

Summary of FY2008 CDM/JI Feasibility study report

Waste Coke Oven Gas (COG) Based Electricity Generation Plant

E&E Solutions Inc.

1. Project description

Currently, from the coke plant of the Shanxi Haiyang Coke-making (Group) Co. Ltd (Shanxi Province, China. Production capacity 1 million tons per year), approximately 40 thousand Nm³/h of Coke Oven Gas (COG) is generated during the production process, thus emitting some 350 million Nm³ of unused COG to the air annually. This project aims to recover 25.8 thousand Nm³/h of waste COG, and install 2×75t/h boiler and two sets 2sets of 12 MW steam turbine generators to utilize the recovered gas. The generated electricity shall be exported to the North West China Power Grid (NWPG: Shanxi, Gansu, Qinghai, Ningxia and Xinjiang are counted in the grid). The total exported electricity is expected to total to 162.6 GWh, and the GHG emission reduction is expected to be 138 thousand ton/year.

The project site is located within the Longmen Ecological Industrial Park, Hancheng City, Shanxi Province, which is in the west-inland area of China, where the economy is relatively under developed compared to the seaside. In the Industrial District, there are many heavy pollution industries such as coal, steel (including coke factory) and cement, therefore the current annual emission of dust is 24 thousand tons/year and of SO₂ is 39.8ton/year. Thus, environmental pollution is becoming to be a very serious problem in this area. The Chinese government has temporally ceased to grant permits for new projects that have fear of serious pollution, as well as ordered many small scaled coke, cement, steel factories and coal mines to stop the operation. To achieve the environmental standards required by the Chinese Government, it is said that the countermeasures to the large-scale enterprises are necessary, thus, this project shall have an important meaning to the district as a model air-pollution countermeasure for others.

2. Study contents

(1) Issues to be studied

Through this study the followings were considered and revealed.

- The environmental and social background of the project surroundings: for consideration of project baseline scenario, to write the general description in the PDD.
- Selection of the related laws and regulation of China and Shanxi province, along with confirmation of law-abidance by the Project: For confirmation of the Project additionality and for consideration of co-benefit indices.
- The details of the Project technology, the specification of the machines and equipments planned to be installed, confirmation of COG gas balance, etc, updating of information.
- Confirmation of the project status and determination of problems or issues confronted for the implementation
- The cost on the installation and operation of the equipments and the financial plan (Especially investigation was conducted focusing on the changes made from the time of FSR)
- Collection of information and examples of general practices concerning the utilization of COG in the coke factories.

- Getting information on the trend and status of the energy-saving and environmental measures in the coke factories.
- Collecting data on the district electric grid of the Project area and confirmation on the emission coefficient of electricity.
- Development on the monitoring plan in the Project.
- Consideration of the monitoring structure and coordination with the Shanxi Haiyan coke-making (Group) Co.,Ltd
- Documentation of the PDD based on the approved consolidated methodology ACM0012 version03.
- Confirmation on the project implementation structure and status on the CER transfer to the Japanese Government
- Project economical calculation
- Extraction and consideration of issues concerning implementation of the Project
- Consideration of co-benefit indices (Calculation of pollution prevention effect/ environmental improvement effect on behalf of the host country)

(2) Organization to conduct the study

During the study, the Shanxi Haiyan coke-making (Group) Co.,Ltd, the Proponent of the Project, as well as the CDM Development Room of the Shanxi Industrial and Science Institute, which is an independent semi-governmental research and development institute in the Shanxi Province. Also, for the translation and organizing the information gathered as well as collection of the stakeholder comments, Tepia Cooperation Japan, which has closed an exclusive basic agreement on the CDM development with the CDM development room of the Shanxi Industrial and Science Institute.

(3) Contents of the Study

1) Pre-study

Existent data was collected and on-site study method was considered through bibliographical study and interviews with experts, concerning the project related information and data which is necessary to perform the Study.

In particular, the data was focused on the policies concerning the energy-savings and dissemination of the energy-saving technology in China and the Shanxi-Province, and also on the environmental, social and economical information of the Project site surroundings.

