



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

CONTENTS

- A. General description of project activity
- B. Application of a baseline and monitoring methodology
- C. Duration of the project activity / crediting period
- D. Environmental impacts
- E. Stakeholders' comments

Annexes

- Annex 1: Contact information on participants in the project activity
- Annex 2: Information regarding public funding
- Annex 3: Baseline information
- Annex 4: Monitoring plan

**SECTION A. General description of project activity****A.1 Title of the project activity:**

Zhang Jiagang waste heat recovery from sulphuric acid production for electricity generation project

Version 05

Date: November 11, 2008

Version 05 is updated according to the decision made by EB at its 42nd meeting: “Zhang Jiagang waste heat recovery from sulphuric acid production for electricity generation project” (1685) if the project participant and DOE (DNV) submit a revised PDD and a corresponding revised validation report which include information on assessment of the suitability of the benchmark, in particular, whether the project activity produces electricity predominately for supply to the grid or for captive consumption through wheeling.

In response of EB’s request the further clarifications and revisions include information on assessment of the suitability of the benchmark have been updated in B.3. Sub-step2b and some minor changes in the relevant part in order to consistencies.

A.2. Description of the project activity:**The summary of the project activity:**

The project activity is developed by TWO LIONS (ZHANGJIAGANG) FINE CHEMICALS CO., LTD (hereafter referred to TFC for short) which will recover waste heat from sulphuric acid production process to produce electricity, displacing part of electricity supplied by the East China Grid which predominantly relies on fossil fuel-fired power plants for power generation. The total production capacity of sulphuric acid by TFC is 1.0 million tonnes annually, and most of the chemical reaction thermal energy by the industrial facility would be wasted in the cooling water and released to the atmosphere.

A Heat Recovery System (HRS) will be installed to recover the waste heat, and the steam generated by HRS will be exported to Siemens condensing turbine to generate electricity. The power generation capacity is 50MW, and 302,120MWh/yr electricity will be exported to East China Grid. It is expected to reduce the GHG emissions about 273,328 tCO₂e over the 10 years credit period by avoiding CO₂ emissions from electricity generation in fossil fuel power plants connected into the East China Grid.

The contribution of the sustainable development:

Being an environmentally sound project, the Project will not only supply carbon-free electricity by means of utilization of waste gas, but also contribute to sustainable development of the local community, the host country and the world by means of:

- ♦ Reducing GHG emissions compared to a business-as-usual scenario;
- ♦ Reducing energy waste and facilitating the technology development of integrated resource utilization in sulfuric acid industry;
- ♦ Reducing the emission of other pollutants resulting from the power generation industry in China, compared to a business-as-usual scenario;
- ♦ Creating 30 positions for local people during construction and operation of the Project.

A.3. Project participants:

Name of Party involved (*) (host) indicates a host	Private and/or public entity (ies) project participants (*)	Kindly indicate if the Party involved wishes to be
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Party)	(as applicable)	considered as project participant (Yes/No)
P.R.China (host)	TWO LIONS ZHANGJIAGANG) FINE CHEMICALS CO., LTD ¹	No

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

China

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

Jiangsu Province

A.4.1.3. City/Town/Community etc:

Zhang Jiagang City

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project site is located in the Jiangsu Yangtze River International chemistry park, which is 20km distance from the downtown of Zhang jiagang, Suzhou city, Jiangsu Province. The geographical coordinate of the centre of project site is: East Longitude 120 ° 27 ' 52 " , North Latitude 32 ° 00 ' 10 " . It has the Yangtze River to the north, national highway No.204 in the east, Yanjiang highway in the south and Jiangyin Yangtze big bridge in the northwest. The site is 80km from Suzhou, and 120km from Shanghai. (see Figure1 and Figure2)

¹ Project Developer (The Owner): TWO LIONS(ZHANGJIAGANG) FINE CHEMICALS CO., LTD
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Figure 1: Location of Jiangsu Province in China



Figure 2: Location of the proposed project in Jiangsu Province

A.4.2. Category(ies) of project activity:

The project activity falls into Sectoral Category 1, Energy Industries.

A.4.3. Technology to be employed by the project activity:

The proposed project activity involves Monsanto Heat Recovery System (HRS) and Siemens condensing

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turbine and power generation units.

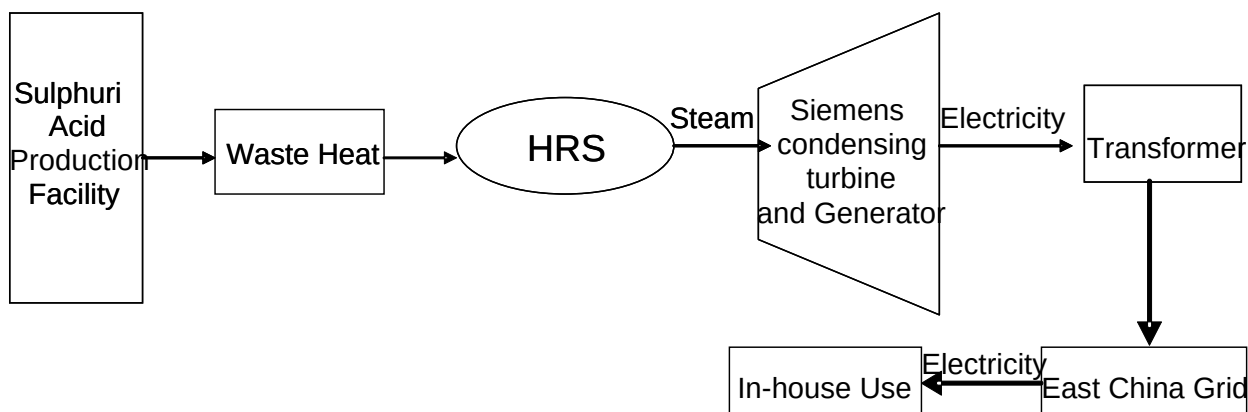


Figure 3: Technique process

Monsanto Heat Recovery System (HRS) is provided by the MONSANTO Enviro-Chemical Systems of China, LLC. Waste heat from 1.0 million sulphuric acid production processes will be recovered by HRS to generate steam for turbine. The technology is proven to be reliable, as the first unit of this type was installed in 1987 in Namahe, South Korea, and 20 units are currently operated worldwide before the proposed project. HRS systems and auxiliary equipments contain tanks and pumps, a steam boiler, water preheater, a dilution device, and the monitoring instrumentation, which are all designed and produced in USA.

The model numbers and operation conditions of the main equipments of HRS can be seen in the table below (Table 1).

Table 1. Major Equipments of HRS

Item NO.	Device Name	Model Numbers	Pressure (MPa)	Temperature (°C)	Medium	Manufacturer
MB151	HRS Boiler	Φ2184*10500	0.83	185	Water and Steam	MECS
MP113	HRS Acid Circulation Pump	1830M ³ /H 18m	0.27	230	99.5% Sulphuric Acid	MECS
MS951	HRS Acid Diluter	Φ700*3000	0.25	200	99.2% Sulphuric Acid	MECS
MX151	HRS Heater	Φ405*9675	1.6	230	99.5% Sulphuric Acid and Water	MECS
MX152	HRS Preheater	Φ890*12070	1.2	180	99.5% Sulphuric Acid and Water	MECS
MX153	HRS 2nd Stage Cooler	Φ406*11605	1	82	98.5% Sulphuric Acid and Water	MECS



VS132-003	HRS Tower Mist Eliminators	ES	0.03	80	SO ₃ Gas and Sulphuric Acid	MECS
VV046	Heat Recovery Tower with Pump Boot	Φ8000*21500	0.03	230	SO ₃ Gas and Sulphuric Acid	MECS
MS962	Steam Injection Nozzle	DN150	0.8	180	Steam	MECS
MS963	Steam Injection Vessel	Φ2100*15000	0.03	260	SO ₃ Gas, Sulphuric Acid and steam	MECS

Siemens Turbine Units, produced by Siemens Company in German, can generate power with high efficient. The turbine can turn steam's enthalpy to power so efficiently that the exhaust steam at the indicated exhaust pressures and temperatures may contain as much as 10-20% water (condensed steam) depending on partial or full load and exhaust pressure. For high efficiency condensing turbines like this kind, water content in the exhaust steam is typical. For a simple explanation, there is water entrained because the turbine has extracted enough power from the steam that some steam has condensed before being exhausted to the condenser. There are several successful models of Siemens Turbine Units in traditional power station all over the world.

Table 2. Parameter about Turbine

Item NO.	Device Name	Model Number	Capacity(MW)	Manufacturer
MG101	Steam Turbine Generator units	ENK63/3.2	50	SIEMENS

The both technologies above referred to the project activity are firstly applied in China Sulphuric acid industry. TFC mastered the basic principle and operation method of the advanced technology in two years during the project construction. Some Chemical Groups in China such as Yichang Chemical Group become interested in this type of project, and dispatches the engineers to the proposed project site to gain the relative experience about HRS and Siemens turbine.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

Year	Annual estimation of emission reductions in tonnes of CO ₂ e
2008(01/06-31/12) ²	159,441.3
2009	273,328
2010	273,328
2011	273,328
2012	273,328
2013	273,328

² The estimated starting date of credit period will be 01/06/2008.



2014	273,328
2015	273,328
2016	273,328
2017	273,328
2018(01/01-31/05)	113,886.7
Total estimated reductions (tonnes of CO ₂ e)	2,733,280
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO ₂ e)	273,328

A.4.5. Public funding of the project activity:

The project will not receive any public funding from Parties included in Annex I of the UNFCCC.

SECTION B. Application of a baseline methodology**B.1. Title and reference of the approved baseline methodology applied to the project activity:**

ACM0004 “Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation”, Version 02, 3rd Mar 06.

ACM0002 “Approved Consolidated Baseline Methodology for grid connected electricity generation from renewable sources”, Version 06 (19th May, 2006).

Additionality of the project has been justified using the approved “Tool for the demonstration and assessment of additionality”, Version 03, EB29.

It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC CDM website (<http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>).

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The table 3 below shows the reason for why the methodology is applicable to the project activity.

Table 3 : Reason for the applicability to project activity

No.	Applicability Conditions as per ACM0004	Situation of this Project Activity	Yes/No
1.	Applicable to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities	This project activity generates electricity from waste heat recovered from sulfuric acid production facility.	Yes
2.	Applicable to electricity generation project activities that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, electricity	This project activity generates electricity exported to Grid, which displaces electricity generated by fossil fuel plants in East China Grid.	Yes



3.	Applicable to electricity generation project activities where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity	This project activity does not result in any fuel switch in sulfuric acid production process from where waste heat is generated since the waste heat is released from chemical reaction.	Yes
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B.3. Description of how the sources and gases included in the project boundary

The spatial extent of the project boundary comprises the waste heat sources, waste heat recovery system equipment, and the power plants connected physically to East China grid that the proposed project activity will affect.

