



**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Nanba Associated Gas Processing Plant and the Auxiliary Engineering
Version number of the PDD	02.2
Completion date of the PDD	19/10/2012
Project participant(s)	Daqing Oilfield Co., Ltd. (Project developer) Macquarie Bank Limited (Purchasing party)
Host Party(ies)	People's Republic of China
Sectoral scope and selected methodology(ies)	Sectoral scope 10: Fugitive emission from fuels (solid, oil, gas) AM0009 (Version 06.0.0)
Estimated amount of annual average GHG emission reductions	301,731tCO ₂ e

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

>>

The Nanba Associated Gas Processing Plant and the Auxiliary Engineering (hereafter referred to as the Project) is located in Daqing City, Heilongjiang Province, People's Republic of China. The Project is developed by Daqing Oilfield Co., Ltd. (hereafter referred to as the project developer).

Purpose of the Project:

The purpose of the Project is to recover and utilise the associated gas from oil wells in the Second Oil Production Plant of Sanan Oilfield that would otherwise be vented, to process into dry gas and condensate. The oil field development of the Second Oil Production Plant of Sanan Oilfield does not apply and will not apply the gas-lift technology, and there is no and will be no gas injection infrastructure at the project site. The Project will construct the associated gas recovery system and associated gas processing and transport infrastructure, including gas collection facilities, booster station, processing plant and transportation pipelines, etc. After recovery, pre-processing, compression, dehydration, condensate-separation etc., the associated gas will be separated into dry gas and condensate. The dry gas will be transferred to the end-users via the transportation system. The condensate will be transferred to storage tank and then eventually sold to the end users. The daily processing capacity of the processing plant is designed to be $90 \times 10^4 \text{ Nm}^3/\text{d}$. According to the FSR, the recovered associated gas will vary from year to year based on the crude oil output of the Second Oil Production Plant of Sanan Oilfield. In the 10 years from 2012 to 2021, the Project will process $17,344 \times 10^4 \text{ Nm}^3$ associated gas and produce $13,875 \times 10^4 \text{ Nm}^3$ dry gas and $3.64 \times 10^4 \text{ t}$ condensate annually on average.

- (a) In the absence of the project, all the associated gas recovered by the Project will be vented to the atmosphere and the existing oil and gas infrastructure at the Second Oil Production Plant of Sanan Oilfield will continue operation without processing of any recovered associated gas and without any other significant changes.
- (b) The baseline scenario of the Project is the same as the scenario existing prior to the start of implementation of the Project.

How the Project reduces GHG emissions:

The project will recover and utilise the associated gas at the Second Oil Production Plant of Sanan Oilfield that would otherwise be vented into atmosphere in the absence of the project activity to process into dry gas and condensate. Thus greenhouse gas (GHG) emission reductions will be generated by utilization of the recovered gas which displaces the use of other fossil fuel sources.

The project was categorized in the sectoral scope 10- Fugitive emission from fuels (solid, oil, gas) and the estimated amount of emission reductions over the chosen crediting period as follows:

Total estimated reductions (tonnes of CO₂e)	2,715,579
Total number of crediting years (years)	9
Annual average over the crediting period of estimated reductions (tonnes of CO₂e)	301,731

Contributions of the Project to sustainable development:

The Project will contribute to sustainable development of the local community, the host country and the world by means of:

- ✧ Avoiding waste of energy in the Oilfield;
- ✧ Improving energy efficiency by the recovery and utilization of the associated gas;
- ✧ Reducing GHG emissions and air pollution from venting of associated gas;
- ✧ Creating many permanent jobs during operation period and lots of short-term employment opportunities during the project construction.

A.2. Location of project activity

A.2.1. Host Party(ies)

>>

People's Republic of China

A.2.2. Region/State/Province etc.

>>

Heilongjiang Province

A.2.3. City/Town/Community etc.

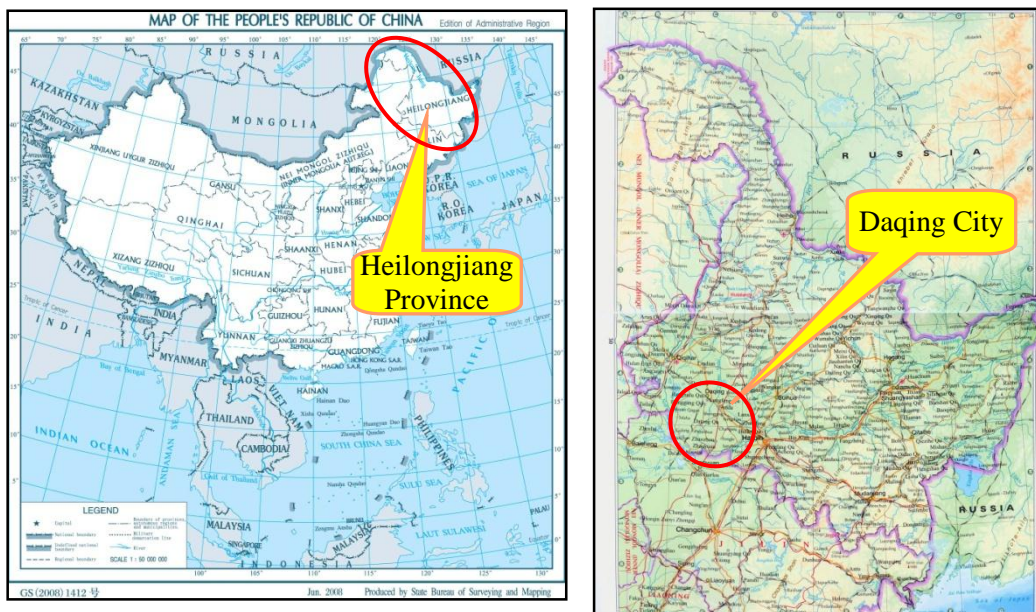
>>

Daqing City

A.2.4. Physical/Geographical location

>>

The Project is located at the Sanan Oilfield in Daqing City, Heilongjiang Province, People's Republic of China. The associated gas processing plant has a geographical coordinates of 125°00'54.9" E and 46°33'00.5" N, located northeast to the Nanba Combined Station. Figure A4-1 shows the location of Daqing City, and Figure A4-2 shows the location of the Project.



FigureA.4-1. Location of Daqing City in China

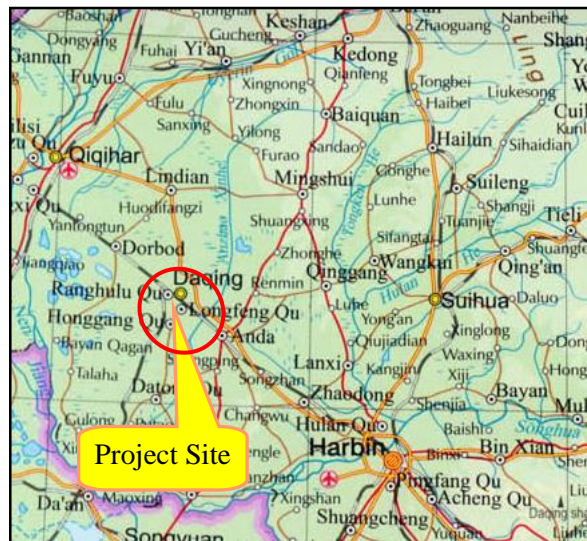


Figure A.4- 2. Location of the Project

A.3. Technologies and/or measures

>>

The associated gas comes from the oil wells of the Second Oil Production Plant of Sanan Oilfield and is separated from the crude oil during the phase separation process in the 370 metering rooms, 50 transferring stations and 3 combined stations, named Nanba Combined Station, Nan-II-1 Combined Station, and Nan-II-2 Combined Stations respectively. The Project will construct the associated gas recovery system, and associated gas processing and transport infrastructure, including gas collection facilities, a booster station named Sanan Booster Station, processing plant and transportation pipelines, etc. The recovered associated gas will be collected by the associated gas recovery system and transported to the gas processing plant. The associated gas processing system is outside the project boundary as per the methodology. The associated gas processing plant applies the deep cooling treatment technology to process the recovered associated gas. After recovery, pre-processing, compression, dehydration, condensate-separation etc., the associated gas will be separated into dry gas and condensate. The dry gas will be transferred to the end-users via the transportation system. The condensate will be transferred to storage tank named Guangming Pool and then eventually sold to the end users. According to the FSR, the recovered associated gas will vary from year to year based on the crude oil output of the Second Oil Production Plant of Sanan Oilfield. In the 10 years from 2012 to 2021, the Project will process $17,344 \times 10^4 \text{Nm}^3$ associated gas and produce $13,875 \times 10^4 \text{Nm}^3$ dry gas and $3.64 \times 10^4 \text{t}$ condensate annually on average. The monitoring equipments including the flow meters and electricity meters and their location in the system are described in the figure below.