2) On-site survey

Based on the results of the above pre-study, with the cooperation of the Shanxi Haiyan coke-making (Group) Co.,Ltd,, the counterpart of the Project, necessary data and information to conduct the (3) - (10) survey was collected.

In particular, for the coke factory, survey on the major facility, data collection on the energy consumption and generation amount of the exhaust gas was conducted.

In addition, data and information on the governing bodies and its administrative status of the Longmen Ecological Industrial Park, major enterprises within the Park, the trends of the energy consumption and serious environmental issues were collected, to be utilized in the consideration of the GHG emission reduction potential, realization of the co-benefit method and its evaluation.

These data and information was mostly collected during the on-site survey, but additional data was collected by the Tepia Japan Cooperation's Chinese network.

3) Survey on the baseline scenario

Baseline scenario of the Project was set based on the local situation such as the future policies if the Host party, dissemination possibility of the targeted technology and the discussion of the CDM Executive Board.

Upon the setting of the baseline scenario, emphasis was made to clarify the project boundary and the idea of the additionality.

The baseline was considered based on the consolidated baseline methodology ACM0012 Version 03 (Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects).

The geographical boundary of the project includes the Coke plant generating the COG, the power plant utilizing the recovered COG and the North west power grid (NWPG).

Moreover, based on the information collected on the on-site survey and the additional data collected by the counterparts, the validity of the baseline scenario and the boundary was considered, and necessary modifications were made.

Also, effort was made to constantly up-date the PDD reflecting the modifications made on the methodologies, through the information on the UNFCCC website.

4) Survey on the monitoring method and plan.

Based on the approved consolidated baseline methodology ACM0012, the appropriate monitoring method concerning the Project was clarified, and the monitoring plan was set up.

Also, the measurement instrument types used for the monitoring of exhaust gases etc., and standards concerning the calibration of the measurement instruments were confirmed.

5) Survey on the Project period and the Crediting Period

Project period and crediting period (including the program implementation period and the individual project implementation period) was set up.

Because there were constraints from the applied methodology, the project period was set up as 20 years and the crediting period as 10 years.

6) Survey on the GHG emission (and emission reduction) calculation

Based on the gathered data, default value which is given by the host country or internationally approved and the performance data, the GHG emission value (and reduction value) was estimated within the project boundary for the project implementation case.

7) Survey on the Environmental impacts

Basic information on the regulations and systems on the environmental impact assessment in the Shanxi Province and the Longmen Ecological Industrial Park of the Hancheng City, the existence environmental data and applied regulation for the equipments and facilities which is to be installed in the project were collected. Upon the

collection of the data, cooperation from the Environmental Protection Agency of the Hancheng City was obtained.

The Environmental Impact Assessment Report of this project was reviewed.

8) Survey on other indirect impacts

Considering the characteristics of this projects, both positive and negative impacts on the social, cultural and economical factors by this project was studied.

9) Survey on the stakeholders' comments

For the stakeholders' comments, there were hearing of opinions on a questionnaire basis was held through the EIA process, but there were additional information collected through direct explanation of the CDM project.

The target stakeholders for the survey were: Hancheng City DRC, Hancheng City EPA, Hancheng City Longmen Ecological Industrial Park administrative council, as well as schools, hospitals, other public facilities, companies and residents in the vicinity of the site.

The comments were collected mostly through the interview survey (As of now, this is not yet conducted because of the proponents' reasons, expected to be finished by the end of the survey and the results shall be reflected in the PDD and the report)

10) Survey on the monetary plan

Survey was conducted on the necessary expenditure and income to operate the Project, and the monetary plan as CDM/JI project was confirmed.

In addition, the project feasibility was evaluated using the indices such as IRR or NPV of the Project.

11) Making the PDD

Based on the survey results of the above 1) - 10), Project Design Document (PDD) was documented. PDD was documented based on the approved consolidated methodology ACM0012 Version 03.