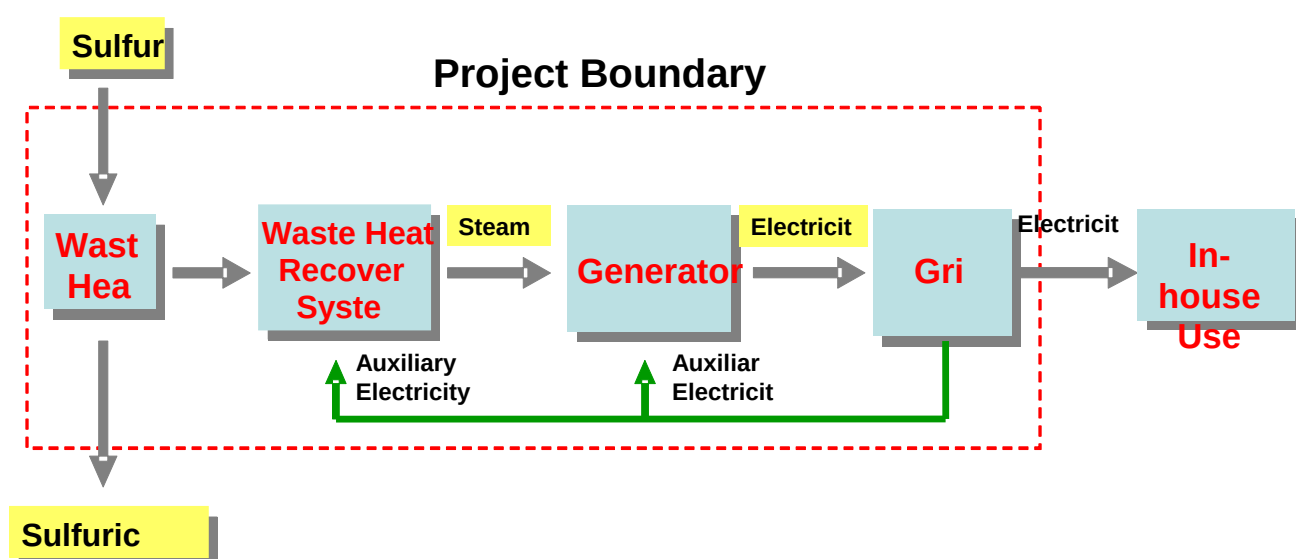


Figure4. Project Boundary

	Source	Gas		Justification / Explanation
Baseline	Grid electricity generation	CO ₂	Included	Main emission source
		CH ₄	Excluded	Excluded for simplification. This is conservative.
		N ₂ O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity	CO ₂	Excluded	May be an important emission source, in this project the source is excluded, since there is no fossil fuel need to be used within the project boundary due to the project activity.
		CH ₄	Excluded	Excluded for simplification.
		N ₂ O	Excluded	Excluded for simplification.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The steps for identification and determination of baseline scenario

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**Step 1: Identify the realistic and credible alternatives to baseline scenario.**

The possible alternative scenarios in absence of the CDM project activity would be as follows:

Alternative 1: The proposed project activity is not undertaken as a CDM project activity;

Alternative 2: Import of electricity from the grid;

Alternative 3: TFC sets up a new fossil fuel-fired power plant on-site for exporting electricity to East China Grid;

Alternative 4: TFC sets up a new renewable energy power plant on-site for exporting electricity to East China Grid;

Alternative 5: Other uses of the waste heat and waste gas: TFC recovers the waste steam to supply heat for other facilities of TFC or other enterprises nearby.

Step 2: Determine the baseline scenario to the project activity.

Alternative 1: The implementation of the alternative will need high cost investment and advanced technology, if without support from CDM, the project will not be operated commercially by TFC (Refer to B.5). Therefore, alternative 1 could be excluded.

Alternative 2: The electricity exported by the project activity will be provided by combination of the operating margin and build margin of East China Grid. TFC would not encounter barriers from investment, technology, or materials. Thus, alternative 2 is a credible and plausible scenario.

Alternative 3: For fossil fuel fired power generation project, the alternative should be eliminated from the following consideration because it does not comply with the national regulation for prohibiting small scale coal-fired power plant. To provide the same output as the proposed project, the capacity of coal power plant will be less than 50 MW then the project will be categorized as the small scale coal power plant. According to the regulations from NDRC, the coal power plant under 50 MW should be shut down and the construction of coal power plant under 100 MW will be forbidden within the connected area. Thus, alternative 3 could be excluded. (<http://info.westpower.com.cn/cgi-bin/Ginfo.dll?DispLaw&w=westpower&ac=&gr=6067&pr=0&lid=15812>)

Alternative 4: The same volume of electricity could be supplied by a new renewable energy (such as wind, hydro, etc) power plant on-site. For hydro power plant, the landform of the site is plain, which is not adapt to set up a hydro power plant; besides, the wind speed of the on site district is about 3 m/s, which belongs to wind resource available district in China³. But the wind resource is not enough for power generation. What's more, TFC is a fine chemical enterprise, and has no interests in the renewable energy investment. Therefore, alternative 4 could be excluded.

Alternative 5: The project activity is located in Jiangsu Yangtze River Chemical Industry district. The *Approval of Environmental Impact Assessment and Environmental Protection Plan of Jiangsu Yangtze River Chemical Industry district* reads: *The heat or steam used in the district must be supplied by the thermal electricity plant of Free Trade Zone*. So TFC can't supply heat or steam to other enterprises. At the same time The Free Trade Zone doesn't forbid the project owner to utilise the waste heat and TFC doesn't have the demand of heat or steam in other facilities, either. Therefore, in the absence of the project activity, TFC would not recover the waste heat for supplying steam. Alternative 5 could be excluded.

To sum of, in the absence of the project activity, the alternative 2 is the most credible and plausible scenario. In the absence of the project activity, waste heat recovery and power generation is not enforced in laws and regulations of China. TFC would not recover the waste heat from 1.0 million sulphuric acid production facilities; the electricity exported to the East China Grid by the project activity will be

³ Wind Energy Distribution Map of China and Distribution of annual duration of wind speed above 3 m/s in China.



supplied by other power plants in the East China Grid, most of which consume fossil fuel, while CO₂ emissions will be generated.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

‘Tool for the demonstration and assessment of additionality (version 03)’ is applied to determine the additionality of the project activity. The processes are as follows:

- In 2003, MONSANTO Enviro-Chem Systems of China, LLC. advised TFC to use advanced technology as well as introduced the concept of CDM.
- In 2003, TFC considered that CDM revenue would compensate the high investment and conquer the high risk.
- On 2003.12.11, MONSANTO Enviro-Chem Systems of China, LLC promised it could help TFC getting the financial support for the proposed project from Rabobank Group.
- On 2003.12.11, MONSANTO Enviro-Chem Systems of China, LLC offered CDM service contents and schedule to TFC for developing CDM project.
- On 2003.12.22, MONSANTO Enviro-Chem Systems of China, LLC drafted the PIN for the project.
- On 2004.4.26, the president of TFC came to Hong Kong for CDM cooperation with Rabobank Group.
- On 2004.10.28, MONSANTO Enviro-Chem systems of China discussed with Rabobank about CDM application issues of Twolions Project.
- On 2005.6.24, the project testing operation was implemented.
- On 2005. 10.17, Twolions Company signed a commission with SYDIC for CDM consulting.
- On 2006. 5.10, Twolions Company signed CDM consulting agreement with SYDIC

According to the milestone above, it demonstrates that CDM revenue has been considered from the early stages of development of the project, and it is a significant part of the financial package of the project. Furthermore, MONSANTO Enviro-Chem Systems of China, LLC helped TFC to develop CDM project in the following period. However, from 2003 to 2004, there is no suitable methodology for the project activity so that the developing period was prolonged. July 8th 2005, ACM0004 “Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation” was approved by EB. All the documents will be sent to DOE, which show that CDM has been always an issue and an important factor from year 2003.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

Referring to B.4, the possible alternative scenarios in absence of the CDM project activity would be as follows:

- Alternative 1: The proposed project activity is not undertaken as a CDM project activity;
- Alternative 2: TFC doesn't recover the waste heat to generate electricity for East China grid, the electricity exported by the project activity will be displaced by combination of the operating margin and build margin of East China Grid;
- Alternative 3: TFC sets up a new fossil fuel fired power plant on-site for exporting electricity to East China Grid;
- Alternative 4: TFC sets up a new renewable energy power plant on-site for exporting electricity to East China Grid;
- Alternative 5: Other uses of the waste heat and waste gas: TFC recovers the waste steam to supply heat for other facilities of TFC or other enterprises nearby.



As described in B.4, Alternative 3 is forbidden in China, due to no suitable renewable resource on site alternative 4 is not feasible, and there is no heat or steam demand in TFC's other facilities, and the heat demand of the Free Trade Zone will be satisfied by designated thermal electricity plant, alternative 5 is not applicable. Therefore, the alternatives leave 1 and 2.

Sub-step1b.Enforcement of applicable laws and regulations:

The current laws and regulations in China show that the government encourages the development of waste heat or waste gas utilization projects. Nevertheless, due to different situation in different enterprises including resources, technologies, financing, etc, the government doesn't enforce to recover waste heat or waste gas to generate electricity. Therefore, alternative 2 obeys the current laws and regulations in China. What's more, alternative 1 is not enforced in China.

Step 2: Investment analysis

The purpose of this step is to determine whether the Proposed Project activity is financially less attractive than other alternatives without the revenue from the sales of CERs. The investment analysis was done in the following steps:

Sub-step2a: Determine appropriate analysis method:

Three analysis methods suggested by *Tools for the demonstration and assessment of additionality* are simple cost analysis (option I), investment comparison analysis (option II) and benchmark analysis (option III). Since in addition to the CDM revenues, the proposed project will earn revenues from the sales of electricity, the simple cost analysis method is not appropriate.

Investment comparison analysis method is only applicable to the case that alternative baseline scenario is similar to the proposed projects. While the baseline scenario of the proposed project is the East China Grid supplies the same amount of electricity rather than a new investment project. Therefore option II is not an appropriate method either.

Since the Project IRR, in this case, the equity IRR is available, the project will use the option 3 benchmark analysis.

Sub-step2b: Option 3-Apply benchmark analysis:

As per the EB's correction request to assess the suitability of the benchmark applied for proposed project it is clarified here whether the project activity produces electricity predominately for supply to the grid or for captive consumption. The project participants note that there is no information available about the definition, approved guidance/methodology or EB's decision how to determine whether the project activity produces electricity predominately for supply to the grid or for captive consumption through wheeling. The project participants therefore rely on the following summary of electricity consumption by TFC's operations comparing to the power generation produced by the project activity as follows:

Time	Electricity consumption by TFC (MWh)	Electricity generated by proposed project(MWh)
2005 from Jul. to Dec.	121292.9	121638.1
2006	398771.4	400860.1
2007	417523.4	418530.0
2008 from Jan. to Sep.	295201.7	295268.7
Total	1232789.4	1236296.9
Percentage	99.7%	100%

Note:



1. The data provided here has been notarized by the Jiangsu Zhangjiagan Grid Company⁴
2. The proposed project started commission at date of 24th June, 2005
3. The estimated electricity produced by proposed project is 392,400 MWh/year

Beside the sulphuric acid production facility TFC⁵ consists of an Ion Exchange membrane Caustic Soda production facility with a capacity of 120 kilotons/year situated next to sulphuric acid production facility. The electricity demand and consumption by the above two facilities is purchased from the electricity grid company in the baseline situation. In the project situation the proposed project (power plant) has to be connected to electricity grid, i.e. Jiangsu Zhangjiagan Grid which is an integral part of East China Grid. Grid-connectedness is required as the project entity is obligated to ensure the safe utilization of electric power for the production facility. The electricity demand and consumption by the project owner has to be deferred to the electricity dispatch centre which is controlled by the grid company. In principle the electricity demand and consumption by project owner for sulphuric acid production and Ion Exchange membrane Caustic Soda production facilities will be first satisfied by the grid company due to the electricity contribution made by project owner. Strictly speaking all the electricity demand and consumption by anyone in China have to be deferred to electricity dispatch centre which is controlled by the grid company following the regulation issued by China State Council.⁶ However, under normal operating conditions TFC's facilities consume more electricity from the grid than the project activity can generate. To minimise transmission loss all the electricity from the project activity is in practice therefore fed back to TFC's facilities through wheeling. According to the data in the above table, the electricity consumption by TFC is nearly equal to the electricity produced by the proposed project from 2005 to date. This means that the project scenario is predominantly for captive purposes and the sector benchmark, i.e. fine chemicals benchmark is suitable for the investment analysis. The benchmark, an equity IRR of 15% selected for project investment analysis is an official benchmark issued by the relevant authority and widely used by project entities when conducting project investment analysis for this sector in China.

The benchmark (15%) applied by proposed project meets the criteria set out in the *Tool for the demonstration and assessment of additionality* approved by the EB. The Tool for the demonstration and assessment of additionality (Version 05.2) states in Step 2, Section (6), *that benchmarks shall be derived from (d) Government/official approved benchmark where such benchmarks are used for investment decisions*;

The benchmark applied by the proposed project is derived from the official guidance *Economic Assessment Methods and Parameters for Project Construction*. This reference is widely used by investor for assessing the financial viability of potential new projects. This publication states that when a project owner invests in a project with key characteristics of another sector rather than its own core business, and has little experience of these characteristics and the project risk, the sectoral benchmark IRR of its own core business will be applied⁷. Based on these guidelines and the logic that the project is totally dependent upon the sulphuric acid market, the internal benchmark of the company is the fine chemicals sectoral benchmark. The appropriateness of applied the benchmark was cross-checked and confirmed by an independent bank and official organization – China Sulfuric Acid Industry Association.⁸ Further

⁴ The letter notarized by Jiangsu Zhangjiagan Grid Company has been provided to DOE for validation

⁵ The business license of TFC clearly shows that TFC's business include the sulphuric acid production and Caustic Soda production. A clarification letter by local authority, Zhangjiagan City Economic Development Bureau, has confirmed that TFC have sulphuric acid production and Ion Exchange membrane Caustic Soda production facilities at same site.