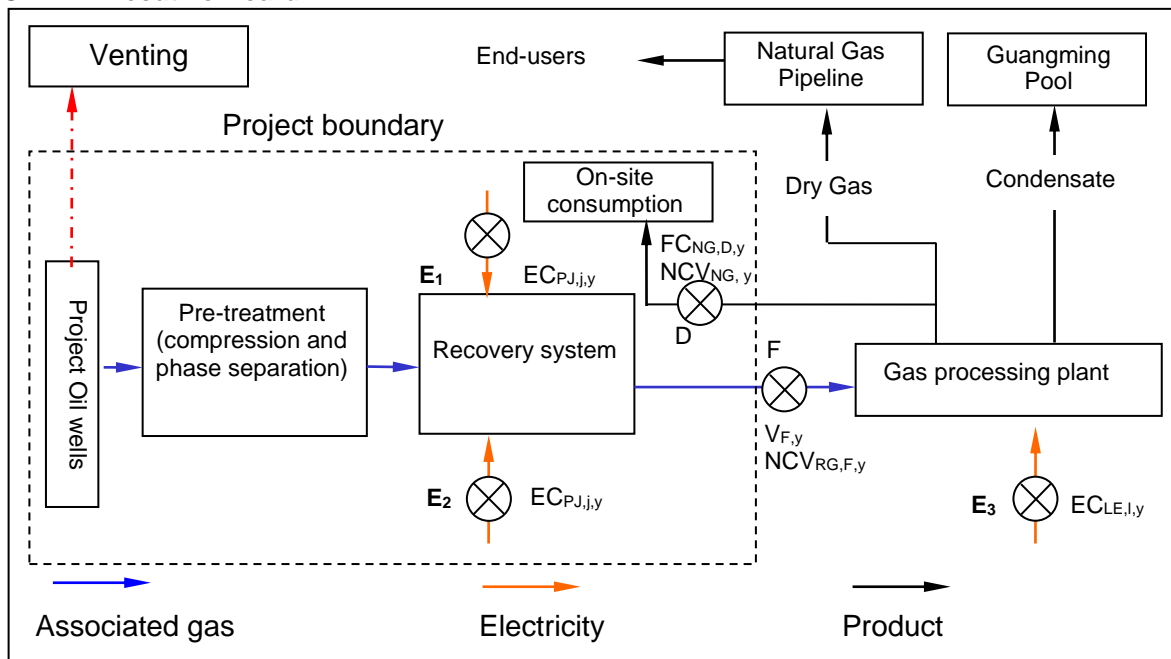


Figure A3-1: Schematic illustration of the project activity

The main equipment and respective technical parameters of the Project are showed on Table A3-1.

Table A3-1 Main equipments and technical parameters in the project

Centrifugal compressor	
Type	MCL526+2BCL458
Molecular weight	20.37
Rated Power	7200 kW
Rated speed	9949 r/min
Technical Life	20 year
Manufacturer	Shenyang Turbo-machinery Co., Ltd.
Regenerable adsorption type of dryer	
Type	HBP-2.2*8.0-4.4/1
Design pressure	4.4MPa
Design temperature	300°C
Period	8 h
Technical Life	20 year
Manufacturer	China Oil HBP Science & Technology Co., Ltd.
Screw refrigeration compressor	
Type	VRS2700
Refrigerant type	Propane
Evaporating temperature	-40°C
Evaporating pressure	0.111MPa
Technical Life	20 year
Manufacturer	Emerson Environment Optimization Technologies (Shanghai) Co., Ltd.
Demethanizer	
Design pressure	2.0MPa
Design temperature	-110°C
Maximum allowable Pressure	1.91MPa
Oil field gas compressor	



Type	JC-SDW-125/0.5-3
Volume flow	125Nm ³ /min
Suction pressure	0.02-0.06MPa
Discharge pressure	0.3MPa
Manufacturer	Beijing Jingcheng Environmental Protection Development Co., Ltd

The Project will employ domestic equipments which involve no technology transfer from abroad.

The baseline scenario of the Project is the associated gas recovered by the Project will be vented to the atmosphere and the existing oil and gas infrastructure at the second Oil Production Plant of Sanan Oilfield will continue operation without processing of any recovered associated gas and without any other significant changes which is the same as the scenario existing prior to the start of implementation of the Project.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
P. R. China (host)	Daqing Oilfield Co., Ltd. (Project developer)	No
Australia	Macquarie Bank Limited (Purchasing party)	No

A.5. Public funding of project activity

>>

No public funding from Annex I Parties is involved in this project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

>>

AM0009“Recovery and utilization of gas from oil wells that would otherwise be flared or vented” (Version 06.0.0)

Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion (Version 02);

Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01);

Tool to calculate the emission factor for an electricity system (Version 02.2.1);

Tool for the demonstration and assessment of additionality (Version 06.1.0).

For more information, please refer to:

<http://cdm.unfccc.int/methodologies/PAMethodologies/approved.html>.

B.2. Applicability of methodology

>>

The baseline and monitoring methodology AM0009 (Version 06.0.0) is applicable to the project, because the project meets all the applicability criteria as below:

Table B2-1 Justification of Methodology Applicable Conditions

AM0009 (Version 06.0.0) applicability requirement	Justification of the project	Whether satisfied
---	------------------------------	-------------------



The methodology is applicable to project activities that recover and utilise associated gas and/or gas-lift gas from oil wells.	The Project is to recover and utilise the associated gas from oil wells in the Second Oil Production Plant of Sanan Oilfield that will be vented prior to the implementation of the Project activity to process into dry gas and condensate.	Yes
Under the project activity the recovered gas, after the pre-treatment (compression and phase separation) in movable or stationary equipment, is: <ul style="list-style-type: none"> o Consumed on-site to meet energy demands; and/or o Transported to a gas pipeline without prior processing; and/or o Transported to a processing plant where it is processed into hydrocarbon products (e.g. dry gas, LPG and condensate). The dry gas is either (i) transported to a gas pipeline directly, or (ii) compressed to CNG first, then transported by trailers/trucks/carriers and then decompressed and gasified again, before it finally enters the gas pipeline. 	The recovered gas after the pre-treatment (compression and phase separation) in stationary equipment is transported to Nanba Associated Gas Processing Plant to process into dry gas and condensate. Dry gas is delivered to the end-users via gas pipeline and the condensate is transferred to Guangming Pool for storage and then eventually sold to the end users.	Yes
The project activity does not lead to changes in the process of oil-production, such as an increase in the quantity or quality of oil extracted, in the oil-wells within the project boundaries;	The Project is limited only to recover the associated gas that would otherwise be vented on site, without affecting oil production of the oil wells.	Yes
The injection of any gases into the oil reservoir and its production system is allowed in the project activity only for the purpose of the gas-lift process;	The oil field does not and will not apply the technology of gas-lift in the oil production system. No gas is injected into the oil reservoir.	Yes
All recovered gas comes from oil wells that are in operation and are producing oil at the time of the recovery of the associated gas and/or gas-lift gas.	All the oil wells the recovered gas comes from are currently in operation and producing oil. The associated gas is dissolved in the oil and is separated from the oil extracted from the oil wells currently in operation and producing oil.	Yes
The applicability conditions included in the tools referred “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” is one of the following three scenarios applies to the sources of electricity consumption: <ul style="list-style-type: none"> a) Electricity consumption from the grid; b) Electricity consumption from an off-grid fossil fuel fired captive power plant; c) Electricity consumption from the grid and a fossil fuel fired captive power plant. 	The electricity consumption of the project supplied by Heilongjiang Power Grid, an integral part of Northeast China Power Grid (NEPG).	Yes
The methodology is only applicable if the identified baseline scenario is: <ul style="list-style-type: none"> a) The continuation of the current practice of either venting (scenario G1), flaring (scenario G2) of the associated gas and/or gas-lift gas; or on-site use of the partial amount of associated gas and/or gas-lift 	As detailed in Section B.4 of the PDD, the identified baseline scenario of the project is the continuation of current practice of venting the associated gas without prior processing (G1) and the continued operation of the existing oil	Yes