12) Survey on the realization on the co-benefiting approach of global warming and pollution countermeasures and development of appropriate index on co-benefit

Studies were made on the co-benefiting indices for this Project. In particular, emphasis was made on the evaluation to decrease the SO₂, which is a serious environmental problem in the Hancheng City Longmen Ecological Industrial Park.

As a part of the study, co-benefiting effect was evaluated through the calculation of SO₂ emission reduction through the Project implementation.

In China, because at present, with the assistance from US NGO and ADB, SO₂ emission trade model project is now under consideration, the SO₂ emission reduction effect can be thought to be a "by-credit" attached with the carbon credit. Although in this Project necessary data for the effect estimation could not be obtained, similar evaluation might be applied for PM (Particulate matter) or NO_x.

3. Project Operation

(1) Setting the Project boundary and the baseline.

1) Methodology

For this project, consolidated baseline methodology ACM0012 Version 03 (Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects) can be applied. This project falls into Type 1 of the applied methodology, and the conditions for the application is mentioned as follows:

Type-1: All the waste energy in identified WECM stream/s, that will be utilized in the project activity, is, or would be flared or released to atmosphere in the absence of the project activity at the existing or new facility. The waste energy is an energy source for:

- Cogeneration; or
- Generation of electricity; or
- Direct use as process heat source; or
- For generation of heat in element process2 (e.g. steam, hot water, hot oil, hot air);

Or

- For generation of mechanical energy.

This project utilizes the COG for power generation where in the absence of the project activity it was flared, thus falls into the above conditions.

2) Boundary

The geographical boundary of the project includes the Coke plant generating the COG, the power plant utilizing the recovered COG and the North west power grid (NWPG). The baseline emission sources include the CO₂ emitted from the power plants of the NWPG using fossil fuel. The Project emission and leakage emission is zero.

3) Baseline

There are no incentives to implement power generation utilizing the recovered COG in neither Shanxi Province nor China, so the baseline shall be to flare the COG and emit to the air. (to be described in the “additionality”).

4) GHG emission reduction calculation method.

Emission reduction is the difference between the baseline emission and project emission.

According to consolidated methodology ACM0012 ver3.0. the baseline emission is derived through the following formula:

$$\begin{aligned} BE_y &= BE_{En,y} + BE_{flst,y} \\ BE_{En,y} &= BE_{Elec,y} + BE_{Ther,y} \\ BE_{Elec,y} &= f_{cap} * f_{wg} * \sum \sum (EG_{i,j,y} * EF_{Elec,i,j,y}) \end{aligned}$$

Because there are neither flaring nor heat supply in the project, BE_y and $BE_{Elec,y}$ can be considered zero. From the steam analysis, f_{cap} is 1. Furthermore, the power generation is only using exhaust gas, f_{wg} is also 1.

The Emission factor of the NWCPG $EF_{Elec,i,j,y}$ can be calculated as 0.877 tCO₂e/MWh. Also, $EG_{i,j,y}$ = 162,600

MWh/yr, $BE_y = 162,600 \times 0.877 = 142,600$, thus BE_y is 142,600 tCO₂e per year.

As the Project emission PE_y being 0, the Emission Reduction ER_y from this project is derived from this formula $ER_y = BE_y - PE_y$, thus equalling to 142,600 tCO₂e per year.

(2) Monitoring Plan

1) Monitoring methodology

The following data shall be monitored.

Project emissions:

- Quantity of fossil fuels used as supplementary fuel
- Net calorific value of fossil fuel,
- CO₂ emission factor of the fossil fuel
- Quantity of electricity consumed by the project operations:
- CO₂ emissions factor of electricity consumed by the project operations.

These data shall be recorded on an electronic file and shall be kept for 2 years after the Project ends.

While the quantity of fossil fuels fired are measured using calibrated flow meters, other data items are only factors obtained from reliable local or national data. If local data is not available, project participant may use default factors published by IPCC.

Depending on the baseline scenario, the following data items need monitoring.