⁶ The notice of measures for electricity dispatch issued by China State Council clearly stipulated the principal and procedure for electricity dispatch. Please see the text from official website of National Development & reform Commission http://www.ndrc.gov.cn/zcfb/zcfbqt/2007qita/t20070828_156042.htm

⁷ Methods and Parameters for Economic Assessment of Construction Project (version 3), published by China's National Development and Reform Commission and Construction Ministry, December 2006, paragraph 2, point 2, page 197

⁸ "Clarifications about the classification on the production scale of sulphuric acid facilities and waste heat recovery and utilization in China", CSAIA, Aug. 2008 submitted in Chinese with English translation.

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evidence that the fine chemicals benchmark was considered at the time of the investment decision can be found in the Loan Agreement from the China Bank of Communications submitted with this document. This explicitly mentions the fine chemical industry's benchmark (IRR of 15%) and states that the request for loan to TFC is approved on the basis that it exceeds this benchmark.⁹

On the basis of above discussion, the calculation and comparison of financial indicators are carried out in sub-step 2c.

Sub-step2c: Calculation and comparison of financial indicators:

Table4. Main parameters for calculation of financial indicators

Items	Unit	Value	Reference
Capacity	MW	50	Feasible study report and fixed asset table
Total Investment	Million Yuan	298.94	Feasible study report
Depreciation Rate	%	5%	Feasible study report
Equity	Million Yuan	89.98	Feasible study report
Annual Operational and Maintenance Fee	Million Yuan	40.38	Feasible study report
Annually output exported to East China Grid	GWh/year	302.12	Feasible study report
Electricity Tariff(Excluding VAT)	Yuan/kWh	0.33	Feasible study report
Value Added Tax (VAT)	%	17%	Feasible study report
Income tax	%	33%	Feasible study report
Expected CERs Price	\$/tCO ₂ e	9.5	ERPA
Emission Reduction	tCO ₂ e/y	273,328	PDD
CERs crediting time Year	Year	10	PDD

The financial indicators (IRR) with and without income from selling CERs are listed in the following table. Without income from selling CERs, the IRR of the proposed project is lower than the benchmark IRR and the proposed project is financially unacceptable because of its low profitability. While considering such income, the financial acceptance will be changed; the IRR of the proposed project is higher than the benchmark then the proposed project is financially acceptable.

Table 5.Comparison of financial indicators with and without income from CERs

Items	Unit	Without income from CERs	Benchmark	With income from CERs
Equity IRR	%	11.76%	15%	17.51%

Sub-step 2d. Sensitivity analysis.

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

Three factors are considered in following sensitivity analysis:

⁹ Loan Agreement between TFC and China Banks of Communications (30 June 2004), submitted with this document in Chinese with English translation.



- 1) Total investment
- 2) Electricity price
- 3) Operation and maintenance fee

We assumed that the above three factors are varied in the range of $\pm 10\%$ in the critical assumptions, the IRR of the proposed project (without income from selling CERs) would be varied to different extent, as shown in Table 6 below.

Table 6. Results of the sensitivity analysis-impact of variations in critical assumptions on IRR

Assumptions Critical assumption	-10%	0%	+10%
Total Investment	12.64%	11.76%	11.00%
Electricity price	9.10%	11.76%	14.25%
Operation and maintenance fee	13.25%	11.76%	10.29%

According to table 6:

1. When the total Investment reduces 10%, IRR is still below benchmark 15%. When the total investment reduces 31%, the IRR of the project will reach 15.01%, which becomes the benchmark 15%. However the project is the first sulfuric acid plant with HRS in China Mainland, all the equipments should be imported from USA. And the raw material price is increasing continuously. So it is impossible that the total Investment will reduce 31%, and the project activity indicates a lowly economically attractive course of action.
2. When the operation and maintenance fee reduces 10%, IRR is still below benchmark 15%. When the operation and maintenance fee reduces 22%, the IRR of the project will reach 15.01%, which becomes the benchmark 15%. As the project is firstly operated for the project owner, it is not likely that the operation and maintenance fee will reduce 22% (details see barrier analysis). So the project activity indicates a lowly economically attractive course of action.
3. In the case that the electricity price increased by 10%, the IRR of the proposed project is still below benchmark 15%. However electricity generation quantity is calculated in the light of academic parameters of facilities, and its changing range is very small. Also electricity price is validated and approved by the government and it won't change largely under the premiss of according with national policy. Therefore, the situation is impossible to be realized and the project is not financially attractive.

As shown in the sensitivity analysis, when the sensitive factors are varied in the reasonable range of $\pm 10\%$, the equity IRR of the project remains lower than the benchmark. Therefore, the project remains economically and financially unattractive to the project owner.

Except for lowly economical attraction, the proposed project activity would meet some barriers in the implementation process. The detailed analysis is in Step 3.

Step 3. Barrier analysis.

The objective of this step is to identify barriers that prevent the implementation of this type of proposed project activity but do not prevent the implementation of at least one of the alternatives identified in Step 1.

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

According to the certification from Monsanto LLC and China Sulfuric Acid Industry Associations (hereafter referred to CSAIA for short), the project activity is the first case in China, which applies to HRS of Monsanto. There are 20 cases applied to HRS around the world before the proposed project,

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which exist mainly in developed country.

Technical Barriers:

➤ High demand to sulfuric acid production

There is a more strict demand of the sulfuric acid production procedures than usual owing to the applied HRS and Power generation system, as the following table:

Table 7 Parameter and Requests Comparison

Phase of Sulfuric Acid Production	Parameter and Demands	Routine Project Without HRS	Project activity With HRS
SO ₃ gas combines with water in HRS Tower	The range of sulfuric acid concentration	Wider (About 98%, Easy to control	Narrow (99.0%-99.7%) ¹⁰ , Hard to control
	Temperature Demand	Lower temperature (90°C-100°C) , Weak causticity;	Higher temperature (225°C ¹¹) , Strong causticity ¹² ;
	Demands for the staff	Familiar with operation and maintenance of Routine equipments from domestic.	Familiar with the new technology, rich experience at the production process, ability to identifying, analysis and disposal of the malfunction.

As showed in Table 7 above, the technical parameter of SO₃ absorbing must be controlled between 99.0%-99.7%, which is more narrow than routine project operation, and the temperature must be controlled above 200 °C, comparing to 90°C-100°C of routine demand. It is hard to manipulate in practice. In addition, tremendous loss would be broken out resulted from stopping Sulfuric acid production in order to eliminate HRS trouble. Although HRS equipment is made of the '310 stainless steel', which is more adapt to the strong causticity materials, it also contains risk on operation. Table A11 showed in annex 3 below is supplied by Monsanto, and 11 times incidents occurred on 8 units HRS in last 8 years all over the world during its operation. If there is additional revenue from CDM, TFC can purchase advanced sensor and control system of HRS, and import some spare of destructible part of HRS. Thus the project will maintain normally.

➤ Need experienced engineers for operating successfully

Referring to table 7 above, new technical criteria brings on the demand of experienced engineers. More accurate management and lots of extra work should be done during the running period. Although experts from Monsanto have made some basic training for TFC' engineers, they have just known the basic operational principle. TFC still lacks of experienced engineers, who are familiar with operating the advanced equipments, and could identify incidents risk, deal with the emergency situation. Besides, before the proposed project activity, there is no example to use such kind of advanced technology in China sulfuric acid industry. Such domestic professional engineers are lacking obviously. Inviting experts aboard to train the local engineers and fetching in specialist working for enterprise are good way to reduce the running risk and insure the operation successfully. However, the extra expense enhances the

¹⁰ Monsanto Operation Manual---Section10 Acid Heat Recovery System

¹¹ Monsanto Operation Manual---Section10 Acid Heat Recovery System

¹² Monsanto Operation Manual---Section10 Acid Heat Recovery System



financial burden in the same time. So, if there is no CDM revenue, the enterprise could not conquer these technical barriers.

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

The baseline scenario is that TFC doesn't recover the waste heat, and the electricity exported by the project activity will be supplied by East China Grid. There is no need to extra investment and new technology application, so the barriers, which mentioned above could not influence this scenario.

Step 4. Common Practice Analysis

Sub-step 4a. Analyse other activities similar to the proposed project

According to the *Tool for the demonstration and assessment of additionality*, "Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc."

There were about 110 sulfuric acid plants in China in 2004, the number of super large scale sulfuric acid facility (above 0.6 million tons per year) was four, and the number of large scale sulfuric acid facility (between 0.2 million to 0.6 million tons per year) was 51, and the number of small scale sulfuric acid facility (below 0.2 million tons per year) was 55¹³. As the sulfuric acid facility of TFC is 1.0 million tons per year, it belongs to the super large scale sulfuric acid facility. So the sulfuric acid facilities below 0.6 million tons were excluded. The China Sulfuric Acid Industry Associations (CSAIA)¹⁴ provides the following country-wide list of super large-scale sulfuric acid production facilities (defined as above 0.6 million tons per year in China):

1. YunTianHua International Chemical;
2. Guizhou Kailing Group;
3. Hubei Yangfeng Company;
4. Guizhou Xiyang fertilizer industry;

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

The projects above were compared with the proposed project because of the similar scale of the underlying sulphuric acid production facility, and were operational in 2004. However, as these super large-scale sulphuric acid facilities use traditional WHRS and were mostly installed in fertilizer plants there are a number of important differences which exclude them from being considered in the common practice analysis:

- Firstly, the project facility is located in the International Chemicals Industrial Park of the Zhangjiagang Free Trade Zone. The tenancy agreement at the park does not allow for the use of waste heat on site or the direct sale to third parties.¹⁵ It is therefore necessary for the owner to invest in far more expensive equipment to produce high pressure steam to generate power. The other facilities all identified do not face this restriction and utilize the waste heat mainly to supply steam. The traditional waste heat recovery in the above WHRS occurs in the liquid phase of the cracking process. The Monsanto HRS heat recovery occurs in the gas phase of the cracking process, which increases the difficulty of controlling sulphuric acid production.

¹³ "Clarifications about the classification on the production scale of sulphuric acid facilities and waste heat recovery and utilization in China", CSAIA, Aug. 2008

¹⁴ "Accounting for utility of the waste heat from super large-scale sulfuric acid facilities in China", CSAIA Dec 2004

¹⁵ This evidence has been submitted to the DOE and validated.



- Secondly, traditional WHRS utilize mature existing boiler technologies which are commonly used in China's sulphuric acid industry. The Monsanto HRS utilizes a double absorption tower to recover reaction heat to generate high temperature acid steam to regenerate steam, which is the core of Monsanto's technology. In the SO₃ gas absorption phase of sulphuric acid production, the Monsanto HRS utilizes the double absorption tower and boiler to replace the intermediary absorption tower and an acid cooler of traditional WHRS. This leads to an enhanced heat recovery and reduced energy waste in the cycle water. The Monsanto HRS double absorption tower is characterised by the high temperature of the gases at the exit, which allows the generation of additional saturated steam, and leads to a greater ratio between the heat recovered and the heat released by the exothermic absorption process.
- Thirdly, with regards to the waste heat recovery technology used by the project activity, in the SO₃ gas absorption phase of sulphuric acid production, the technical parameter of SO₃ absorption must be controlled between 99.0%-99.7%, which is a much narrower range than projects used in a traditional WHRS. In addition the temperature of the Monsanto HRS must be controlled above 200°C, comparing to 90°C-100°C of a WHRS utilizing traditional technology. **Table 7** above shows a comparison of the parameters and operating requirements between the project activity utilizing Monsanto HRS and projects utilizing traditional WHRS.
- Fourthly, the Monsanto HRS is imported from the USA, and its investment cost is far higher than traditional domestic WHRS. As an article from a professional chemical industry publication states: *"The investment of Monsanto HRS is so high that it is hard to be accepted by common investors. It is especially difficult to promote this technology in developing countries such as China. For example, in the installation of a Monsanto HRS linked to a 1000 tons/day sulphuric acid production facility, the Monsanto HRS accounts for 30% of the total sulphuric acid production facilities investment. The total investment of the project with a Monsanto HRS is 1.4 times higher than the project utilizing a traditional WHRS"*.¹⁶

A detailed comparison of the Monsanto HRS with traditional WHRS at existing super large-scale sulphuric acid production facility is provided in **Table 8** below:

Table 8 Super big-scale sulfuric acid facilities in China¹⁷

ID	Enterprises	Producing technology	Scale of facility (Million tons)	Demand of Heat	Utility of waste Heat	Facility	Utility of electricity	Proposed to apply the CDM
1	TFC	Sulfur to sulfuric acid	1.00	No	Utilising high pressure steam	Monsanto HRS	Export to East China Grid	Yes
2	YunTianHua International Chemical	Sulfur to sulfuric acid	0.80	Yes	Utilising low pressure steam	Traditional facility	Meet in-house power demands	No
3	Guizhou Kailing Group	Sulfur to sulfuric acid	0.80	Yes	Utilising low pressure steam	Traditional facility	Meet in-house power demands	No
4	Hubei Yangfeng	Sulfur to sulfuric	0.60	Yes	Utilising low	Traditional facility	Meet in-house	No

¹⁶ 'Waste Heat recovery and utilization from sulphuric acid production', Mr. Yu Xiangdong, Nanjing Chemical Design Institute 'Sulphuric Acid' Volume 3 2000

¹⁷ Accounting for utility of the waste heat from super big-scale sulfuric acid facilities in China by CSAIA in 2004. This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



		acid			pressure steam		power demands	
5	Guizhou Xiyang fertilizer industry	Sulfur to sulfuric acid	0.60	Yes	Utilising low pressure steam	Traditional facility	Meet in-house power demands	No

In conclusion, based on scale and technology as described above, there are essential distinctions between the Monsanto HRS used by the project activity and traditional WHRS used by the four other plants. These four projects have therefore been eliminated in the common practice analysis.