<p>gas to meet on-site energy demands and rest of the gas are either vented or flared (scenario G3); and b) The continued operation of the existing oil and gas infrastructure without any other significant changes (scenario P4); and c) In the case where gas-lift is used under the project activity: the gas-lift gas under the baseline uses the same source as under the project activity and the same quantity as under the project activity (scenario O1).</p>	<p>and gas infrastructure without processing of any recovered associated gas and without any other significant changes (P4). No gas-lift system is utilized under the project.</p>
---	--

The methodology directly or indirectly refers to the following tools:

- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion (Version 02);
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01);
- Tool to calculate the emission factor for an electricity system (Version 02.2.1);
- Tool for the demonstration and assessment of additionality (Version 06.1.0).

These referred tools are also applicable to this project.

B.3. Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Combustion of fossil fuels at end-users that are produced from non-associated gas or other fossil sources	CO ₂	Yes	Main source of emissions in the baseline
		CH ₄	No	Excluded for simplification. This is conservative.
		N ₂ O	No	Excluded for simplification. This is conservative.
Project scenario	Energy use for the recovery, pre-treatment, transportation, and if applicable, compression/decompression, transportation of the recovered gas	CO ₂	Yes	Main source of emissions in the project
		CH ₄	No	Excluded for simplification. This emission source is assumed negligible
		N ₂ O	No	Excluded for simplification. This emission source is assumed negligible

According to the methodology AM0009 (Version 06.0.0), the Project boundary encompasses:

- The project oil reservoir and oil wells where the associated gas is collected;
- The site where the associated gas was vented in the absence of the project activity;
- The gas recovery, pre-treatment, transportation infrastructure, including where applicable, compressors;

Figure B3-1 show the project boundary:

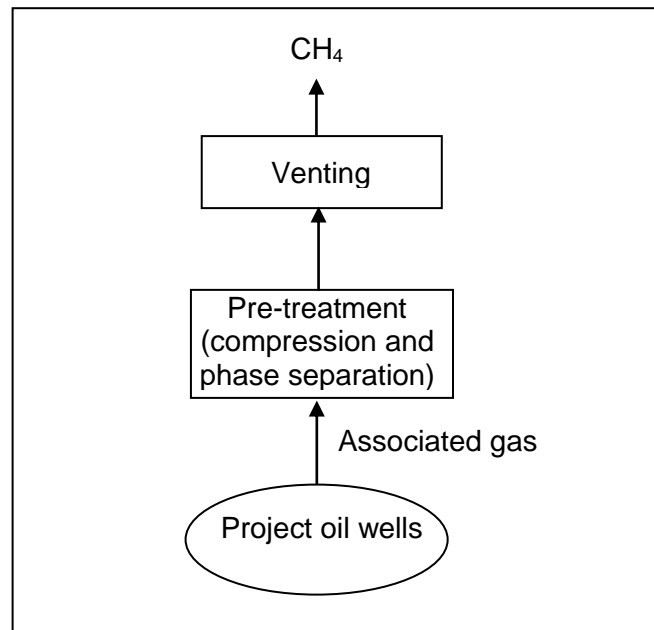


Figure B3-1: Schematic illustration of the baseline activity

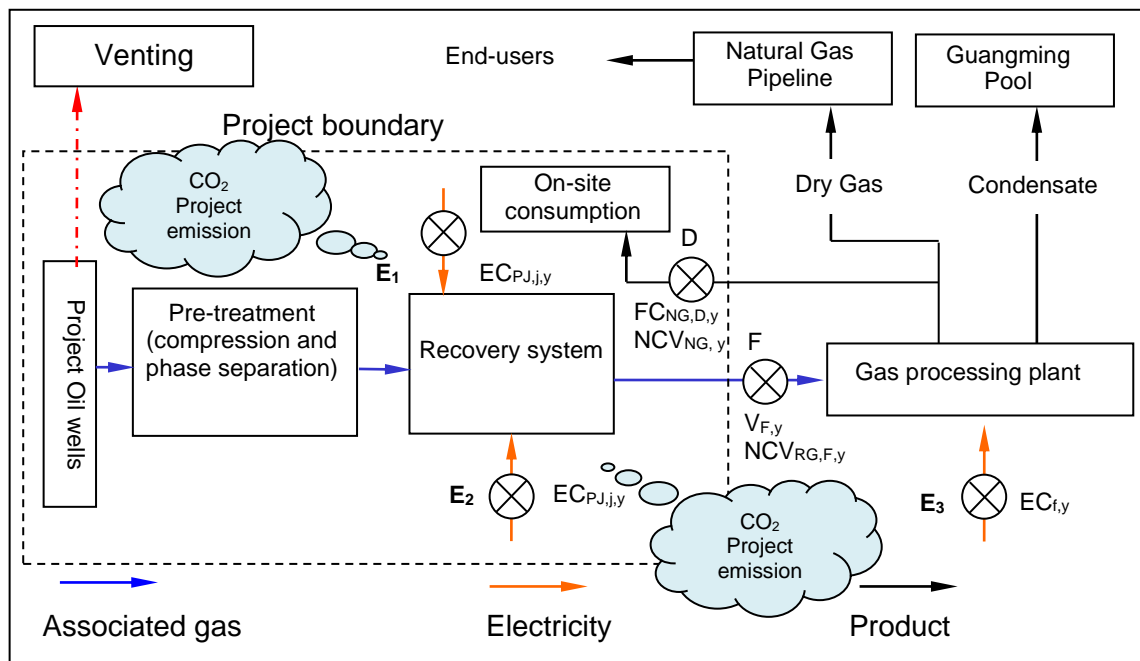


Figure B3-2: Schematic illustration of the project activity

Notes: ⊗ represents Monitoring Points; **E**: Electricity consumption; **F**: recovered gas after pre-treatment.

B.4. Establishment and description of baseline scenario

>>

According to the methodology AM0009 (Version 06.0.0), the baseline scenario is identified and description as follows:

Step 1: Identify plausible alternative scenarios



The project activity involves three components: scenarios of associated gas from the project oil, oil and gas infrastructure, the use of gas-lift. All the project oil wells do not apply and will not apply the gas-lift technology in the oil production, and no gas-lift gas is utilized in the project activity.

Plausible alternative baseline scenarios for the associated gas from the project oil wells were analysed below:

Plausible alternative scenarios	Feasibility analysis	Is this feasible?
G1: Release of the associated gas into the atmosphere at the oil production site (venting);	It is the continuation of current situation and technically feasible. No additional investment or technology is required for the scenario. Therefore G1 is a possible base line scenario.	Yes
G2: Flaring of the associated gas at the oil production site;	According to Code for Fire Protection Design of Petroleum and Natural Gas Engineering (GB50183-2004), the stable materials must be supplied for the flare system for safety purpose. There are 370 metering rooms, 50 transferring stations and 3 combined stations located at the Second Oil Production Plant of Sanan Oilfield for separating the associated gas from the crude oil. If install a flare system at each oil transferring station and combined station for flaring the associated gas, the required materials of the flare system such as N ₂ , cannot be provided steadily at such a large area of the Second Oil Production Plant. Therefore the associated gas from Oil transferring stations of the Second Oil Production Plant of Sanan Oilfield was vented to the atmosphere directly without flaring. Therefore, the scenario is not possible and eliminated.	No
G3: On-site use of the partial amount of associated gas to meet on-site energy demands and rest of the gas are either vented (G1) or flared (G2);	In the existing scenario prior to the implementation of the project activity, all the associated gas was vented to the atmosphere. On-site energy demands for the second Oil Production Plant of Sanan Oilfield is electricity consumption. There are no existing installations to generate power from the associated gas. According to power industry standard (DL/T5174-2003) for the	No



	design requirements of the gas power generation plant ¹ , the natural gas fired in the power plant shall conform to the provision of Code for design of gas transmission pipeline engineering (GB50251-2003) ² , that the hydrogen sulphide (H ₂ S) content of the gas should be no higher than 20mg/m ³ . Based on the measurement result by Petroleum Industry Center for Quality Supervision and Inspection of Crude Oil and Petroleum Products, the hydrogen sulphide (H ₂ S) content of the recovered gas of the project is 75mg/m ³ , much higher than the threshold of 20mg/m ³ , so the recovered gas can not be fired in the power plant. Therefore, this option is not feasible.	
G4: Injection of the associated gas into an oil or gas reservoir;	All the project oil wells do not apply and will not apply the gas-lift technology, and there is no and will be no gas injection infrastructure at the project site. Therefore, this option is not feasible.	No
G5: The proposed project activity without being registered as a CDM project activity;	This is the project scenario without being registered as a CDM project.	Yes
G6: Recovery, transportation and utilization of the associated gas as feedstock for manufacturing of useful products.	Without pre-processing, the high content of CO ₂ in the associated gas makes it technically impossible to transport and compress the gas into a gas pipeline. Furthermore, CO ₂ and other impurities such as H ₂ S in the associated gas can poison the catalyst ³ . If using the associated gas as feedstock for manufacturing of useful products, the associated gas need to be recover, processed and purified such as dehydration, desulphurization and separation, as well as more transportation equipments, and the Project will be constructed as a prerequisite. Therefore, this option is not feasible.	No

Plausible alternative baseline scenarios for oil and gas infrastructure should include the project activity and all relevant scenarios for any existing or new gas processing plants, pipelines, compressors, etc. They

¹ Please refer to the power industry standard *DLT5174-2003* with the application scopes for gas fired power plant, issued by the Department of Power of the State Economy and Trade Commission of the People's Republic of China on 18/03/2003.

² Please refer to: *GB50251-2003 Code for design of gas transmission pipeline engineering* issued by the Ministry of Construction of the People's Republic of China and General Administration Quality Supervision, Inspection and Quarantine of the People's Republic of China on 10/06/2003.

³ <http://center.cnpc.com.cn/bk/system/2007/04/20/001084519.shtml>

depend heavily on the context of the project but could include, *inter alia*:

Plausible alternative scenarios	Feasibility analysis	Is this feasible?
P1: Construction of a processing plant for the purpose of processing the recovered gas, in the same way as in the project activity, without being registered as a CDM project activity;	This is the project scenario without being registered as a CDM project. It is a possible baseline scenario.	Yes
P2: Construction of a processing plant of a lower capacity than under the project activity, which processes only non-associated gas and does not process recovered gas;	There is no natural gas supply onsite. So there is no non-associated gas feedstock onsite and it is not feasible to construct a processing plant which processes only non-associated gas and does not process recovered gas.	No
P3: Supplying recovered gas to an existing gas processing plant and constructing the necessary infrastructure, without being registered as a CDM project activity;	There is no existing gas processing plant at the second Oil Production Plant of Sanan Oilfield which can process the associate gas. Therefore this option is not feasible.	No
P4: Continuation of the operation of the existing oil and gas infrastructure without any other significant changes;	No any additional investment or technology is necessary and technically viable.	Yes
P5: Supplying recovered gas to a gas pipeline without prior processing and without being registered as a CDM project activity.	According to the standard of Run criterion of natural gas pipeline (SY/T 5922-2003) ⁴ and the People's Republic of China national standard for Natural Gas (GB17820-1999), the hydrogen sulphide (H ₂ S) content of the gas should be no higher than 20mg/m ³ . Based on the measurement result by Petroleum Industry Center for Quality Supervision and Inspection of Crude Oil and Petroleum Products, the hydrogen sulphide (H ₂ S) content of the recovered gas of the project is 75mg/m ³ , much higher than the threshold of 20mg/m ³ , therefore the recovered gas can not be injected in a gas pipeline without prior processing and let alone without being registered as a CDM project activity.	No

Plausible alternative baseline scenarios for the use of gas-lift could include, *inter alia*:

Plausible alternative scenarios	Feasibility analysis	Is this feasible?
O1: Gas from the same source as under the project activity and in the same quantity as under the project activity, is used for the	No gas-lift gas is utilized in the project activity.	No

⁴ Please refer to: SY/T 5922-2003 *Run criterion of natural gas pipeline* issued by the State Economy and Trade Commission of the People's Republic of China on 18/03/2003.

gas-lift system;		
O2: Gas from a different source than under the project activity but using the same quantity of gas-lift gas as under the project activity, is used for the gas-lift system;	No gas-lift gas is utilized in the project activity.	No
O3: Gas from the same source as under the project activity but using a different quantity of gas-lift gas, is used for the gas-lift system;	No gas-lift gas is utilized in the project activity.	No
O4: Gas from a different source than under the project activity, and in a different quantity than under the project activity, is used for the gas-lift system;	No gas-lift gas is utilized in the project activity.	No
O5: No gas-lift system is utilized.	It is the realistic baseline scenario.	Yes

Conclusion: It is concluded that **G1**, Release of the associated gas and/or gas-lift gas into the atmosphere at the oil production site (venting); **G5**, the proposed project activity without being registered as a CDM project activity; **P1**, Construction of a processing plant for the purpose of processing the recovered gas, in the same way as in the project activity, without being registered as a CDM project activity; **P4**, Continuation of the operation of the existing oil and gas infrastructure without any other significant changes.

As analyzed above, the likely baseline scenarios for the project activity are following Table B4-1:

Table B4-1 The baseline scenarios matrix of the Project

Associated Gas	<i>P1 Construction of a processing plant for the purpose of processing the recovered gas, in the same way as in the project activity, without being registered as a CDM project activity;</i>	<i>P4 Continuation of the operation of the existing oil and gas infrastructure without any other significant changes;</i>
Oil and Gas Infrastructure		
<i>G1 Release of the associated gas into the atmosphere at the oil production site (venting);</i>	This combination is not possible, as there will be no project activity if the associated gas is vented to atmosphere.	Alternative 2: The associated gas is vented to the atmosphere directly and continuation of the operation of the existing oil and gas infrastructure, it is a possible combination and the existing situation prior to the project activity.
<i>G5 The proposed project activity without being registered as a CDM project activity;</i>	Alternative 1: To implement the project activity, but not in CDM mode, it is a possible combination.	This combination is not possible, as there will be no project activity if the existing oil and gas infrastructure continue operation.

Therefore, there are two combinations which could not be excluded among the alternatives in associated gas and oil and gas infrastructure, i.e.