- Quantity of electricity supplied to the recipient plant(s)
- CO₂ emission factor of electricity that would have been consumed by the recipient plant(s) in the absence of the project activity
- Quantity of gas supplied to the recipient plant(s)
- Properties of gas (e.g. pressure and temperature of the steam) supplied to the recipient plant(s)
- Properties of gas return to element process (e.g. pressure and temperature of the condensate return) supplied by the recipient plant(s) to the project plant
- Efficiencies of element process or cogeneration plant or mechanical conversion equipment that would have been built in the absence of the project activity;
- Mechanical energy delivered to the recipient plant(s).

2) Monitoring operational and management scheme

The project operator plans to appoint a CDM project director and a monitoring manager and several monitoring engineers. The respective responsibilities are as follows :

CDM Project Director : Receive reports from the monitoring manager; manage the CDM project jointly with the CER buyer; coordinate with the Chinese Government and stakeholders; submit the monitoring report to the DOE and deliver the CERs.

Monitoring Manager: Based on the monitoring plan in the PDD, he records the net electricity supplied monthly and the annual totals, prepares the monitoring reports, etc. The Monitoring manager reports to the CDM project director.

Monitoring engineers, responsible for the daily operation and maintenance of the plant, and the recording of the daily electricity generation.

(3) GHG Emission Reduction Amount

The emission reductions during the crediting period are estimated as:

YEAR	Annual Reduction Amount (t-CO ₂ e)
2009	71,826
2010	143,653
2011	143,653
2012	143,653
2013	143,653
2014	143,653
2015	143,653
2016	143,653
2017	143,653
2018	143,653
2019	71,826
Total (tCO ₂ e)	1,436,526

(4) Project period/ Crediting period

The crediting period of this Project starts from 1-7-2009 and lasts for 16 years, and the crediting period is expected for 10 years (01/07/2009 - 30/06/2019). The project period is set according to the starting of operation of the coke furnace, now under construction.

Also, according to the methodology, the credit can be claimed only the shorter term of either the remaining period of the expected lifetime of the facility or the crediting period, and as being the legal lifetime of the power plant is 15 years, the crediting period was set for 10 years.

(5) Environmental impacts and other impacts.

Shanxi Environmental Protection Bureau, Weinan in March.2008, has approved the proposed project. It can not only enhance local economic strength, but also result in prominent environmental and social benefit; therefore, the proposed project is feasible. Refer to *Environmental Impact Assess Report of Coke Oven Waste gas Recovery Power Plant of Shanxi Haiyan Coke Making (Group) Co., Ltd.*

The main conclusions on environmental impact assess of the proposed project are following:

1. Waste gas

The proposed project is to recover the waste gas during the coke production; no additional waste gas will be generated in the proposed project.

2. Waste water

The sewage in this project includes residential drainage and production drainage. Production wastewater will be reused for Coke Quenching. Residential wastewater will be used for sprinkling and water grass after treated by existing sewage treatment equipment. Therefore, due to the reuse of the production wastewater and the utilization of the residential wastewater, it will not cause water pollution.

3. Solid wastes

The proposed project is to recover the waste gas during the coke production, no additional solid waste will be generated in this project.

4. Noise

The noise sources of the proposed project are from boiler fan, boiler exhaust gas valve, electricity motor, water pumps, etc., its sound level generally is 95~110dB (A). The noise will meet the criteria of the environmental requirements of the "Standards for noise for industrial plant" (GB12348-90), through the following measures: install the noise equipment far from the residential areas, use of less noise-polluted equipment, install a noise reduction device for shock absorption, and strengthen worker protection measures, etc.

(6) Stakeholders' comments

For the stakeholder's comments concerning the project, the Shanxi Academy of Environmental Science conducted a questionnaire survey on July 2008 as a part of EIA. The questionnaire scope includes different ages, educational degree, occupations and living areas. The participants are residents, officers and others. Therefore, the survey can fully represent the opinion of local people on this project. The main results are as follows:

- 92% of the participants think it would the project help to improve the local quality of the environment (air, water, noise).
- 96% of the participants think it would the project facilitate to the local economic development.
- 98% of the participants think it would the project increase employment opportunities.
- 94% of the participants think that the construction of the project is feasible.