As the project is the first-of-its-kind in mainland China, there exist no similar project to the project activity. Further evidence by Monsanto Enviro-Chem Systems Inc. that this project is unique is submitted with this document. This evidence states that the Monsanto HRS installed on 12 April 2005 at Zhangjiagang Two Lions Fine Chemical Co., Ltd. is the first sulphuric acid plant in mainland China.¹⁸

The capture and utilization of waste heat for export of electricity to the grid is consequently not a common practice in the sulphuric acid industry in China.¹⁹ Therefore, without the project activity, the waste heat from sulphuric acid facility would be released by condensed water, and the electricity supplied by the project activity would be supplied by other power plants in the East China Grid, most of which consume fossil fuels.

Based on the above analysis and demonstration, the proposed project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

In accordance with the calculating steps and formulas provided in ACM0004 and ACM0002, the emission reductions of the project activity are calculated as follow:

1. Calculation of Project Emissions

The calculation of the Project Emissions will use the following formula:

$$PE_y = \sum_i Q_i \times NCV_i \times EF_i \times \frac{44}{12} \times OXID_i \quad (1)$$

where:

- PE_y is Project Emissions in year y in tCO_2 ,
- Q_i is mass or volume unit of fuel i consumed in t or m^3 ,
- NCV_i is net calorific value per mass or volume unit of fuel i in TJ/t or m^3 ,
- EF_i is carbon emissions factor per unit of energy of the fuel i in tC/TJ ,
- $OXID_i$ is oxidation factor of the fuel i .

¹⁸ Certification from Monsanto Enviro-Chem Systems Inc.(May 2005) in English.

¹⁹ "Clarifications regarding the classification on the production scale of sulphuric acid facilities and waste heat recovery and utilization in China", CSAIA Aug. 2008



Because no auxiliary fuel is used in the process of heat recovery or power generation of the proposed project, therefore, the PE_y is 0.

2. Calculation of Baseline Emissions

The baseline emissions are calculated with the formula given as:

$$BE_{electricity,y} = EG_y \times EF_{electricity,y} \quad (2)$$

where:

- $BE_{electricity,y}$ is the baseline emissions during the year y in tCO₂,
- EG_y is net quantity of electricity supplied to the grid by the project during the year y in MWh,
- EF_y is CO₂ baseline emission factor for the electricity displaced due to the project activity during the year y in tCO₂/MWh.

➤ Calculation of EG_y

According to the monitoring methodology of ACM0004, the net electricity supplied to the grid equals to the total electricity supplied minus the auxiliary electricity, which includes electrical energy utilized by the waste heat recovery equipments and the power generating facilities in the project boundary. Net electricity supplied to the power grid is calculated based on follows:

$$EG_y = EG_{GEN} - EG_{AUX} \quad (3)$$

Where:

- EG_y is net quantity of electricity supplied to the grid by the project during the year y in MWh,
- EG_{GEN} is Total electricity supplied by the project during the year y in MWh,
- EG_{AUX} is Auxiliary electricity which includes electrical energy utilized by the waste heat recovery equipments and power plant in the project boundary during the year y in MWh.

➤ Calculation of EF_y

As the baseline scenario of the proposed project is the electricity exported by the project activity will be supplied by other power plants in the East China Grid, while most of them are fossil fuel fired power plants. Referring to the delineation of grid boundaries as provided by the DNA of China, *East China Grid covers five provinces (Jiangsu, Shanghai, Anhui, Zhejiang, Fujian)*²⁰, the proposed project locates in Zhangjiagang city, which belongs to Jiangsu Province. So it is appropriate to select the East China Grid as project system boundary.

According to ACM0002, the baseline emission factor ($EF_{y,y}$) is calculated as a combined margin (CM) of $EF_{OM,y}$ and $EF_{BM,y}$, based on the following three steps:

The emissions factor of East China Grid is calculated as follows:

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

Calculation of OM emission factor should be based on one of the following four methods:

(a) Simple OM, or

²⁰ <http://cdm.ccchina.gov.cn/web/index.asp>



- (b) Simple adjusted OM, or
- (c) Dispatch Data Analysis OM, or
- (d) Average OM.

Each method is analyzed as below.

Method (c) Dispatch data analysis OM

If the dispatch data is available, method (c) should be the first methodological choice. This method requires the dispatch order of each power plant and the dispatched electricity generation of all the power plants in the power grid during every operation hour period. Since the dispatch data, power plants operation data are considered as confidential materials and only for internal usage not available publicly. Thus, method (c) is not applicable for the proposed project.

Method (b) Simple adjusted OM

The application of simple adjusted OM method requires the annual load duration curve of the power grid and the load data of every hour data during the whole year on the basis of the time order. As mentioned above, the dispatch data and detailed load curve data were not available publicly. Therefore, method (b) is not applicable for the proposed project as well.

Method (d) Average OM

Method (d) will only be used when (1) low-cost/must run resources constitute more than 50% of total grid generation and detailed data to apply method (b) is not available, and (2) where detailed data to apply option (c) above is unavailable. From 2001 to 2005, the low-cost/ must run resources constitute less than 50% of total amount grid generation output. (See Table 9). Hence method (d) is not applicable for the proposed project.

Method (a) Simple OM

The simple OM method 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. Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants. From 2001 to 2005, the low cost must run resources constitute less than 50% of total amount grid generation output. (See Table 9). Therefore, method (a) is applicable for the project.

Table 9. 2001-2005 East China Power Grid Electricity Generation²¹

Year	Installed capacity (MW)					Electricity generation (GWh)				
	Total	Hydro	Thermal	Others	% low cost/ must run	Total	Hydro	Thermal	Others	% low cost/ must run
2001	71939.1	12555	59021	363.1	17.96%	327014	34999	289436	2579	11.49%
2002	76025.5	13165.1	61120.2	1740.2	19.6%	367814	37835	324204	5775	11.86%
2003	81096.7	13602.5	65036.5	2457.7	19.8%	429127	31982	382112	15033	10.96%

²¹Numbers are calculated on the basis of data for Shanghai, Jiangsu, Zhejiang, Anhui and Fujian. Low cost / must run resources in Table 9 are composed of “Hydro” and “Others”. The category “Others” is mainly composed of wind power and is therefore included as part of low cost / must run.



2004	96970.5	14417.8	79424.1	3128.6	18.09%	487986	25556	440292	22138	9.77%
2005	123613.3	16069.4	104076.6	3467.3	15.8%	5723.33	442.37	5056.63	224.33	11.65%

Source: China Electric Power Yearbook (editions 2002, 2003, 2004, 2005 and 2006)

In conclusion, method (a) is the only reasonable and feasible method among the four methods for calculating the Operating Margin emission factor ($EF_{OM,y}$) of the East China Power Grid.

According to the ACM0002, 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, not including low-operating cost and must-run power plants, the detailed formulas are as following:

$$EF_{OM, simple, y} = \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j,y}}{\sum_j GEN_{j,y}} \quad (4)$$

Where:

- $F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y ,
- j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid²,
- $COEF_{i,j,y}$ 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 percent oxidation of the fuel in year(s) y , and
- $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by sources j .

The CO₂ emission coefficient $COEF_i$ is obtained as

$$COEF_{i,j,y} = NCV_i \times EF_{CO_2,i} \times OXID_i \quad (5)$$

Where:

- NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i , (TJ/ mass or volume unit),
- $OXID_i$ is the oxidation factor of the fuel i (IPCC 2006 default values),
- $EF_{CO_2,i}$ is the CO₂ emission factor per unit of energy of the fuel i (tCO₂e/TJ).

Regarding parameter selection, local values of NCV_i and $EF_{CO_2,i}$ should be used where available. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

In this PDD, the Net Calorific Value (NCV_i) of each type of fossil fuel used in the calculation comes from China Energy Statistic Yearbooks. IPCC 2006 default values are adopted for emission factors ($EF_{CO_2,i}$) and oxidation factor $OXID_i$ of each type of fossil fuel.

The Simple OM Emission Factor ($EF_{OM, simple, y}$) of the proposed project is calculated ex ante on the basis of the fuel consumption data for electricity generation of the East China Grid, excluding those of low operating cost and must-run power plants, such as wind power, hydropower and nuclear etc. These data are obtained from the *China Electric Power Yearbook* (2004~2006, published annually) and *China Energy Statistical Yearbook* (2004~2006). Based on these data, the Simple OM Emission Factor ($EF_{OM, simple, y}$) of the East China Grid is calculated as 0.9422 tCO₂e/MWh (see Annex 3 for details).

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

According to ACM0002, $EF_{BM,y}$ is determined by the formula as follow:



$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m,y}}{\sum_m GEN_{m,y}} \quad (6)$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method in step 1 for plants m .

ACM0002 provides two options for sample group m :

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

The one with larger annual generation should be used.

However, in China, 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 electricity system that comprise 20% of the system generation (in MWh) and that were built most recently because these data are considered as confidential business information by the plant owners. Taking notice of this situation, EB accepts the following deviation in methodology application²²:

- 1) Use of capacity additions during the last 1~3 years for estimating the build margin emission factor for grid electricity.
- 2) Use of weights estimated using installed capacity in place of annual electricity generation.

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

The calculation of the Build Margin for the proposed project makes use of aggregated data to identify the 20% most recent capacity additions (sample group). This is identified by direct comparison of the total installed capacity on East China Power Grid in the most recent year for which data is available, in this case 2005, with historical data from preceding years until the 20% addition is reached. BM is determined by selecting the year since which the new capacity additions are equal to or greater than 20%.

The percentage is calculated as follows:

$$[(C_{2005} - C_n) / C_{2005}] * 100\%$$

Where:

C_{2005}	is the capacity in 2005 (most recent year for which published data are available)
C_n	is the capacity in the preceding year n

Statistical data available in China shows installed capacities of thermal, hydro and other plant. No subdivision of capacity by fuel type, such as coal, oil and gas, is available. However, coal-fired plants dominate East China Power Grid with other fuels mostly used for start-ups only. The BM, therefore, is calculated from the capacity of thermal power plant and the CO₂ emission factor of the best commercially available coal-fired thermal power plant ($EF_{Thermal}$) in China.

To be conservative, this CO₂ emissions factor is discounted further for the share of emissions from other fuels, i.e. discounted by 3.29% compared to the best available technology for coal-fired plant.

$$EF_{BM} = [C_{Thermal} / (C_{2005} - C_n)] * EF_{Thermal}$$

²² <http://cdm.unfccc.int/Projects/Deviations>.



Where:

$C_{Thermal}$	is the thermal power plant capacity amongst the sample group with the capacity ($C_{2005} - C_n$)
$EF_{Thermal}$	is the CO ₂ emissions factors of the thermal power plant with the best available technology, discounted for the share of non-coal fuels among thermal plant.

