 ⁸ m ³	1.68	1.38		1.71		4.77	12.1	100	16726	353970.67
Other Gas	10 ⁸ m ³	83.72	24.97	0.06	30		138.75	12.1	100	5227	3217675.86
Crude Oil	10 ⁴ t			27.01			27.01	20	100	41816	828263.45
Diesel Oil	10 ⁴ t	1.25	16	4.52		1.67	23.44	20.2	100	42652	740491.04
Fuel Oil	10 ⁴ t	59.39	13.22	153.22		7.45	233.28	21.1	100	41816	7546991.82
PLG	10 ⁴ t						0	17.2	100	50179	0.00
Refinery Gas	10 ⁴ t	0.57	0.83				1.4	15.7	100	46055	37117.26
Nature Gas	10 ⁸ m ³	1.09	1.85	0.62			3.56	15.3	100	38931	777514.36
Other Petroleum Products	10 ⁴ t	21	8.38	34.8			64.18	20	100	38369	1805849.77
Other Coking Products	10 ⁴ t						0	25.8	100	28435	0.00
Other Energy	10 ⁴ tce	12.36		15.29			27.65	0	100	0	0.00
Subtotal										464,834,887.21	
CO ₂ emission caused by power import from CCG										208,009,959	
CO ₂ emission caused by power import from Yangcheng										12,933,008	
Total CO ₂ emission										498,647,411	
Total power supply of ECG										515,638,698	
OM										0.9670	

Data source: China Energy statistical Yearbook 2006

¹⁰ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook¹¹ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

Table B17. Fossil Fuel-fired Power Generation of ECG in 2006

Regions	Electricity Generation (MWh)	Rate of Electricity Consumption (%)	Electricity Supply to Grid (MWh)
Shanghai	74606000	5.05	70,838,397
Jiangsu	211429000	5.96	198,827,832
Zhejiang	108110000	5.59	102,066,651
An'hui	62918000	5.9	59,205,838
Fujian	48600000	4.57	46,378,980
Total			477,317,698

Data source: China Electric Power Yearbook 2007

Table B18. Power Import of CCG in 2006

Power Import from CCG	24,029,150
Emission Factor of CO ₂ (tCO ₂ /MWh)	0.7713
Power Import from Yangcheng Power Plant	11,150,820
Emission Factor of CO ₂ for Yangcheng Powe Plant	1.0748

Data source: <http://cdm.ccchina.gov.cn/web/index.asp>

Table B19. Calculate the Operating Margin Emission Factor of ECG in 2006

Fuel	Unit	Shanghai	Jiangsu	Zhejiang	An'hui	Fujian	Total	Emission Factors ¹² tc/TJ	Oxidation Factor ¹³ %	Average Low Calorific Value MJ/t, km ³	Emission of CO ₂ tCO ₂ e
Raw Coal	10 ⁴ t	2,744.45	10,945.42	6,065	34,55.2	2,369.63	25,579.7	25.8	100	20908	505,940,068
Cleaned Coal	10 ⁴ t						0	25.8	100	26344	0
Other Washed Coal	10 ⁴ t		150.54		23.06		173.6	25.8	100	8363	1,373,419
Coke	10 ⁴ t			39.07			39.07	29.2	100	28435	1,189,463
Coke Oven Gas	10 ⁸ m ³	1.71	3.13	0.23	0.71		5.78	12.1	100	16726	428,920
Other Gas	10 ⁸ m ³	84.64	106.54	3.28	25.12		219.58	12.1	100	5227	5,092,160
Crude Oil	10 ⁴ t			20.3			20.3	20	100	41816	622,501
Gasoline	10 ⁴ t						0	18.9	100	43070	0
Diesel Oil	10 ⁴ t	2.13	3.7	4.11	1.21	1.11	12.26	20.2	100	42652	387,305
Fuel Oil	10 ⁴ t	44.51	3.77	71.98	0.02	4.5	124.78	21.1	100	41816	4,036,838
PLG	10 ⁴ t						0	17.2	100	50179	0
Refinery Gas	10 ⁸ m ³	0.29	0.4		2.95		3.64	15.7	100	46055	96,505
Nature gas	10 ⁴ t	3.2	13.5	9.18			25.88	15.3	100	38931	5,652,267
Other Coking Products	10 ⁴ t	18.82	3.57				22.39	20	100	38369	629,993
Other Petroleum Products	10 ⁴ t						0	25.8	100	28435	0
Other Energy	10 ⁴ tce	6.66	2.8	27.45	3.21		40.12	0	100	0	0
Subtotal											525,449,440
Total CO₂ emission											555,969,131
Total power supply of ECG											593,583,295
OM											0.936632

Data source: China Energy statistical Yearbook 2007

¹² Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook¹³ Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

Table B20. The Operating Margin Emission Factor of ECG in 2004~2006

Year	2004	2005	2006	OM
CO ₂ emission (tCO ₂ e)	434,043,338	498,647,411	555,969,131	0.9540
Fuel-fired power generation of ECG (MWh)	453,378,723	515,638,698	593,583,295	