In conclusion, the public will support the proposed project very much, but there are no survey focused on the CDM project, so there are plans to conduct an additional survey afterwards (Currently, the schedule is being adjusted, and the survey is to be conducted during the survey period and reflected in the final report)

(7) Project operational structure

The Chinese proponent is the Shanxi Haiyang Coke-making (Group) Co. Ltd, and the investment of the equipments and the operation is on their part. As the Japanese Project Participant, Tepia Cooperation Japan shall assist in the registration and validation of CDM and buy the Credit. For the registration and implementation of the CDM, E&E Solutions Inc. shall give technical assistance.

Also, Shanxi Province Industrial Technology Institute CDM development room will give on-site CDM implementation support.

(8)Investment plan

The construction cost for this project is estimated as shown below.

The total project investment cost of 98.4 million Yuan shall be supplied by the funds of the Group which the Shanxi Haiyang Coke-making (Group) Co. Ltd belongs to.

Estimated Construction Cost

No.	Item	Investment (1,000Yuan)	Percentage of the total cost (%)
1	Construction works cost	26,843.5	27.28
2	Installation cost	16,108.1	16.37
3	Equipment purchase cost	46,494	47.25
4	Other cost	5,362.8	5.45
5	Reserve cost	3,591.6	3.65
	Total cost	98,400	100

(9) Economical Analysis

The main parameters for the economical analysis was set as follows:

Items	Unit	Value	Remarks
Installed Capacity	MW	24	
Total Investment	Million Yuan	98.4	
Current capital	Million Yuan	7.65	
O&M	Million Yuan/yr	29.89	
Delivered Electricity	GWh/yr	163.8	
Electricity Tariff	Yuan/MWh	285	Including VAT
Value added tax	%	17%	
Other taxes	%	10%	city tax plus education tax
Project life	Years	16	excluding one year for construction.
Time span for IRR calculation	Years	17	including one year for construction.
CERs price (assumed)	€/tCO ₂	9	Assumed, with exchange rate 9.5
Credit period	Years	10	

- The working hours for the power facility: 7,500 hours
- The internal power utilization rate of the power station: 9%
- Fixed asset formation rate: 95%, Depreciation Period 15 years, Salvage value 5%
- Number of power plant staff: 115 people, Annual average wage including social welfare: 12,000Yuan/person/year
- Overhaul cost rate: 1.5%, Material cost 2.5Yuan/Mwh. Other cost 5.0Yuan/MWh
- Electricity tariff for grid supply: 285Yuan/MWh, Water tariff: 2.5Yuan/MWh, COG: 0.10Yuan/MWh
- VAT: 17%, City Construction Tax 5%, Education Additional Tax 3%
- Profit bond: 10% of the profit after tax

Annual electricity generation: 180,000MWh, Annual electricity supply: 162,600MWh, Annual water consumption 130,500m³, Annual COG consumption: 205,500 thousand m³

The major economical factors based on the above assumption are shown below:

If there is no CER revenue, the NPV (Net Present Value) of the project is below 0, meaning the Project will not be financially attractive. However, if we consider the CER revenue, the NPV shall become 48,360 thousand Yuan, then the Project shall be financially attractive. Also, the IRR (FIRR: Financial Internal Rate of Return) shall be 3.8% without the CER revenue, lower than the benchmark of 8% for the coke industry, but if we consider the CER revenue, the IRR become 15.8%, which is over the benchmark.

Financial Indicators with and without CER (after Tax)

	Item	Value	Evaluation
NPV	Without income from CERs	-2,512	< 0
	With income from CERs	4,836	> 0
IRR	Without income from CERs	3.8%	< 8%
	With income from CERs	15.8%	> 8%

(10) Demonstration of additionality

This project is a “Green Field” project, meaning that upon the demonstration of additionality of this Project, that the COG will be redundant after the construction of the coke furnace, and the gas shall be either flared or emitted must be proven. For this, the gas balance has been considered in the F/S during the planning process. Also, from the interviews during the on-site survey, we obtained information that “for the coke factories that are under annual capacity of 2million tons, COG have no value to be recovered, and thus normally the gas is flared in the open-air”, and examples proving this information has been collected.