Based on the method issued by China's DNA on 09/08/2007, the $EF_{Thermal}$ is calculated as following:

Firstly, use the following equations to calculate weights of CO₂ emissions by coal-fired, oil-fired and gas-fired plants in total CO₂ emissions of East China Power Grid.

$$\lambda_{Coal} = \frac{\sum_{i=COAL,j} F_{i,j,y} * COEF_{i,j}}{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}$$

$$\lambda_{Oil} = \frac{\sum_{i=OIL,j} F_{i,j,y} * COEF_{i,j}}{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}$$

$$\lambda_{Gas} = \frac{\sum_{i=GAS,j} F_{i,j,y} * COEF_{i,j}}{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}$$

Where:

$F_{i,j,y}$: is the total amount of fuel I (in a mass or volume unit) consumed by Province j in East China Power Grid for power generation in year y;

$COEF_{i,j,y}$: is the total amount of 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 source j and the oxidation rate of the fuel in year y.

Secondly, the $EF_{thermal\ power}$ is calculated as a weighted emission factor as the following formula:

$$EF_{Thermal} = \lambda_{Coal} * EF_{Coal,Adv} + \lambda_{Oil} * EF_{Oil,Adv} + \lambda_{Gas} * EF_{Gas,Adv}$$

Where:

$EF_{coal,adv}$, $EF_{oil,adv}$, and $EF_{gas,adv}$ are the emission factors of the best technology for coal, oil, gas fired power plants commercially available in China, which are calculated based on the efficiency level of the best technology for each fuel type commercially available in China (see details in Annex 3)

In conclusion, the procedure to be used for calculating the build margin using the most recent additional capacity follows steps below:

- Using the latest statistical data available (from the China Electric Power Yearbook 2006) determine the year from which the added generation capacity is equal to or just exceeds 20% of the capacity of the latest statistic year 2005. The year selected is 2004, since which about 21.55% capacity has been added
- Of the added capacity since 2004 92.53% is thermal capacity.
- The CO₂ emission weights by coal-fired, oil-fired and gas-fired plants of total CO₂ emission of East China Power Grid in 2005, namely λ_{coal} , λ_{oil} , λ_{gas} is calculated as 96.71%, 2.35%, 0.94%.

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- According to the data issued by China DNA, the efficiency levels of domestic sub-critical 600MW coal power unit and the efficiency level of 200MW combined cycle power unit are taken as the efficiency level of the best technology for coal-fired power plants, oil and gas fired power plants commercially available in China, which are at 35.82%, 47.67%, 47.67%, respectively.

The emission factor is calculated as follows:

$$EF_{\text{thermal power}} = 96.71\% \times 0.9508 + 0.94\% \times 0.4237 + 2.35\% \times 0.5843 = 0.9372 \text{ tCO}_2\text{e/MWh}$$

The Build Margin emissions factor is now calculated as the percentage of thermal plant additions and thermal plant emissions factor.

Based on the formula above, the BM emission factor of East China Power Grid for the proposed project in the crediting period is calculated ex ante as:

$$EF_{BM} = 0.8672 \text{ tCO}_2\text{e /MWh.}$$

The details of EF_{BM} calculation are given in Annex 3.

Step3. Calculate the baseline emission factor EF_y

Based on ACM0002, the baseline emission factor EF_y should be 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. $w_{OM} = w_{BM} = 0.5$) by default, and ($EF_{OM,y}$) and ($EF_{BM,y}$) are calculated as described in Step 1 and 2.

$$EF_y = 0.9422 \times 0.5 + 0.8672 \times 0.5 = 0.9047 \text{ (tCO}_2\text{e/MWh)}$$

The value of EF_y calculated ex-ante will be used and won't be updated during the fixed crediting period.

3. Calculation of Leakage

In accordance with ACM0004, no leakage is considered.

4. Calculation of Emission Reductions

The emission reductions (ER_y) by the project activity during the year y is the difference between the baseline emissions (BE_y) and project emissions (PE_y), the Emission Reductions is calculated as follows:

$$ER_y = BE_y - PE_y \quad (7)$$

where:

ER_y is the emissions reductions of the project activity during the year y (tCO₂), and
 BE_y is the baseline emissions due to displacement of electricity during the year y (tCO₂), and
 PE_y is the project emissions during the year y (tCO₂).

According to the description above, the PE_y is 0, so we know that,

$$ER_y = BE_y \quad (8)$$

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

Data / Parameter:	$F_{i,j,y}$
Data unit:	t/m ³ , t/t
Description:	Total amount of fuel i (in a mass or volume unit) consumed by all the relevant power sources j in year of y .
Source of data used:	China Energy Statistic Yearbook
Value applied:	Please refer to annex 3.
Justification of the choice	The detailed data of fuels consumed by power plants are not available

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of data or description of measurement methods and procedures actually applied :	publicly, so the aggregated data by fuel types are used instead.
Any comment:	

Data / Parameter:	$GEN_{j,y}$
Data unit:	MWh
Description:	Electricity imported to the grid by power source j in year of y .
Source of data used:	China Electric Power Yearbook
Value applied:	Please refer to annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The detailed data of fuels consumed by power plants are not available publicly, so the aggregated data by fuel types are used instead.
Any comment:	

Data / Parameter:	NCV_i
Data unit:	TJ/t(ce), TJ/m ³ (ce)
Description:	Net calorific value per mass or volume unit of a fuel i .
Source of data used:	China Electric Power Yearbook
Value applied:	Please refer to annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data comes from an official statistic.
Any comment:	

Data / Parameter:	$OXID_i$
Data unit:	
Description:	oxidation factor of the fuel i
Source of data used:	IPCC default value in revised 1996 IPCC Guideline for National Greenhouse Gas Inventories.
Value applied:	Please refer to annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is based on IPCC default value because the national specific value is unavailable.
Any comment:	

Data / Parameter:	$EF_{CO_2,i}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor per unit of energy of the fuel i .
Source of data used:	IPCC default value in revised 1996 IPCC Guideline for National Greenhouse Gas Inventories.
Value applied:	Please refer to annex 3.

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Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is based on IPCC default value because the national specific value is unavailable.
Any comment:	

Data / Parameter:	$COEF_i$
Data unit:	tCO ₂ /t(m ³)
Description:	CO ₂ emission coefficient of fuel <i>i</i> .
Source of data used:	Calculated
Value applied:	Please refer to annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according to the formula suggested by ACM0002.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

As described in B.6.1, ex-ante calculation of emission reductions is as follow:

Project Activity Emissions in the Crediting Period

The emission of the proposed project in crediting period is 0.

Baseline emissions in the crediting period

The formula of baseline emission calculation is as follow:

$$BE_{electricity,y} = EG_y \times EF_{electricity,y} \quad (9)$$

I. Calculation of EG_y

EG_{GEN} is an estimative value, which is the power capacity (50MW²³) multiplies running hours in one year (7848h²⁴). And the amount of auxiliary electricity equals the total related power of auxiliary equipments (11.5MW²⁵) multiply the running hours in one year (7848h).

EG_{GEN} (MWh/y)	EG_{AUX} (MWh/y)	EG_y (MWh/y)
A	B	A-B=C
50*7848=392,400	11.5*7848=90,279	392,400-90,279=302,120

II. Calculation of EF_y

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

The result of $EF_{OM,y}$ is 0.9422 tCO₂e/MWh. Detailed calculation can be referred in Annex 3.

²³ The feasibility study report of waste heat recovery for generation.

²⁴ The feasibility study report of waste heat recovery for generation.

²⁵ The calculation of the amount of auxiliary electricity can refer to Annex 4.

**Calculate the Build Margin Emission Factor ($EF_{BM,y}$)**

The result of $EF_{BM,y}$ is 0.8672 tCO₂e/MWh. Detailed calculation can be referred in Annex 3.

Calculate the Baseline Emission Factor (EF_y)

$$EF_y = 0.9422 \times 0.5 + 0.8672 \times 0.5 = 0.9047 \text{ tCO}_2\text{e/MWh}$$

Leakage in crediting period

There is no leakage in the proposed project activity.

Estimation of Emission Reductions in the Crediting Period

EG_y (MWh/y)	$EF_{\text{electricity}, y}$ (tCO ₂ e/MWh)	BE_y (tCO ₂ e/y)
A	B	C = A * B
302,120	0.9047	273,328

$$ER_y = BE_y = 273,328 \text{ tCO}_2\text{e}$$

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

Year	Estimation of project activity emissions (tonnes of CO ₂ e)	Estimation of 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)
2008(01/06-31/12)	0	159,441.3	0	159,441.3
2009	0	273,328	0	273,328
2010	0	273,328	0	273,328
2011	0	273,328	0	273,328
2012	0	273,328	0	273,328
2013	0	273,328	0	273,328
2014	0	273,328	0	273,328
2015	0	273,328	0	273,328
2016	0	273,328	0	273,328
2017	0	273,328	0	273,328
2018(01/01-31/05)	0	113,886.7	0	113,886.7
Total (tonnes of CO₂e)	0	2,733,280	0	2,733,280

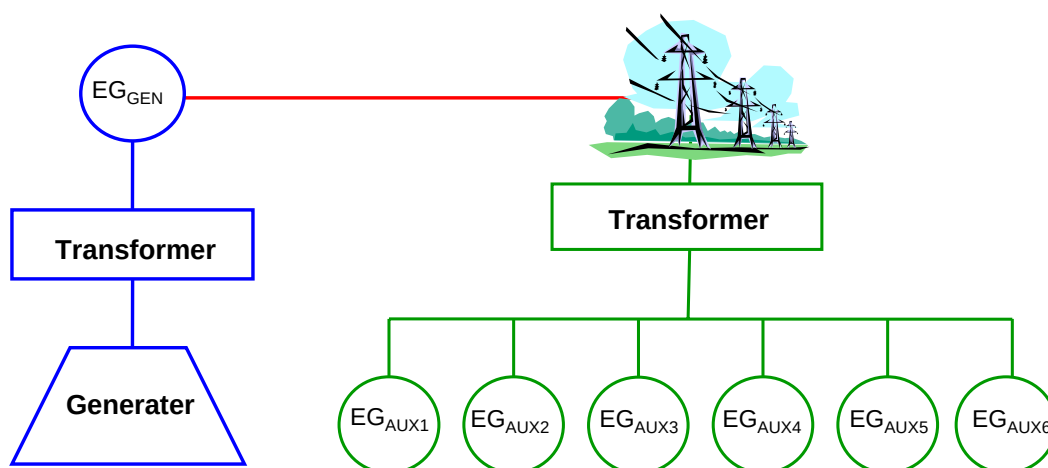
B.7 Application of the monitoring methodology and description of the monitoring plan:

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B.7.1 Data and parameters monitored:

The amount of net electricity supplied to the power grid is equal to the total electricity supplied by the proposed project minus the auxiliary electricity which includes electrical energy utilized by waste heat recovery equipments and the power plant in the proposed project boundary.

Here is a sketch of the position of each Electricity meters.



Data / Parameter:	EG_{GEN}
Data unit:	MWh
Description:	Total electricity supplied to the grid by the proposed project in the year y.
Source of data to be used:	Accumulative value of electricity supplied will be showed on electricity meter and on DCS
Value of data applied for the purpose of calculating expected emission reductions in section B.5	392,400
Description of measurement methods and procedures to be applied:	Measurement equipment: the electronic electricity meter. Accuracy degree: 1 . Measurement methods: Online measurement, the value of electricity supplied can be accumulated and saved by the electricity meter and showed on DCS. Recording frequency: Continuously. The recorded data will be archived in electronic, and will be kept in Credit period + 2 yrs. Emergency measures: Data can not be measured because of calibration or the electricity meter is out of order in the crediting period, then emergency measures should be taken. Please refer to section B.7.2 for detail information.



QA/QC procedures to be applied:	QA/QC for Monitoring Equipment: Calibration procedure: Both main meter and backup meter are calibrated by Suzhou measure and test institute once a year in accordance with the “<i>Criterion of electric energy meters for AC measure (TTG307-2006)</i>”; The relative work will be done by CDM manager. A calibration report will be provided by Suzhou measure and test institute and saved by TFC. CDM manager is responsible for responsible for regular calibration of the meter. QA/QC for Data: The Zhangjiagang Power Supply Company will monitor the data at switch box by a backup meter, which is installed and sealed by Zhangjiagang Power Supply Company. The measured value of the backup meter will serve as a cross-check of the accuracy.
Any comment:	

Data / Parameter:	EG_{AUX}
Data unit:	MWh
Description:	Auxiliary electricity which includes electrical energy utilized by the waste heat generation equipments and the power generating equipment in the project boundary in the year y.
Source of data to be used:	Accumulative value of electricity consumed will be showed on electricity meters ($EG_{AUX1} - EG_{AUX6}$) and on DCS ²⁶
Value of data applied for the purpose of calculating expected emission reductions in section B.5	90,279
Description of measurement methods and procedures to be applied:	Measurement equipment: The electronic electricity meter. ($EG_{AUX1} - EG_{AUX6}$). Accuracy degree: 1. Measurement methods: Online measurement, the value of electricity supplied can be accumulated and saved by the electricity meter and showed on DCS. Recording frequency: Continuously. The recorded data will be archived in electronic, and will be kept in Credit period + 2 yrs. Emergency measures: Data can not be measured because of calibration or the electricity meter is out of order in the crediting period, then emergency measures should be taken. Please refer to section B.7.2 for

²⁶ DCS is an abbreviation of Distributed Control System



	detail information.
QA/QC procedures to be applied:	QA/QC for Monitoring Equipment: Calibration procedure: Electricity meters are calibrated by Suzhou measure and test institute once a year in accordance with the “ <i>Criterion of electric energy meters for AC measure (TTG307-2006)</i> ”; A calibration report will be provided by Suzhou measure and test institute once a year and saved by TFC. CDM manager is responsible for responsible for regular calibration of the meter.
Any comment:	The total value of auxiliary electricity contains the energy consumed in sulphuric acid production, which is a conservative method.

