

Monitoring Report

Version 2

**Zhejiang Provincial Energy Group Zhenhai Natural Gas
Power Generation Co., Ltd.'s NG Power Generation Project**

(CDM Registration Reference No.1344)

Monitoring Period: 9 January 2007 to 25 March 2008

Date of Report: September 10, 2008

1. Introduction

The purpose of this monitoring report is to calculate the emission reductions achieved by the Zhejiang Provincial Energy Group Zhenhai Natural Gas Power Generation Co., Ltd.'s Natural Gas Power Generation Project (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 and issuance of CERs.

The present monitoring periods is chosen from 9 January 2007 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 1344, 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 Hongqiao Village, Zhenhai District, Ningbo 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 795.6MW. 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 American manufacturer of GE 109FA system, which includes following main equipments:

- GE makes PG9351FA type gas turbine;
- Heat recovery steam generator – HF-9FA-285.49/9.87-566.5-3P(R), supplied by Ha'erbin Heat Recovery Boiler Plant;
- Steam turbine, supplied by Ha'erbin Steam Turbine Plant, D10—33.5;
- Electricity generator (capacity 397.8MW), 390H, supplied by Ha'erbin Power Generator Plant.

3 Methodology and Monitoring 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.

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:

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

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 35.82%.

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)	
$EF_{BL,CO_2,2007}$	0.9508
$EF_{BL,CO_2,2008}$	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	0.8857
Option 3	0.9508	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 ($EF_{NG,upstream,CH_4}$) 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,

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

$$EF_{Coal,Adv} = SCC \times \frac{NCV_{standard,coal}}{NCV_{Rawcoal}} \times EF_{coal,upstream,CH_4}$$

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;

$EF_{coal, upstream, CH_4}$: 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; 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:	$FC_{f, y}$
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 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.

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 daily 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)
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2007/01/09~2007/04/30	6,864.00	2,960.32	3,903.68
2007/05/01~2007/05/31	25,652.00	1,194.16	24,457.84
2007/06/01~2007/06/30	142480.80	865.04	141,615.76
2007/07/01~2007/07/31	103259.20	1441.44	101,817.76
2007/08/01~2007/08/31	49,825.60	1,454.64	48,370.96
2007/09/01~2007/09/30	7,629.60	1,224.08	6,405.52
2007/10/01~2007/10/31	10,832.80	775.28	10,057.52
2007/11/01~2007/11/30	38,227.20	1,344.64	36,882.56
2007/12/01~2007/12/31	0	671.44	-671.44
Subtotal			372,840.16
2008/01/01~2008/01/31	0	444.40	-444.40
2008/02/01~2008/02/29	16,852.00	1,146.64	15,705.36
2008/03/01~2008/03/25	0	0	0
Subtotal	16,852.00	1,591.04	15,260.96
Total			388,101.12

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 (MJ/m ³)	Weight Average Net Calorific Value of nature gas (MJ/m ³)
2007/01/09~2007/01/31	1,089,936	37.03	33.32
2007/02/01~2007/02/29	845,371	37.13	33.42
2007/03/01~2007/03/31	901,357	37.17	33.45
2007/04/01~2007/04/30	736,743	37.07	33.37
2007/05/01~2007/05/31	6,740,426	37.21	33.49
2007/06/01~2007/06/30	28,711,542	37.56	33.81
2007/07/01~2007/07/31	21,456,050	36.74	33.07
2007/08/01~2007/08/31	10,521,712	36.76	33.08
2007/09/01~2007/09/30	1,695,817	36.83	33.15
2007/10/01~2007/10/31	2,738,887	36.61	32.95
2007/11/01~2007/11/30	7,471,946	36.62	32.96
2007/12/01~2007/12/31	0	0	0
Subtotal	82,909,787		
2008/01/01~2008/01/31	0		
2008/02/01~2008/02/29	4,252,159	37.32	33.58
2008/03/01~2008/03/25	0		
Subtotal	4,252,159		
Total	87,161,946		

Note: The Natural Gas Supplier has provided the Gross Calorific Value, in the monitoring report the Net Calorific Value of the NG was calculated according to the IEA industry standard (1 Net Calorific Value = 0.9 Gross Calorific Value).