Alternative 1: To implement the project activity, but not in CDM mode;

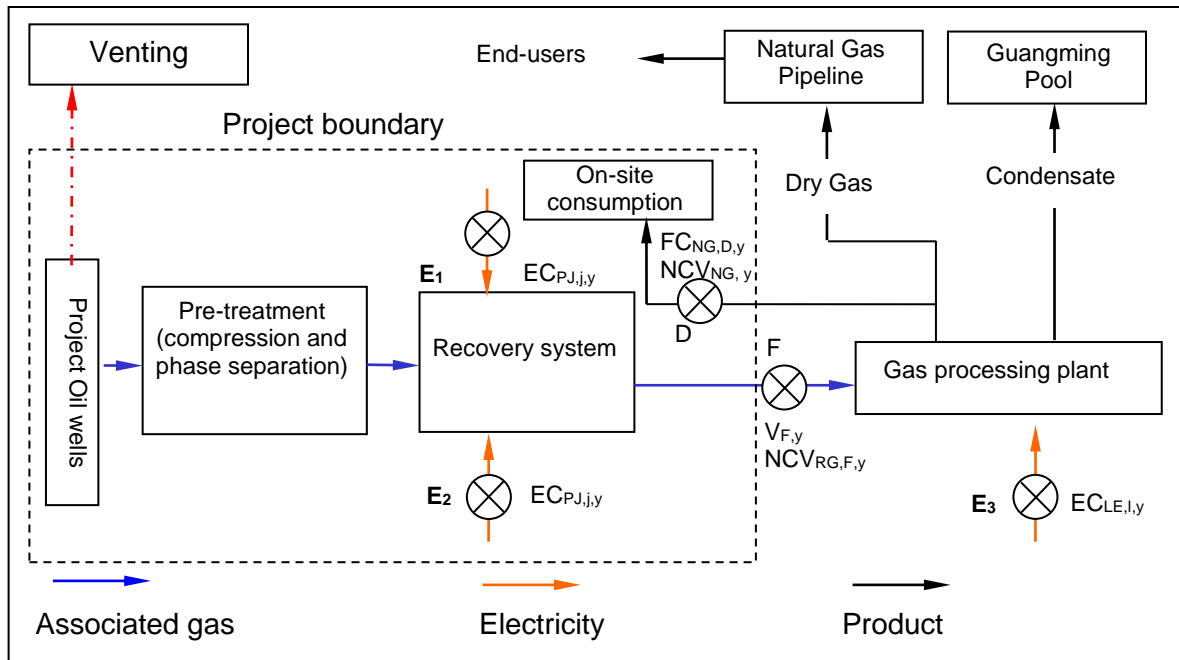


Figure B4-1: Schematic illustration of Alternative 1

Alternative 2: The associated gas is vented to the atmosphere directly and continuation of the operation of the existing oil and gas infrastructure, and no gas-lift system is utilized.

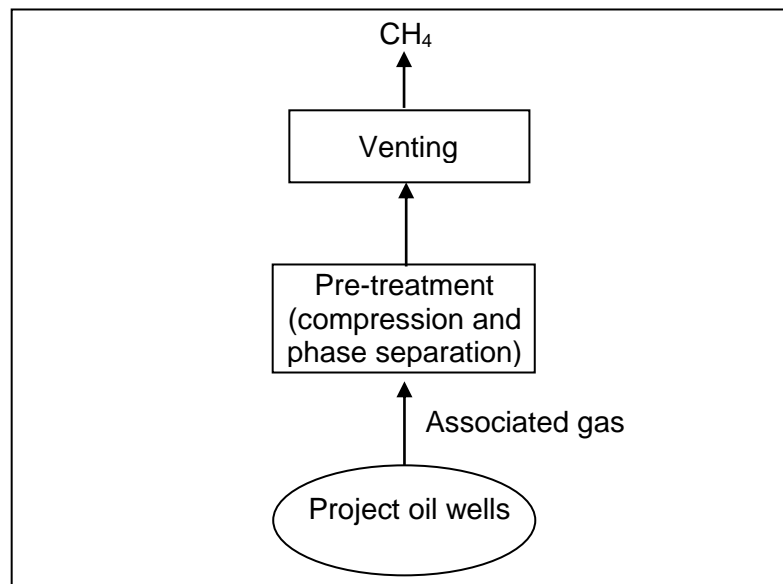


Figure B4-2: Schematic illustration of Alternative 2

Step 2: Evaluate legal aspects

The realistic Alternative 1 and Alternative 2 are both in compliance with the relevant laws and regulations.

Step 3: Evaluate the economic attractiveness of alternatives

The Alternative 1 is the same way as in the project activity, without being registered as a CDM project activity. According to investment analysis in section B.5, if the project is not undertaken as CDM project,

its IRR is only 4.97% (after tax) and lower than the benchmark IRR of 12% (after-tax) of oil industry, which means the alternative is financially unattractive. So alternative 1 is excluded from further consideration. Details are demonstrated in section B.5.

Alternative 2 which is also the scenario existing prior to the start of the implementation of the project activity and it is the baseline scenario of the project activity.

Step 4: Common practice analysis

In Section B.5 of the PDD, the common practice analysis has been described.

B.5. Demonstration of additionality

>>

The FSR of the project was completed by Daqing Oilfield Engineering Co., Ltd. (hereafter referred to as the Institute) in August 2010. The financial indicator of investment analysis in the FSR shows that the IRR of the project is lower than the benchmark IRR of 12% (after-tax) and the project financially unviable. So the Institute suggested the project developer to develop the project as a CDM project.

Based on the FSR, the project developer agreed the Institute's suggestion and decided to construct the project under CDM support on 25/11/2010. The FSR was approved by Daqing City Development and Reform Commission on 12/04/2011. The project developer signed the Purchase Agreement equipments on 12/04/2011 which is the starting date of the project activity.

Since the project starting date is after 02/08/2008, the project developer submitted the notification of CDM consideration to UNFCCC and Chinese DNA on 23/03/2011, 28/04/2011 respectively⁵. The consultancy agreement of CDM project was signed by the project developer with Beijing MD Energy Technology Co., Ltd. on 09/05/2011. The construction contract of the project was signed on 12/05/2011. The detail timeline of the project is illustrated below:

Date	Documents	Milestones
August, 2010	Feasibility Study Report (FSR)	The FSR of the project was completed by a qualified third party which is Daqing Oilfield Engineering Co., Ltd. The financial analysis in the FSR shows that the IRR of the project was lower than the benchmark IRR of 12%. The project is shown to be not viable financially. Taking into account the income from selling CERs, the project IRR is higher than the benchmark IRR of 12%. Then the project is economically attractive.
October, 2010	Environmental Impact Assessment Report(EIA)	The environmental impact assessment report of the project was completed by Daqing Oilfield Engineering Co., Ltd.
25/11/2010	Decision to develop the project activity as a CDM project	The Project developer decided to develop the project under CDM revenue assistance based on the conclusion of the FSR that without the income from selling CREs, the project IRR is lower than the benchmark IRR of 12% and the project is financially unattractive.
08/12/2010	EIA Approval	EIA was approved by the Environmental Protection Bureau of Daqing City.

⁵ The Prior Consideration CDM Form of the project was submitted to EB and Chinese DNA with a different project title. According to the UNFCCC secretariat requirement, the PDD should be updated accordingly at the validation stage.



23/03/2011	The notification of CDM consideration to UNFCCC	The notification of prior consideration of the CDM has been forward to UNFCCC. ⁶
12/04/2011	FSR Approval	FSR was approved by Daqing City Development and Reform Commission.
12/04/2011	Equipment Contract of regenerable adsorption type of dryer (the starting date of the project activity)	The project developer signed the equipment contract of regenerable adsorption type of dryer with China Oil HBP Science & Technology Co., Ltd.
28/04/2011	The notification of CDM consideration to Chinese DNA	The notification of prior consideration of the CDM has been forward to Chinese DNA.
09/05/2011	Cooperation Agreement of CDM Project	The project developer signed the cooperation agreement of CDM project with Beijing MD Energy Technology Co., Ltd.
12/05/2011	Construction Contract (Part 1)	The construction contract of project was signed between Daqing Oilfield Construction Group and the project developer.
12/05/2011	Construction Contract (Part 2)	The construction contract of project was signed between Daqing Oilfield Construction Group and the project developer.
20/05/2011	Construction Date	The construction start time has been provided in the Construction Contract (Part 1) and Construction Contract (Part 2).
25/05/2011	Equipment Contract of centrifugal compressor	The project developer signed the equipment contract of centrifugal compressor with Shenyang Turbo-machinery Co., Ltd.
28/05/2011	Construction Contract (recovery system)	The construction contract of project was signed between Daqing Oilfield Construction Group and the project developer.
17/08/2011	Equipment Contract of screw refrigeration compressor	The project developer signed the equipment contract of screw refrigeration compressor with Emerson Environment Optimization Technologies (Shanghai) Co., Ltd.
30/09/2011	ERPA	The project developer signed the ERPA with Macquarie Bank Limited.
29/05/2012	Operation log	The project started commissioning.
26/07/2012	UNFCCC website ⁷	The project started the global stakeholders publication.