B.7.2 Description of the monitoring plan:**MONITORING PLAN**

Emission factor of the project is determined ex ante. ACM0004 monitoring methodology defines the net electricity supply is calculated by the difference between the electricity supply and the energy consumption of auxiliary equipments. Therefore, the monitoring plan is drafted to focus on the two data referred above.

1. Monitoring Targets**(1) Monitoring of Electricity supplied by the Proposed Project**

There are 2 electricity meters used to monitor electricity supplied by the proposed project. The main meter and the backup meter are installed in the transformer station of TFC by Zhangjiagang Power Supply Company. Both the main measurement system equipments and the backup measurement equipments will be operated and maintained by TFC. The data recorded by both meters will be showed on the DCS and will be saved into a database. And paper record will be recorded every 2 hours.

(2) Monitoring of Auxiliary Electricity

Auxiliary electricity includes energy consumed by all equipments in the project boundary as well as the sulfuric acid production in a conservative way. The 6 auxiliary electricity meters (detailed information in Annex4) are installed in the transformer station of TFC by project owner. And the data can be showed on the DCS and will be saved into a database. And paper record will be recorded every 2 hours.

2. Monitoring Procedures**(1) Measurement**

The accumulate data for EG_{GEN} and EG_{AUX} will be measured by 8 meters, which is also showed on DCS on line. The accumulate data of 8 meters the will be recorded once per 2 hours by DCS and it will be saved in a database and recorded in paper.

(2) Identification

The trained operators will identified the data which is showed on DCS whether it is reasonable in 24
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hours. And they will go on a tour of inspection at the power plant, focusing on the meter. The process will be recorded and provided to DOE on Verification. If the operator finds out the data isn't credible, emergency plan will be used. The method of data identification and the detailed procedure are defined on CDM Operational Manual.

(3) Calculation

The Emission Reduction Calculation will be executed by computer with the data saved on DCS, based on the defined formula of ACM0004. The calculation will be executed once a day.

(4) Achievement

The operator will achieved the identified data on electronic document and saved in Computer.

3. Quality Assurance and Quality Control

(1) For measurement equipments——Calibration of Meters

All of electricity meters will be calibrated once a year by Suzhou measure and test institute. After calibration, calibration reports (F-2) will be provided by Suzhou measure and test institute and kept by the project owner. This would be a part of the .CDM manager will in charge of this job. The procedure of calibration will be detailed defined on CDM Operational Manual. The process of Meter calibration should be reported (F-3).

8 calibrated meters will be prepared for replacement of each meter in case any of them doesn't work.

(2) For Monitoring Data—— Double Meters for Double Check

For the EG_{GEN}, Zhangjiagang Power Supply Company installed and sealed a backup meter at switch box. The measured value of the backup meter can be showed on DCS of TFC, which will serve as a cross-check of the accuracy.

(3) For Monitoring Process——Computer Execution with Human Supervision

The Monitoring Process will be ordered and supervised by humans, while executed by computer, which will avoid artificial errors. In addition, the operators in the transformer station of TFC will copy the data on paper once 2 hours, in order to supervise whether the electricity meter and the computer are working normally. The operation report forms (F-4) should be archived. The procedures of copying data will be defined in CDM Operational Manual. If the abnormal situation happens, the emergency plan will be started up. And all the monitoring meters will be checked monthly to prevent erroneous measurements.

(4) For Emergency Situation——Backup Meters and Conservative Method

When the main meter is on calibration or out of work, the data in the calibration or malfunction period is measured by back up meter, which is used to calculate the emission reduction. The start time and the end time should be recorded carefully; and the report (F-5) needs to be archived and provided to DOE.

When the backup meter is on calibration or out of work, a new meter should be replaced it. The start time and the end time should be recorded carefully; and the report (F-5) needs to be archived and provided to DOE.

When the auxiliary electricity meter is on calibration, the calibrated meter should replace it in time. The start time and the end time should be recorded carefully; and the report (F-5) needs to be archived and provided to DOE.



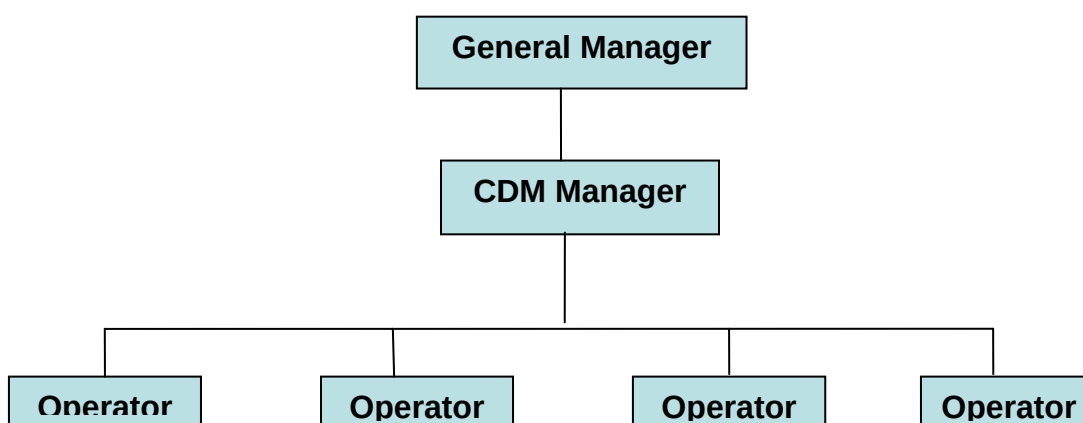
If the auxiliary electricity meter is out of work, the monitoring data is not available during the malfunction period, the largest amount consumed by auxiliary equipments is used for ER calculation as conservative considering. The start time and the end time of the malfunction period should be recorded carefully; and the report (F-5) needs to be archived and provided to DOE. If erroneous measurements take place, the electricity generation will be replaced by the lowest value during the latest month and the auxiliary electricity will be replaced by the rating capacity of the auxiliary facility during malfunction period. It is considered conservative.

(5) For Human Resource Management— —Training Plan

The training course should according to the methodology version 2 of ACM0004--“*Consolidated monitoring methodology for waste gas and/or heat and/or pressure for power generation*”, “*Monitoring Plan*”, “*CDM Operational Manual*” and conducted appropriately by CDM consultant. Relative documentation (F-6) or other materials such as: the training plan, training materials, training report or test paper should be archived and provided to DOE.

The contents and procedures of quality assurance and quality control is an on-going process which will be updated in the crediting period.

4. Operational and Management Structure



(1) Responsible for General Manager:

All the affairs related to CDM project monitoring is managed by general manager.

(2) Responsible for CDM Manager:

In charge of Meters calibration and training affairs; Check the daily operation report forms; Archive emergency situation disposal report

(3) Responsible for CDM Manager:

4 operators take turns to work in the transformer station of TFC during 24 hours.

In charge of data supervision, identification, and achievement; Executive emergency plan; Draft operation report forms and emergency situation disposal report.

5. Verification

It is expected that the verification of emission reductions generated from the Project will be done annually.

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The Table 10 below outlines the key documents relevant to monitoring and verification of the emission reductions from the Project. With all these documents compiled, the Project owner will sign a verification service agreement with specific DOE.

Table 10. List of the key documents relevant to monitoring and verification

I.D. No.	Document Title	Main Content	Source
F-1	PDD, including the electronic spreadsheets and supporting documentation (assumptions, estimations, measurement, etc)	Calculation procedure of emission reduction and monitoring items	TFC, or directly download from UNFCCC website
F-2	Meter calibration Report	Equipments and national and industry standards	Suzhou measure and test institute
F-3	Process Report for calibration	Start time and end time of calibration, Reasons for maintenance and calibration and the precision after maintenance and calibration	TFC
F-4	Operation Report Forms	The data of 8 meters per 2 hours, the abnormal situation.	TFC
F-5	Emergency situation disposal report	the process of the event and the disposal method	TFC
F-6	Relative materials about training	the training plan, training materials, training report or test paper	TFC
F-7	Monitoring report	CO ₂ emission reduction calculation	TFC or CDM consultant

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

Date of completing draft of the baseline and monitoring section:

The current version of baseline and monitoring study was completed on 20 Nov. 2007.

The name of the responsible person/ entity:

Tao Kanghua, Shanghai Yangtze Delta Investment Consulting Co., Ltd. (CDM Service Centre), which is not the project participant.

Address: Room 603, Guilin Road 46, Shanghai, China, 200233

Tel: +8621-54181842-110

Email: khtaoc@online.sh.cn

Xu Yong, Shanghai Yangtze Delta Investment Consultancy Co., Ltd. (CDM Service Centre), which is not the project participant.

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Tel: +8621-54181842-132

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Email: sansan001231@yahoo.com.cn

SECTION C. Duration of the project activity / crediting period**C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

07/05/2004 (It is the date of receiving the starting order of the project)

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

20 years

C.2 Choice of the crediting period and related information:**C.2.1. Renewable crediting period**

Not applicable

C.2.1.1. Starting date of the first crediting period:**C.2.1.2. Length of the first crediting period:****C.2.2. Fixed crediting period:**

The project activity will be using a fixed crediting period.

C.2.2.1. Starting date:

A fixed crediting period expects to start from 1 June 2008, and the actual starting date will be the date of registration.

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts**D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

The project activity has developed and passed full Environmental Impact Assessment (EIA) in line with the requirements of the Chinese Government. All the documents related to EIA of the project activity will be detailed in the final version of this PDD for validation. No adverse impacts including trans-boundary impacts are arising due to the project activity.

During the construction of the project activity, Manifold elements have been thought over, such as location, layout, vane and so on. So its benefits to the environment improvement would be as follows: The project activity will provide the Grid of East China clean energy resource; thereby successfully reduce the consuming of the non-renewable resource (such as coal, oil, natural gas etc.) and the consequent emission of GHG.

With the implementation of international advanced technology, the project activity will recover waste heat more effectively, which will avoid pollution caused by emission of waste heat..

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➤ **During Construction Phase :**

1. Dust control: Dust will be suppressed by regular water sprinkling and suitable road surface treatment to ease traffic flow.
2. noise control: Construction with big noise will be avoided during the night. And the noise caused by the activity will be restricted to be within the range of the permission of industry standard.
3. Water pollution control: Effluent will be disposed before discharge.

➤ **During Operational and Maintenance Phase**

1. Air pollution: Monitoring and recording system will be built up around the chimney, including the waste emission of chimney. And waste gases such as SO₂ will be discharged in line with <standard on environmental air quality>. The utilizing of the waste heat will greatly reduce thermal pollution.
2. Noise pollution: Turbines, pumps and other equipments will be designed and specified with a view to minimize noise pollution. Adequate measures have been adopted in the project activity to ensure noise levels are maintained well within permissible industrial norms.
3. Water pollution. 97.1 percent of industrial water are reused in the process of production. Industrial sewage will be neutralized and then sent to Chemical park sewage disposal plant with living sullage.
4. Solid waste: Parts of solid wastes are recovered to be raw materials and the remained will be innocuously disposed in solid waste disposal center.
5. Ecology impacts. There are no endangered species located in and around the plant area. There are also no landscape conservation zone and cultural relic. Therefore, it will have no impact on ecology.
6. Working security. The company's operations are managed with high safety level systems. This includes equipment shutdown procedure, use of personal protection equipments like safety helmets, emergency response plan, mock drills, training on use of fire fighting equipment etc. For ensuring safety of the workmen all moving parts of all machinery and exposed parts of machines would be provided with guards.
7. Social impact. The project activity has obvious socio-economic benefits creating employment opportunities and other ancillary businesses in the area. The development of economy on site will also be promoted by this project activity.