Furthermore, for the demonstration of additionality, barrier analysis based on the “Tool for the demonstration and assessment of additionality” is required, thus it has to be demonstrated that the COG recovery from the coke factory is inhibited by the existence of either investment barrier, technical barrier or common practice barrier.

From the survey conducted, the below barrier is confirmed.

i) Investment barrier

To enforce a COG recovery-utilization-power generation plant project, there needs a lot of investment cost, and, the profitability is low. Therefore, COG shall be as before be emitted unused unless the project become a CDM project and have credit revenue, because of investment barrier.

ii) Technology barrier

For the Shanxi Haiyang Coke-making (Group) Co. Ltd, the power generation itself is their first experience; they are faced with the technology barrier from the construction to the future operation. Furthermore, from the on-site survey, it was found that the COG fueled power generation is the first of its kind in the Shanxi Province.

iii) Common Practice barrier

At present there are no regulations enforcing the enterprises to use COG for energy, therefore there is no incentive for the companies in Shanxi Province or China to recover and use COG for power, meaning that it is common to flare the COG in the area.

(11) Perspectives for operation and issues.

The Shanxi Haiyang Coke-making (Group) Co. Ltd., which is the Project proponent, has exchanged exclusive agreement on the CDM development through the CDM Development Room of the Shanxi Province Industrial and Technology Institute. For the acquisition of the National approval, although at present it is before the consultation with the DNA of China which is the NDRC, pre-consultation with Shanxi-Province DRC and the Shanxi-Province EPA have already been undergone and the construction permit have already been authorized with the premises of CDM project.

Furthermore, there are plans to proceed to the validation procedure as soon as the PDD is finalized after this study has been finished.

As such, there are no obstacles or issues to be clarified at this moment. The construction schedule is shown on the below table.

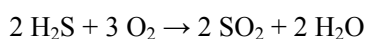
Construction Schedule

Schedule	2008												2009																		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12							
Designing of work drawing					—————																										
Foundation work					—————																										
Engineering work								—————																							
Installation of first unit											—————																				
Commissioning and Generation																	—————														
Installation of second unit																	—————														
Commissioning and Generation																					—————										

4. Realization of co-benefit in the host country

(1) Evaluation on pollution prevention in the host country

The evaluation of the pollution prevention effect from the project is based on SO₂ emission. H₂S, which is included in the COG, is a combustive gas, and if combusted, is turned into SO₂.



Currently the SO₂ generated from the flare combustion is emitted to the air without any treatment. From the contents of the COG and the amount of gas generated, the amount of SO₂ emitted to the atmosphere is estimated to be 139t SO₂/year:

Where: SO₂ concentration in the exhaust gas: 0.06% (Volume rate)

Exhaust gas from the boiler: 10,566Nm³/h

Boiler operating hours: 7,500hrs

Density of SO₂ ρ : 2.9269 g/l

Thus the annual amount of SO₂ can be calculated as:

$$10,566 \text{Nm}^3/\text{h} \times 7,500 \text{hours} \times 0.06\% \times 2.9269 \text{g/l} = 139 \text{t -SO}_2/\text{years}$$

If the desulfurizing rate of the boiler waste gas treatment system is assumed to be 70%, 97t of SO₂ can be removed.

Also, the reduction effect of fossil fuel from this project is, converted to standard coal, 88.5 thousand t per year (1t standard coal = 7000kcal).

Assuming the sulfur content of the coal in the Shanxi Province as 0.6%, it can be calculated that

$$88.5\text{thousand t} \times 0.6\% \times 64 / 32 = 1,062 \text{ t / year}$$

of SO₂ generation is reduced.

(2) Recommendation of co-benefit index

Apart from the reduction of COG (including methane gas) emission to the air and GHG reduction from the effective use of COG, this Project can benefit the region by:

Protection of exhaustible resource by reducing the use of fossil fuel;

Improvement of hygiene by air pollution prevention;

Reduction of air pollutants such as dust and SO_x,

meaning that this Project is a co-benefit type CDM.