The additionality of the project is demonstrated by using the *Tool for the Demonstration and Assessment of Additionality* (Version 06.1.0) approved by the CDM EB. The *Tool for the Demonstration and Assessment of Additionality* provides a step-wise approach to demonstrate and assess the additionality. These steps include:

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

Define realistic and credible alternatives⁸ to the project activity(s) through the following Sub-steps:

⁶ In the notification of the UNFCCC of the commencement of the project activity and the intention to seek CDM status, the project title is “Southern of Daqing Oilfield Associated Gas Recovery and utilization Project”. Since the other information such as the project location, geo-coordinates, project participant is same, the project with the previous title “Southern of Daqing Oilfield Associated Gas Recovery and utilization Project” and the project with the current title “Nanba Associated Gas Processing Plant and the Auxiliary Engineering” is the same project.

⁷ <http://cdm.unfccc.int/Projects/Validation/DB/UZEKWF4NNHEIIZR6JXM6EYMQZHB4YI/view.html>

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

The detailed analysis on determination of the baseline scenario is in Section B.4. Based on Section B.4, the alternative 1 to the project activity is to implement the project activity, but not in CDM mode; the alternative 2 to the project activity is the Continuation of the current situation, i.e. the associated gas is vented to the atmosphere directly and continuation of the operation of the existing oil and gas infrastructure, and no gas-lift system is utilized (baseline scenario).

Sub-step 1b. Consistency with mandatory laws and regulations:

Alternative identified in Step 1a is in line with all current applicable law and regulations in China, but doesn't belong to mandatory scope.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

According to the methodology AM0009 (Version 06.0.0), the Internal Rate of Return (IRR) is used to assess the financial viability of the project, following the guidance for the investment analysis in the latest approved version of the *Tool for the demonstration and assessment of additionality*.

Option I: Simple cost analysis. This analysis method can be used if the CDM project activity and the alternatives identified in Step 1 generate no financial or economic benefits other than CDM related income. However, this option is not applicable to the project because the project will generate dry gas and condensate sales revenue.

Option II: Investment comparison analysis. This analysis method can only be used if the alternatives to the project are similar investment projects. However, this option is not applicable here as the alternative is not a new investment project.

Option III: Benchmark analysis. According to *Economic Assessment Parameters for Construction Projects of China National Petroleum Corporation* version 2008, the Internal Rate of Return (after tax) of total investment for oil industry project is 12%. Thus, the benchmark analysis is applicable to the project.

Hence, the benchmark analysis is chosen and the Internal Rate of Return (IRR) is used to assess the financial viability of the project.

Sub-step 2b. Apply benchmark analysis

The benchmark of project IRR for the oil industry project is 12%⁹ (after tax) which is referred to the *Economic Assessment Parameters for Construction Projects of China National Petroleum Corporation* version 2008. Accordingly, 12% is regarded as criterion for assessing whether the project is economically attractive, if the IRR of the project less than 12%, it is economically unattractive and meets the requirement of additionality.

Sub-step 2c. Calculation and comparison of financial indicators

As detailed in the table above, the project developer made investment decision based on the FSR to proceed with the project under CDM revenue assistance, therefore the project developer selected the input

⁸ Reference to “alternatives” throughout this document denotes “alternative scenarios”

⁹ *Economic Assessment Parameters for Construction Projects of China National Petroleum Corporation* issued by China National Petroleum Corporation (CNPC), in 06/09/2007.

values from the FSR for demonstration additionality of the project that is in line with CDM relevant guidelines.

Based on the FSR, the input values in decision making stage for demonstration of additionality were listed in the table B.5-1.

Table B5-1: The input values for demonstration of additionality in investment decision stage

No.	Items	Unit	Amount	Data sources
1	Quantity of associated gas	10 ⁴ Nm ³ /a	17,344	FSR
2	Capital expenditure for gas infrastructure. (CAPEX)	10 ⁴ RMB	62,892	FSR
3	Operational expenditure (OPEX, annual average)	10 ⁴ RMB/a	14,918	FSR
4	Project production of dry gas (annual average)	10 ⁴ Nm ³ /a	13,875	FSR
5	Price of dry gas (excluding VAT)	RMB/Nm ³	0.98	FSR
6	Project production of condensate (annual average)	10 ⁴ t/a	3.64	FSR
7	Price of condensate (excluding VAT)	RMB/t	2,702	FSR
8	Income tax	%	25	FSR
9	VAT (condensate)	%	17	FSR
10	VAT (dry gas)	%	13	FSR
11	Project lifetime	year	10	FSR
12	Depreciation period	year	10	FSR
13	Rate of residual value	%	3 ¹⁰	
14	Loan	10 ⁴ RMB	27,513	FSR
15	Rate of loan	%	5.94	FSR

Calculation is based on the data list above, without CERs revenue, the project IRR of the project is only 4.97% which is lower than benchmark IRR. Thus, the project is not financially attractive.

Sub-step 2d. Sensitivity analysis

According to Guidelines on the assessment of investment analysis, only variables that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation, and the variation should cover at least a range of $\pm 10\%$. Thus, four parameters with variation range of $\pm 10\%$ are selected to check the financial attractiveness and the result of the sensitivity analysis is shown as follows:

- CAPEX
- Sale price of condensate
- Sale price of dry gas
- Sale volume of condensate
- Sale volume of dry gas

¹⁰ Source: *Economic Assessment Parameters for Construction Projects of China National Petroleum Corporation* issued by China National Petroleum Corporation (CNPC), in 06/09/2007.

➤ OPEX

Table B5-2. IRR values of sensitivity analysis of the Project

Variation Parameter	-15.12%	-13.63%	-10%	-5%	0	5%	10%	14.32%	19.86%
CAPEX	12.00%		9.44%	7.13%	4.97%	2.93%	1.01%		
Sale price of condensate			0.18%	2.77%	4.97%	6.93%	8.74%		12.00%
Sale price of dry gas			-2.25%	1.82%	4.97%	7.65%	10.06%	12.00%	
Sale volume of condensate			0.18%	2.77%	4.97%	6.93%	8.74%		12.00%
Sale volume of dry gas			-2.25%	1.82%	4.97%	7.65%	10.06%	12.00%	
OPEX		12.00%	10.36%	7.87%	4.97%	1.22%	-5.28%		

As shown in the sensitivity analysis above, even when the factors fluctuated in the range of $\pm 10\%$, the IRR of the project could not reach the figure (12%) and the conclusion stated above is still tenable.

As for CAPEX, when it decreases 15.12%, the IRR can reach the benchmark of 12%.

Considering economical development in China and the price rising of materials and equipments during construction, the capital expenditure for all oil and gas infrastructure (CAPEX) couldn't be cut down to the amount required to reach the benchmark.

The past 5 years' statistical data published by the National Bureau of Statistics of China¹¹ shows that price index of fixed asset investment in China has been rising and the annual average increasing rate is 3.1% (please referred to the below table).

Furthermore, based on the available main contracts, the actual investment for equipments purchase and construction is 63565.40×10^4 RMB which is 1.07% higher than the estimated in the FSR. Therefore, decrease of capital expenditure over 15.12% is impossible.

As for sale price of condensate and dry gas, when the sale price of the condensate is increased by 19.86%, or dry gas is increased by 14.32%, the project IRR can reach benchmark (12%). The sale prices of condensate and dry gas are under the administration of National Development and Reformation Commission (NDRC) and local authorities in China. The actual sale prices indicated on the invoices of the condensate and dry gas and the actual sales contracts of the condensate and dry gas are the same as that estimated in the FSR. According to the actual sales contracts of the condensate and dry gas, the sales prices will be fixed during the whole project lifetime of the proposed project. Therefore, it is unlikely for the project IRR to reach the benchmark of 12%.

As for volume of condensate and dry gas, where the volume of the condensate is increased by 19.86%, or dry gas is increased by 14.32%, the project IRR can reach benchmark (12%). Volume of condensate and dry gas from the project is based on the geological condition of the oil and material balance analysis. Therefore, it is extremely difficult to increase volume of the condensate by 19.86% and for dry gas by 14.32%. Therefore, it is unlikely for the project IRR to reach the benchmark of 12%.