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

The EIA study on the project has revealed that there are no significant environmental risks and the net impacts under environmental pollution category are positive as all necessary and good measures for abatement have been adopted.

SECTION E. Stakeholders' comments

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

There are two stakeholder investigations of the projects. During 15th Jun. to 18th Jun. in 2004, the project owner conducted the first interviews and received comments from local stakeholders. The second stakeholder investigations took place during 18th Jun. to 20th Jun. in 2006, and it was regarded as review of the first investigation.

The stakeholders identified with the project are as follows:

1. Inhabitants of local community
2. Employees of TFC
3. Jiangsu Environmental Protection Bureau
4. Jiangsu Economy and Trade Committee
5. Zhangjigang Free Trade Zone Administration Committee
6. China Sulfuric Acid Industry Association



Before the construction of the project, TFC conducted questionnaire and interviewed local inhabitants door by door for their comments. Besides, TFC draft project proposal to relative official departments for collect their comments.

In addition, it is the first time for HRS and Siemens turbine units applied to China sulfuric acid industry, So TFC invited some experts of this field and delegates of China Sulfuric Acid Industry Association to discuss about the adaptability and signification of the advanced technology in China and how to boost technology transfer.

E.2. Summary of the comments received:**➤ Local Community :**

The local community mainly comprises of inhabitants from villiages of Beiyin and shuangfeng, who are living around the project site. According to the results from the questionnaire conducted and family interview, majority of local people support the project because it makes the waste heat useful as energy source, which is a good way to save the energy and benefit for East China energy crises. Minority of them are worried about the noise from running power generator.

➤ Employees of TFC :

Employees of TFC are mostly support the project, but should improve their management level and take some safety measures to help the project implementation normally.

➤ Related Government Departments :

The project activity has received approvals from related government departments, who encourage TFC to adopt advanced technologies in energy saving and recycling so as to meet the needs of sustainable development.

➤ Industry Association and Experts in the Field :

Representatives of the Industry Association and experts in the field expressed their worried about risks of the project activity as the first case which adopts advanced HRS technology. They reserved judgement on whether the equipment can work smoothly and take effect as expected. They hope TFC applying to advanced technology initially since it is good at advanced technology transfer.

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

In fact, the noise of Siemens Turbine Units is much lower than that of domestic one; while the nearest local Inhabitants live away from the power plant 1500 meters. So the operational sound would not influence the local Inhabitants. This has been proved true according to the family interviews conducted by TFC and Shanghai Yangtze Delta Investment Consulting Co., Ltd. after the project construction.

Considering the comments of Employees, TFC established the safety alarm system, precaution Measures and there is no accident occurred since the project start to test-operation.

During the construction period, TFC invites experts from MEC to introduce the advanced technology and trained their employees. The training report can be provided to DOE on Validation and Verification. What's more, TFC establishes the education training plan to facilitate the implementation of the project activity, which is based on ISO9001. In the face of foreign patent protection barrier, TFC has summarized the important experience and theories during their practice, to promote advanced technology transfer in China.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	TWO LIONS(ZHANGJIAGANG) FINE CHEMICALS CO., LTD
Street/P.O.Box:	No.1 Donghua Road, Jiangsu Yangtze River International Chemical Industry district, Zhangjiagang Free Trade Zone.
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Represented by:	Yafei Yuan
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Salutation:	Mr.
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Direct tel:	+86-0512-58726909
Personal E-Mail:	jhyyf@21cn.com



Annex 2
INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from countries in Annex 1 for the proposed project.



Annex 3
BASELINE INFORMATION

OM Calculation

The following tables summarize the numerical results from the equations listed in the ACM0002. The information listed in the tables includes data, data sources and the underlying computations. Table A1~A3 listed the basic data of the East China Power Grid in the year 2003, 2004 and 2005, including installed capacities, annual electricity generation under various electricity generation technologies.

TableA1 The fossil-fired electricity generation of East China Grid in 2003

Province	Fossil-fired power (TWh)	The proportion of Electricity use by plant (%)	Electricity of Fossil-fired power (MWh)
Shanghai	69.4	5.14	65874578
Jiangsu	1332.7	5.9	125413657
Zhejiang	830.89	5.31	78676974
Anhui	541.56	6.06	50874146
Fujian	421.46	5.07	40009198
Sum			360848554

Data source: China Electric Power Yearbook 2004

TableA2 The fossil-fired electricity generation of East China Grid in 2004

Province	Fossil-fired power (TWh)	The proportion of Electricity use by plant (%)	Electricity of Fossil-fired power (MWh)
Shanghai	711.27	5.22	67414171
Jiangsu	1635.45	5.93	153846782
Zhejiang	952.55	5.68	89844516
Anhui	598.75	6.03	56264538
Fujian	504.9	6.07	47425257
Sum			414795263

Data source: China Electric Power Yearbook 2005

TableA3 The fossil-fired electricity generation of East China Grid in 2005

Province	Fossil-fired power (MWh)	The proportion of Electricity use by plant (%)	Electricity of Fossil-fired power (MWh)
Shanghai	74606000	5.05	70838397
Jiangsu	211429000	5.96	198827831.6
Zhejiang	108110000	5.59	102066651
Anhui	62918000	5.9	59205838
Fujian	48600000	4.57	46378980
Sum			477317697.6

Data source: China Electric Power Yearbook 2006

**TableA4 Energy consumption and CO₂ emissions of East China Grid in 2003**

Fuel Type	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Sum	CO ₂ emission (tc/TJ)	average Caloric (MJ/t,km ³ ,tce)	low value CO ₂ emission (tCO ₂ e)
	A	B	C	D	E	F	G=B+C+D+E+F	H	J	K=G*H*J*44/12/10 ²
raw coal	Mtons	2618	6417.74	3442.4	2669.67	1754	16901.81	25.8	20908	334300359.1
clean coal	Mtons						0	25.8	26344	0
other washed coal	Mtons						0	25.8	8363	0
coke	Mtons						0	29.2	28435	0
coke-oven gas	108m3	1.99	0.06				2.05	12.1	16726	152125.7577
other coal gas	108m3	66.34					66.34	12.1	5227	1538454.895
crude oil	Mtons						0	20	41816	0
gasoline	Mtons							18.9	43070	0
diesel oil	Mtons	1.26	14.71	13.99			29.96	20.2	42652	946463.8034
fuel oil	Mtons	95.49	0.76	174.48		18.89	289.62	21.1	41816	9369683.521
LPG	Mtons						0	17.2	50179	0
refinery gas	Mtons	0.49	0.96				1.45	15.7	46055	38442.87608
natural gas	108m3						0	15.3	38931	0
other petroleum products	Mtons	18.91	5.3	15.04			39.25	20	38369	1104387.717
other parched products	Mtons						0	25.8	28435	0
other energy	Mtons	5.68		7.08			12.76	0	0	0
standar d coal									total	347449917.70

Data source : China Energy Statistic Yearbook 2004, 2006 IPCC



Total emission of the Central China Power Grid (tCO ₂ e) :	276371085	
Total electricity supply of the Central China Power Grid (MWh) :	346613868	
Emission factor of the Central China Power Grid (tCO ₂ e/MWh) :	0.797345722	
Electricity importation from Central China Power Grid MWh :	13756040	
Electricity importation from Shanxi Yangcheng plant :	10705870	
Emission factor of the Yangcheng plant :	0.949780	coal consumption: 343gce/kWh

Total emission (tCO₂e): 368586453.8
Total electricity supply (MWh): 385310463.7
EF₍₀₃₎: 0.956596014

Table A5 Energy consumption and CO₂ emissions of East China Grid in 2004

Fuel Type	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Sum	CO ₂ emission (tc/TJ)	average Caloric (MJ/t,km ³ ,tce)	low value CO ₂ emission (CO ₂ e)
	A	B	C	D	E	F	G=B+C+D+E+F	H	J	K=G*H*J*44/12/10 ²
raw coal	Mtons	2779.6	7601.9	4008.9	2906.2	2183.7	19480.3	25.8	20908	385300230.3
clean coal	Mtons						0	25.8	26344	0
other washed coal	Mtons		5.46			4.63	10.09	25.8	8363	79826.00582
coke	Mtons						0	29.2	28435	0
coke-oven gas	108m3	2.59					2.59	12.1	16726	192197.9085
other coal gas	108m3	72.46					72.46	12.1	5227	1680380.49
crude oil	Mtons						0	20	41816	0
gasoline	Mtons						0	18.9	43070	0
diesel oil	Mtons	2.69	27.17	6.23			36.09	20.2	42652	1140116.11
fuel oil	Mtons	58.52	55.07	202.89		23.26	339.74	21.1	41816	10991147.99



CDM – Executive Board

page 42

LPG	Mtons				0	17.2	50179	0
refinery gas	Mtons	0.77	0.55		1.32	15.7	46055	34996.2734
natural gas	108m3		0.14		0.14	15.3	38931	30576.4074
other petroleum products	Mtons	21.22	1.37	24.89	47.48	20	38369	1335957.421
other parched products	Mtons				0	25.8	28435	0
other energy	Mtons standard Coal	6.43		15.48	21.91	0	0	0
							total	400785428.93

Data source : China Energy Statistic Yearbook 2005, 2006 IPCC

Total emission of the Central China Power Grid (tCO ₂ e) :	346035809.7
Total electricity supply of the Central China Power Grid (MWh) :	418261666.3
Emission factor of the Central China Power Grid (tCO ₂ e/MWh) :	0.827318967
Electricity importation from Central China Power Grid MWh :	26933850
Electricity importation from Shanxi Yangcheng plant :	11649610
Emission factor of the Yangcheng plant :	0.944241481 coal consumption: 341gce/kWh

Total emission (tCO₂e): 434068358.9
Total electricity supply (MWh): 453378722.6
EF₍₀₄₎: 0.957407874

Table A6 Energy consumption and CO₂ emissions of East China Grid in 2005

Fuel Type	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Sum	CO ₂ emission (tc/TJ)	average value (MJ/t, km ³ , tce)	Caloric	CO ₂ emission (tCO ₂ e)
	A	B	C	D	E	F	G=B+C+D+E+F	H	J		K=G*H*J*44/12/10 ^{^2}
raw coal	Mtons	2847.31	9888.06	4801.52	3082.9	2107.69	22727.48	25.8		20908	449526099.6
clean coal	Mtons						0	25.8		26344	0
other washed coal	Mtons						0	25.8		8363	0
coke	Mtons			0.03			0.03	29.2		28435	913.3322
coke-oven gas	108m3	1.68	1.38		1.71		4.77	12.1		16726	353970.6654
other coal gas	108m3	83.72	24.97	0.06	30		138.75	12.1		5227	3217675.863
crude oil	Mtons			27.01			27.01	20		41816	828263.4507
gasoline	Mtons						0	18.9		43070	0
diesel oil	Mtons	1.25	16	4.52		1.67	23.44	20.2		42652	740491.0398
fuel oil	Mtons	59.39	13.22	153.22		7.45	233.28	21.1		41816	7546991.823
LPG	Mtons						0	17.2		50179	0
refinery gas	Mtons	0.57	0.83				1.4	15.7		46055	37117.25967
natural gas	108m3	1.09	1.85	0.62			3.56	15.3		38931	777514.3596
other petroleum products	Mtons	21	8.38	34.8			64.18	20		38369	1805849.775
other parched products	Mtons						0	25.8		28435	0
other energy	Mtons	12.36		15.29			27.65	0		0	0
standard coal										total	464834887.2

^oData source : China Energy Statistic Yearbook 2006, 2006 IPCC

**CDM – Executive Board**

page 44

Total emission of the Central China Power Grid (tCO ₂ e) :	360323575
Total electricity supply of the Central China Power Grid (MWh) :	466644030
Emission factor of the Central China Power Grid (tCO ₂ e/MWh) :	0.772159402
Electricity importation from Central China Power Grid MWh :	160410000
Electricity importation from Shanxi Yangcheng plant :	77244000
Emission factor of the Yangcheng plant :	0.938703407 coal consumption: 339gce/kWh

Total emission (tCO ₂ e): 661206182.8
Total electricity exportation (MWh): 714971697.6
EF ₍₀₅₎ : 0.924800499

According to consolidated baseline methodology “Tool to calculate the emission factor for an electricity system”, the Simple OM emission factors of the East China Power Grid in the year 2003, 2004 and 2005 were calculated in A4~A6 above. The Simple OM emission factor of the Project is the weighted average value of the Simple OM emission factors in the year 2003, 2004 and 2005, i.e. $EF_{OM, simple, y} = 0.942201101$ tCO₂e/MWh.