5 Calculations of Emission Reductions

5.1 Project Emission Calculation

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 tCO ₂
2007/01/09~2007/01/31	1,089,936	33.32	15.30	56.10	1.00	2,038
2007/02/01~2007/02/29	845,371	33.42	15.30	56.10	1.00	1,585
2007/03/01~2007/03/31	901,357	33.45	15.30	56.10	1.00	1,691
2007/04/01~2007/04/30	736,743	33.37	15.30	56.10	1.00	1,379
2007/05/01~2007/05/31	6,740,426	33.49	15.30	56.10	1.00	12,664
2007/06/01~2007/06/30	28,711,542	33.81	15.30	56.10	1.00	54,450
2007/07/01~2007/07/31	21,456,050	33.07	15.30	56.10	1.00	39,800
2007/08/01~2007/08/31	10,521,712	33.08	15.30	56.10	1.00	19,528
2007/09/01~2007/09/30	1,695,817	33.15	15.30	56.10	1.00	3,153
2007/10/01~2007/10/31	2,738,887	32.95	15.30	56.10	1.00	5,063
2007/11/01~2007/11/30	7,471,946	32.96	15.30	56.10	1.00	13,815
2007/12/01~2007/12/31	0	-	-	-	-	0
Subtotal	82,909,787					155,167
2008/01/01~2008/01/31	0	-	-	-	-	0
2008/02/01~2008/02/29	4,252,159	33.58	15.30	56.10	1.00	8,011
2008/03/01~2008/03/25	0	-	-	-	-	0
Subtotal	4,252,159					8,011
Total	87,161,946					163,178

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 ($EF_{BL,CO_2,y}$), 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.

Based on the above analysis, the Project shall use for $EF_{BL, CO_2, 2005}$ and $EF_{BL, CO_2, 2006}$ 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	$EF_{BL, CO_2, y}$ (tCO ₂ e/MWh)	BE tCO ₂
2007/01/09~2007/04/30	3,903.68	0.8672	3,385
2007/05/01~2007/05/31	24,457.84	0.8672	21,210
2007/06/01~2007/06/30	141,615.76	0.8672	122,809
2007/07/01~2007/07/31	101,817.76	0.8672	88,296
2007/08/01~2007/08/31	48,370.96	0.8672	41,947
2007/09/01~2007/09/30	6,405.52	0.8672	5,555
2007/10/01~2007/10/31	10,057.52	0.8672	8,722
2007/11/01~2007/11/30	36,882.56	0.8672	31,985
2007/12/01~2007/12/31	-671.44	0.8672	-582

Subtotal	372,840.16	0.8672	323,327
2008/01/01~2008/01/31	-444.40	0.8154	-362
2008/02/01~2008/02/29	15,705.36	0.8154	12,806
2008/03/01~2008/03/25	-	0.8154	-
Subtotal	15,260.96	0.8154	12,444
Total	388,101.12		335,771

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	82,909,787.00	33.36	296	372,840.16
Subtotal for the year of 2008	4,252,159	33.58	296	15,260.96
Total	87,161,946	-	296	388,101.12

	$EF_{BL,upstream,CH_4}$ (tCH ₄ /MWh)	GWP_{CH_4} (tCO ₂ /tCH ₄)	LE tCO ₂
Subtotal for the year of 2007	0.0057	21	-27,934
Subtotal for the year of 2008	0.0055	21	-860
Total	-	21	-28,794

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	155,167	323,327	0	168,160
Subtotal for the year of 2008	8,011	12,444	0	4,432
Total	163,178	335,771	0	172,592

Annex 1

BASELINE INFORMATION-----Calculation of the Build 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 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
Gas-fired power plant	EF _{Gas,Adv}	47.67%	15.30	1
Oil-fired power plant	EF _{Oil,Adv}	47.67%	21.10	1
				0.95
				0.42
				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											
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 Products	10 ⁴ t	21.00	34.80	8.38			64.18	20.00	100.00	38,369.00	1,805,849.77
Subtotal											
Coke oven gas	10 ³ m ³	1.68		1.38	1.71		4.77	12.10	100.00	16,726.00	353,970.67
Other coal gas	10 ⁶ 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 ⁶ m ³	1.09	0.62	1.85			3.56	15.30	100.00	38,931.00	777,514.36
Subtotal											
Total											
449,526,906.63											
10,921,596.09											
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.

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

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

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 (tCO_2/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 CO_2 emission coefficient of fuel i ($tCO_2/mass$ 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 CO_2 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 ₂ e
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	0.00
Refinery Gas	10 ⁸ m ³						0	15.3	100	38,931	38,442.87608
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											347449917.70
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: Workbook

³ 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				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.cchina.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
CO ₂ emission caused by power import from CCG											208,009,959
CO ₂ emission caused by power import from Yangcheng											82,288,008
Total CO ₂ 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: Workbook

⁷ 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 Power 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	
Emission Factor of CO ₂ (tCO ₂ /MWh)	27,039,000
Power Import from Yangcheng Power Plant	
Emission Factor of CO ₂ for Yangcheng Power Plant	11,282,000
	1,1463

Data source: <http://cdm.cchina.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
Power Import from Yangcheng Power Plant	11,150,820
	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	34,552.2	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 CO ₂ 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: Workbook

¹³ 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	
Fuel-fired power generation of ECG (MWh)	453,378,723	515,638,698	593,583,295	0.9540