As for OPEX, when it decreases 13.63%, the IRR can reach the benchmark of 12%. Operational expenditure (OPEX) is mainly composed of raw material, employee salary and welfare cost, and some maintenance, management, security cost, etc. Average increment of the purchasing price of raw material is 4.52% and Average increment of Index of Average Wage is 16.52% in the past 5 years in China (also referred to the below table). Since the salary and the material fees are increasing, the actual operational

¹¹ Please refer to the website: <http://www.stats.gov.cn/tjsj/ndsjs/>

and maintenance cost will be higher than the evaluated in the FSR. It is therefore impossible to lower the operational expenditure of the project by 13.63%. Hence within the reasonable range of operational expenditure, the IRR will not surpass the benchmark.

Table B5-3 Price indexes in the recent years (set the previous year = 100%)¹²

Item	2006	2007	2008	2009	2010	Average
Price Index of Fixed Asset Investment in China	101.5%	103.9%	108.9%	97.6%	103.6%	103.1%
Producer price index of manufactured goods	103.0%	103.1%	106.9%	94.6%	105.5%	102.62%
Purchasing Price Index of Raw material, fuel and power	106.0%	104.4%	110.5%	92.1%	109.6%	104.52%
Index of Average Wage	115.1%	120.0%	117.2%	113.8%	116.5%	116.52%

In conclusion, the investment analysis above shows that the project without taking into accounts CERs revenue is not economically attractive.

Step 3. Barrier Analysis

No barrier analysis has been applied.

Step 4. Common practice analysis

According to paragraph 43 of the “tool for the demonstration and assessment of additionality” (Version 06.1.0), different procedures of common practice analysis will be adopted under the conditions as below:

- (i) Project type has not been demonstrated to be first-of-its kind;
- (ii) Measures that are listed in paragraph 6 of the tool;

The Project will recover and utilization Associated Gas to process into dry gas and condensate. It belongs to the measures listed in paragraph 6 Measure (b), therefore, common practice analysis for the Project should follow the requirements from paragraph 47 of the tool.

Step 1, Calculate applicable output range as +/-50% of the design output or capacity of the project activity;

As the Project is an Associated Gas Recovery and utilization Project with a capacity of $90 \times 10^4 \text{ Nm}^3$ associated gas per day applying the deep cooling processing technology, +/- 50% of which should be selected within $45 \times 10^4 \text{ Nm}^3/\text{d} \sim 135 \times 10^4 \text{ Nm}^3/\text{d}$.

Step 2, In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the project activity and have started commercial operation before the start date of the project. Note their number N_{all} . Registered CDM project activities (under validation) shall not be included in this step;

Selected Heilongjiang Province as applicable geographical area

According to the definition of paragraph 5 of the tool, applicable geographical area covers the entire country as a default, Project participants may provide justification that the applicable geographical area is smaller than the host country for technologies that vary considerably from location to location depending on local conditions. As for the Project, justification of selected Heilongjiang Province as applicable geographical area is listed below:

¹² Please refer to the website: <http://www.stats.gov.cn/tjsj/ndsjs/>

China covers an extremely large area, where the investment circumstance, policies and regulations and natural sources of each province are different. The general environment of crude oil production in China such as investment climate, tariff policy and resource differs for each province. The Heilongjiang Province is at the highest latitudes and the northernmost end of the China, with an area of 473,000km² is comparatively larger than many countries. The mineral resources of Heilongjiang Province are most resourceful, especially crude oil rank first in China.¹³ Besides, different regions have different crude oil production capacity and the gas-oil ratio. In China, crude oil production of Heilongjiang Province is the most,¹⁴ and the climate character of the Heilongjiang Province is the coldest, the annual average temperature in Heilongjiang Province is lower than¹⁵ the annual average temperature in China¹⁶, and the longest wintertime is in Heilongjiang Province. The economy development level is also much different in China. The Project is situated in Heilongjiang Province, therefore, the Heilongjiang Province is chosen as the geographical area for the common practice.

According to the notification on the statistics data issued by Committee of Industry and information on technology of Heilongjiang Province, there is no other projects applying deep cooling treatment technology to recovery associated gas with the capacity below 135×10⁴ Nm³/d in Heilongjiang Province¹⁷; And there is no projects applying shallow cooling treatment technology to recovery the associated gas with the capacity from 45×10⁴ Nm³/d to 135×10⁴ Nm³/d.

According to the definition of paragraph 9 of the “tool for the demonstration and assessment of additionality” (Version 06.1.0), the shallow cooling treatment technology can be regarded as the different technology from that (i.e. deep cooling treatment technology) applied by the proposed project due to below reasons, i.e.

- The local government, i.e. Daqing city development and reform commission, issued Guidance on the construction of the Daqing Oilfield on 18th March 2010 before the FSR of the proposed project in August 2010.
- In this guidance, it is clearly said that considering the component of associated gas in Daqing Oilfield and the efficiency of the Associated Gas Recovery and utilization, only the deep cooling treatment technology shall be selected.

As per the analysis above, it was able to be concluded that there is no similar projects as the proposed project in Helongjiang Province. So N_{all} =0¹⁸. The difference between deep cooling and shallow cooling processing technology was summarized as below:

	Deep cooling	Shallow cooling
Temperature	-70°C and below -70°C	-15~-37°C
Product	The degree of the associated gas liquefying increased with the decrease of the refrigerating temperature. The main product is condensate which is to recover 70% of ethane or	The main purpose is to satisfy the dew point requirement for transportation. Therefore the shallow cooling only recovers 60% of the propane in the associated gas. Main product is dry gas, and condensate

¹³ Please see the website: <http://www.hlj.gov.cn/zlj/wzzk/>

¹⁴ Please see the website: http://www.askci.com/news/201205/29/155728_49.shtml

¹⁵ Please see the website: <http://www.hlj.gov.cn/zlj/wzzk/>

¹⁶ Please see the website: <http://www.chinanews.com/gn/2013/01-16/4493631.shtml>

¹⁷ Committee of Industry and information on technology of Heilongjiang Province: the notification on the statistics data of non-CDM associated gas recovery and processing projects applying deep cooling treatment technology with capacity below 135×10⁴ m³, 16 May 2012.

¹⁸ Committee of Industry and information on technology of Heilongjiang Province: the notification on the statistics data of non-CDM associated gas recovery and processing projects applying deep cooling treatment technology with capacity below 135×10⁴ m³, 16 May 2012.

	more than 90% of propane from the associated gas. Dry gas is the by-product.	is the by-product.
Cooling processing	Two-stage expansion refrigeration; Expansion machine and auxiliary cooling agent refrigeration J valve throttling and auxiliary cooling agent refrigeration technology (propane compress refrigeration or ammonia compress refrigeration technology)	Propane compress refrigeration; Ammonia compress refrigeration; Hot-splitting refrigeration

So, the processing plants using shallow cooling technology are not included in N_{all} .

$$N_{all} = 0$$

Step 3, Within plants identified in Step 2, identify those apply technologies different that the technology applied in the project activity. Note their number N_{diff} ;

$$N_{diff} = 0$$

Step 4, Calculate factor $F = 1 - N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the project activity in all plants that deliver the same output or capacity as the project activity.

Since the factor $F (= 1 - N_{diff}/N_{all})$ is 1 which is greater than 0.2, however $N_{all} - N_{diff} = 0$ which is not greater than 3.