**Table A7 Resume EF_{OM, simple, y} calculations**

	2003			2004			2005		
	electricity exportation	emissions factor	CO2 emissions	electricity exportation	emissions factor	CO2 emissions	electricity exportation	emissions factor	CO2 emissions
	MWh	tCO2/MWh	tCO2	MWh	tCO2/MWh	tCO2	MWh	tCO2/MWh	tCO2
fossil-fired power generation of East China grid	360.848.55 4		347.449.918	414.795.263		400.785.429	477.317.698		464.834.887
import from central china grid	13.756.040	0.79734572 2	10.968.320	26.933.850	0.82731896 7	22.282.885	160.410.000	0.77215940 2	123.862.090
import from Yangcheng plant	10.705.870	0.94978000 0	10.168.221	11.649.610	0.94424148 1	11.000.045	77.244.000	0.93870340 7	72.509.206
sum	385.310.46 4		368.586.454	453.378.723		434.068.359	714.971.698		661.206.183
EF _{OM,y} (tCO2e/MWh)		0.95659601 4			0.95740787 4			0.92480049 9	
EF _{OM, simple, y} (tCO2e/MWh)	0.942201101								

BM Calculation

The conservative calculation of the build margin emission factor of the East China Power Grid has been explained in Section B in the PDD. The data, sources and calculation process of the build margin emission factor and combined emission factor of the East China Power Grid are shown in Table A8 and Table A9. According to the China Energy Statistic Yearbook 2006 and Table A8 below, $\lambda_{coal}=96.71\%$, $\lambda_{oil}=2.35\%$, $\lambda_{gas}=0.94\%$ (λ is the ratio of CO2 emission by burning coal, oil, gas to the total emission), it obviously shows that the amount of gas-fired and oil-fired power is very small. We consider the EF_{coal} as the EF_{thermal} for facilitation, at the same time, in the conservative consideration, the 600 MW sub-critical coal-fired power generator should multiply the λ_{coal}

Table A8 Energy consumption and CO₂ emissions of East China Grid in 2005

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Fuel Type	Unit	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Sum	CO ₂ emission (tc/TJ)	average low Caloric value (MJ/t, km ³ , tce)	CO ₂ emission (tCO ₂ e)
	A	B	C	D	E	F	G=B+C+D+E+F	H	J	K=G*H*J*44/12/10 ²
raw coal	Mtons	2847.31	9888.06	4801.52	3082.9	2107.69	22727.48	25.8	20908	449526099.6
clean coal	Mtons						0	25.8	26344	0
other washed coal	Mtons						0	25.8	8363	0
coke	Mtons			0.03			0.03	25.8	28435	807
subtotal										449526907 96.71%
crude oil	Mtons			27.01			27.01	20	41816	828263.4507
gasoline	Mtons						0	18.9	43070	0
diesel oil	Mtons	1.25	16	4.52		1.67	23.44	20.2	42652	740491.0398
fuel oil	Mtons	59.39	13.22	153.22		7.45	233.28	21.1	41816	7546991.823
other petroleum products	Mtons	21	8.38	34.8			64.18	20	38369	1805849.775
subtotal										10921596 2.35%
coke-oven gas	108m ³	1.68	1.38		1.71		4.77	12.1	16726	353970.6654
other coal gas	108m ³	83.72	24.97	0.06	30		138.75	12.1	5227	3217675.863
LPG	Mtons						0	17.2	50179	0
refinery gas	Mtons	0.57	0.83				1.4	18.2	46055	43028
natural gas	108m ³	1.09	1.85	0.62			3.56	15.3	38931	777514.3596
subtotal										4392189 0.94%

**Table A8-2 Emission Factor of best advanced commercial power technologies**

	variable	Power generation efficiency	Emission factor	oxidation	Emission factor
		A	B	C	$D=3.6/A/1000*B*C*44/12$
Coal-fire power plant	EF coal,adv	35.82%	25.8	1	0.9508
Gas-fired power plant	EF gas, adv	47.67%	15.3	1	0.4237
Oil-fired power plant	EF oil,adv	47.67%	21.1	1	0.5843

Table A9 capacity additions used to determine the Build Margin of East China Grid from 2003 to 2005

	Installed capacity in 2003 (MW)	Installed capacity in 2004 (MW)	Installed capacity in 2005 (MW)	New capacity additions (MW)	Share of new capacity(%)
Fossil-fired power	65036.5	79424.1	104076.6	24652.5	92.53%
Hydro power	13602.5	14417.8	16069.4	1651.6	6.20%
Nuclear power	2406	3056	3066	10	0.04%
Others(Wind)	51.7	72.6	401.3	328.7	1.23%
Sum	81096.7	96970.5	123613.3	26642.8	
Share of installed capacity in 2004	65.61%	78.45%	100.00%		

Data source: China Electric Power Yearbook 2004-2006.

Table A10. Calculation of build margin emission factor and combined emission factor of the East China Grid

	Change in installed capacity (2005 compared to 2003, MW)	Best commercially available power generation technology in China (600 MW sub-critical coal-fired power generator)
Hydro power	1651.6	Emission factor: 0.9372 tCO₂e/MWh
Fossil fuel-fired power	24652.5	
Other	338.7	
Total	26,642.8	
Fuel-fired electricity capacity share	0.9253	
Build margin emission factor in the East China Grid (tCO₂e/MWh)		0.8672
Combined emission factor in the East China Grid (tCO₂e/MWh)		0.9047

**Table A11 HRS Incidents Record**

Time of Incident	Cause of Incident	Equipment Damaged
July 1990	HRS boiler failed during initial start up.	Boiler, perheater, heater, circulation pump, drain pumps, piping, significant metal loss in pump boot.
April 1992	Failure of u-bend in economizer ahead of HRS tower, filled economizer and duct and surged blower.	Boiler corroded and leaking, towers damaged, heaters/perheaters damaged, circulation pump lost, lost drain pump, leaking piping
March 1993 August 1993 July 1996	March 1993 , Leak in HP boiler August 1993, Leak in HP boiler July 1996, Leak in HRS boiler	
March 1995	Not determined, the source may have been a leak in the boiler. Leak developed on restrat after turnaround.	Boiler 235 plugged tubes, lost drain pump.
June 1997	Leaking HRS heater tube. Suspect tube had been previously plugged as a precaution form eddy current tests, indicating fault in tube.	Leaking tube in boilers, many tube less than 60% of design wall thickness. Heaters/preheaters damaged, lost drain pumps, pipe between heater/preheater needed to be replaced.
July 1997	Leaking boiler's tube. Suspect tube had been previously plugged as a precaution form eddy current tests, indicating fault in tube.	Hole in boiler's tube sheet; boiler was repaired and put back in operation. Lost drain pumps.
October 1997	Leaking Waste Heat Boiler after the sulfur burner filled plant with steam. Circulation pumps were stopped. When pumps were restrated, the cold acid repidly condensed/absorbed the steam, which created a vacuum and collapsed the tower.	Mist Eliminator housing, Mist Eliminators, Converter Shell.
Startup date 28 Feb 1998 Incident date 2 Sep 1998	Leak in perviously plugged preheater tube.	11 preheater tubes, acid pipe form preheater to FAT, HRS pump casing, lost 5 out of 13 mm on tower botton and pump boot

**Annex 4****MONITORING INFORMATION****Table B1. Auxiliary Electricity Meters' list**

Auxiliary Electricity	Objects of Measurement
(EG _{AUX1})	Main Compressor
(EG _{AUX2})	High Pressure Boiler Feed-water Pump A
(EG _{AUX3})	High Pressure Boiler Feed-water Pump B (for backup)
(EG _{AUX4})	Other Electricity-consumed Equipments in the Sulfuric Acid Unit
(EG _{AUX5})	Electricity-consumed Equipments in the Power Plant
(EG _{AUX6})	Circulating-water Pump

Calculation of EG_{AUX}**Annex B2. EG_{AUX1}**

Electricity meter 1	Electricity-consumed by Main Compressor
Equipments	Rated Power (MW)
Main Compressor	5.6
Total	5.6
Running time in one year(h)	7848
EG _{AUX1} (MWh)	43948.8

Annex B3. EG_{AUX2}

Electricity meter 2	Electricity-consumed by High Pump Boiler Feed-water Pump A
Equipments	Rated Power (MW)
High Pump Boiler Feed-water Pump A	0.9
Total	0.9
Running time in one year(h)	7848
EG _{AUX2} (MWh)	7063.2

Annex B4. EG_{AUX3}

Electricity meter 3	Electricity-consumed by High Pump Boiler Feed-water Pump B
Equipments	Rated Power (MW)
High Pump Boiler Feed-water Pump B (Spare)	0.9
Total	0.9
Running time in one year(h)	0
EG _{AUX3} (MWh)	0

Annex B5. EG_{AUX4}

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Electricity meter 4	Electricity-consumed by Other Electricity-consumed Equipments in the Sulfuric Acid Unit
Equipments	Rated Power (MW)
Main Compressor Main Lube Oil Pump	0.0185
Drying Tower Acid Circulation Pump	0.28
Final Tower Acid Circulation Pump	0.28
HRS Acid Circulation Pump	0.25
Sulfur Burner Feed Pump	0.022
Treated Water Transfer Pump	0.045
IP Boiler Feedwater Pump	0.075
WHB Chemical Feed Pump	0.0011
WHB Chemical Tank Agitator	0.00037
HRS Boiler Chemical Feed Pump	0.0011
HRS Boiler Chemical Tank Agitator	0.00037
Lighting	0.03
UPS	0.015
HVAC for Electrical Room/MCC	0.04
Total	1.058
Running time in one year(h)	7848
EG _{AUX4} (MWh)	8307.108

Annex B6. EG_{AUX5}

Electricity meter 5	Electricity-consumed by the Power Plant
Equipments	Rated Power (MW)
TG Main Lube Oil Pump	0.045
TG Lube Oil Vapor Extractor	0.00085
TG Condensate Pump	0.132
Instrument Air Compressor	0.045
TG Building Ventilation Fans	0.022
HVAC System for TG Electrical Rooms	0.05
UPS	0.015
Lighting	0.1
Total	0.32
Running time in one year(h)	7848
EG _{AUX5} (MWh)	2511.36

Annex B7. EG_{AUX6}

Electricity meter 6	Circulating-water Pump
Equipments	Rated Power (MW)
Cooling Water Circulation Pump 1	0.9
Cooling Water Circulation Pump 2	0.9
Cooling Water Circulation Pump 3	0.9
Fan of Cooling 1	0.185



Fan of Cooling 2	0.185
Fan of Cooling 3	0.185
Fan of Cooling 4	0.185
Fan of Cooling 5	0.185
Total	3.625
Running time in one year(h)	7848
EG _{AUX6} (MWh)	28449

Annex B8. EG_{AUX}

Auxiliary Electricity	EG _{AUX1}	EG _{AUX2}	EG _{AUX3}	EG _{AUX4}	EG _{AUX5}	EG _{AUX6}	EG _{AUX}
MWh	43948.8	7063.2	0	8307.108	2511.36	28449	90279.468



Annex 5 Equity IRR calculation of the proposed project without carbon income

Unit: Million RMB Yuan

		total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	cash inflow	204309			7952	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	17439
1.1	sales income	196810			7952	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940	9940
1.2	reclaim capital asserts residual value	6918			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6918
1.3	reclaim floating capital	581			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	581
2	cash outflow	163093	8794	174	7931	9791	9746	9731	9715	16101	6508	6508	6508	6508	6508	6508	6508	6508	6508	6508	6508	6508	6508	6508
2.1	capital	8998	8794	174	0	30	0																	
2.2	principal refunding	6791			1640	2534	2617	2703	2792	9235														
2.3	debt interest	3491			1276	1181	1035	883	727	566	32	32	32	32	32	32	32	32	32	32	32	32	32	32
2.4	running costs	11885			3808	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038	4038
2.5	sales tax and surtax	3977			1136	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421	1421
2.6	income tax				70	587	636	686	737	841	1017	1017	1017	1017	1017	1017	1017	1017	1017	1017	1017	1017	1017	1017
3	net cash flow	41216	-8794	-174	21	149	194	209	225	-6161	3432	3432	3432	3432	3432	3432	3432	3432	3432	3432	3432	3432	3432	10931
		after tax																						
	Equity IRR	11.76%																						