Then it can be concluded that the project is not a common practice.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>>

The emission reduction of the project was calculated based on the applied methodology, the details are as below:

1. Baseline emissions (BE_y)

Baseline emissions are calculated as follows:

$$BE_y = V_{F,y} \cdot NCV_{RG,F,y} \cdot EF_{CO_2,Methane} \tag{1}$$

Where:

- BE_y = Baseline emissions in year y, (tCO₂e)
- $V_{F,y}$ = Volume of total recovered gas measured at point F in Figure B3-2, in year y, (Nm³)
- $NCV_{RG,F,y}$ = Average net calorific value of recovered gas at point F in Figure B 3-2 in year y, (TJ/Nm³)
- $EF_{CO_2,Methane}$ = CO₂ emission factor for methane (tCO₂/TJ)

2. Project emissions (PE_y)

Project emissions are calculated as follows:

$$PE_y = PE_{CO_2,fossilfuel,y} + PE_{CO_2,elec,y} \tag{2}$$

Where:

- PE_y = Project emissions in year y , (tCO₂e)
 $PE_{CO_2, fossil fuels, y}$ = CO₂ emissions due to consumption of fossil fuels for the recovery, pre-treatment, transportation, and if applicable, compression of the recovered gas up to the point F in Figure B3-2 in year y (tCO₂e)
 $PE_{CO_2, elec, y}$ = CO₂ emissions due to the use of electricity for recovery, pre-treatment, transportation and if applicable, compression of the recovered gas up to the point F in Figure B3-2 in year y (tCO₂e)

Project emissions from the consumption of fossil fuels

According to the latest approved version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”, $PE_{CO_2, fossil fuels, y}$ is calculation as follows:

$$PE_{CO_2, fossil fuels, y} = \sum_j PE_{FC, j, y} = \sum_j \sum_i FC_{i, j, y} \times COEF_{i, y} \quad (3)$$

Where:

- $PE_{CO_2, fossil fuels, y}$ = CO₂ emissions due to consumption of fossil fuels for the recovery, pre-treatment, transportation, and compression of the recovered gas up to the point in Figure B3-2 in year y (tCO₂e)
 $PE_{FC, j, y}$ = CO₂ emissions of fossil fuels consumption in process j in year y , (tCO₂/yr)
 $FC_{i, j, y}$ = The quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
 $COEF_{i, y}$ = The CO₂ emissions coefficient of fuel type i in year y (tCO₂/mass or volume unit)
 i = The fuel types combusted in process j during the year y

Option B is selected by the project activity since the chemical composition of the emission factor of the generated dry gas is not certain, and some composition will be likely omitted, the necessary data which involved in Option A is not available.

Option B: The CO₂ emission coefficient $COEF_{i, y}$ is calculated based on net calorific value and CO₂ emission factor of the generated dry gas, using the following approach:

$$COEF_{i, y} = NCV_{NG, y} \times EF_{CO_2, NG, y} \quad (4)$$

Where:

- $COEF_{i, y}$ = The CO₂ emissions coefficient of fuel type i in year y (tCO₂/mass or volume unit)
 i = The fuel types combusted in process j during the year y
 $NCV_{NG, y}$ = The weighted average net calorific value of the generated dry gas (natural gas) in year y (TJ/mass or volume unit);
 $EF_{CO_2, NG, y}$ = The weighted average CO₂ emission factor of the generated dry gas (natural gas) in year y (tCO₂/TJ)

Project emissions from consumption of electricity

According to “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, $PE_{CO_2, elec, y}$ is calculation as follows:

$$PE_{CO_2, elec, y} = PE_{EC, y} = \sum_j EC_{PJ, j, y} \times EF_{EL, j, y} \times (1 + TD L_{j, y}) \quad (5)$$

Where:

- $PE_{EC,y}$ = CO₂ emissions due to the use of electricity for the recovery, pre-treatment, transportation, and compression of the recovered gas up to the point in Figure B3-2 in year y (tCO₂e)
- $EC_{PJ,j,y}$ = Quantity of electricity consumed by the project activity source j in year y (MWh/y);
- $EF_{EL,j,y}$ = Emission factor for electricity generation for source j in year y (tCO₂/MWh).
- $TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y ;
- j = Sources of electricity consumption in the project.

According to the latest approved version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”, $TDL_{j,y}=20\%$.

Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the version 02.2.1 of the “Tool to calculate the emission factor for an electricity system”,

$$EF_{EL,j,y} = EF_{grid,CM,y} \quad (6)$$

Therefore,

$$PE_{CO_2,elec,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,CM,y} \times (1 + TDL_{j,y}) \quad (7)$$

Where:

- $PE_{CO_2,elec,y}$ = CO₂ emissions due to the use of electricity for pre-treatment, transportation and if applicable, compression of the recovered gas before point F in Figure B3-2 in year y (tCO₂e)
- $EC_{PJ,j,y}$ = The quantity of electricity consumed by the project activity source j in year y (MWh/y);
- $EF_{grid,CM,y}$ = The emission factor for electricity generation for source j in year y (tCO₂/MWh).
- $TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y ;
- j = Sources of electricity consumption in the project.

The “Tool to calculate the emission factor for an electricity system” (Version 02.2.1) determines the CO₂ emission factor for the displacement of electricity generated by power plants in NEPG, by calculating the “operating margin” (OM) and “build margin” (BM) as well as the “combined margin” (CM). The operating margin refers to a cohort of power plants that reflect the existing power plants whose electricity generation would be affected by the proposed CDM project activity. The build margin refers to a cohort of power units that reflect the type of power units whose construction would be affected by the proposed CDM project activity.

The following steps are applied to calculate the emission factor of NEPG:

Step 1: Identify the relevant electricity systems.

The electricity generation of the proposed project will be connected to Heilongjiang Power Grid based on the Feasibility Study Report of the proposed project. According to *Notification on Determining Baseline Emission Factors of China Power Grid*¹⁹ issued by the National Development and Reform Commission of the Government of China (China DNA), Heilongjiang Power Grid is an integral part of NEPG which is composed of Liaoning Power Grid, Jiling Power Grid and Heilongjiang Power Grid. Therefore, the proposed project electricity system is defined as NEPG.

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

¹⁹ <http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2720.pdf>

The methodological tool for calculating operating margin and build margin emission factors provides two options:

Option I: Only grid power plants are included in the calculation

Option II: Both grid power plants and off-grid power plants are included in the calculation.

For the proposed project, Option I is chosen to calculate emission factor.

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

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

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

Considering the low cost/must run resources²⁰ only constitute 8.28%, 5.64%, 5.51%, 5.81% and 6.11% of total generation of NEPG from the year 2005 to 2009, respectively (China Electric Power Yearbooks 2006-2010).

Based on these parameters, the simple OM method (option a) can be used for low-cost/must-run resources constitute less than 50% of total grid generation in the five most recent years.

Therefore, method (a) is chosen to calculate OM emission factor for the proposed project. The ex-ante option of the data vintages is chosen to calculate the emission factor of the NEPG that should be documented in the CDM-PDD and not be changed during the crediting periods.

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

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

Option A: Based on net electricity generation and a CO₂ emission factor of each power unit²¹; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

As per *Tool to calculate the emission factor for an electricity system*, Option A should be preferred. However, the CO₂ emission factor and net electricity generation of each power plant/unit is not publicly available. Thus, Option A cannot be adopted for the proposed project.

According to the *Notification on Determining Baseline Emission Factors of China Power Grid*, only nuclear and renewable power generations are considered as low-cost / must-run power sources. And the quantity of electricity supplied to the grid by low-cost / must-run power sources is known. Therefore, Option B is adopted to calculate the simple OM emission factor of NEPG.

The simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost / must-run power plants / units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (8)$$

²⁰ Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They 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 set of plants.

²¹ Power units should be considered if some of the power units at the site of the power plant are low-cost/must-run units and some are not. Power plants can be considered if all power units at the site of the power plant belong to the group of low-cost/must-run units or if all power units at the site of the power plant do not belong to the group of low-cost/must-run units.

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO₂ emission factor in year y (tCO₂/MWh)

$FC_{i,y}$ = Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)

$EF_{CO_2,i,y}$ = CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ)

EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year y (MWh)

i = All fossil fuel types combusted in power sources in the project electricity system in year y

y = The three most recent years.

The simple operating margin CO₂ emission factor ($EF_{grid,OMsimple,y}$) of the NEPG is 1.0852tCO₂/MWh according to the public data from DNA of China²². The detailed calculations and data are listed in the annex 3.

$EF_{grid,OMsimple,y} = 1.0852 \text{ tCO}_2/\text{MWh}$

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

In terms of vintage of data, one of the following two options can be chosen:

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

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

For the proposed project, option 1 is chosen to calculate Build Margin emission factor.

The build margin emissions factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (9)$$

²² Notification on Determining 2010 Baseline Emission Factors for Regional Power Grids in China issued by China's DNA on, Dec 20, 2010 on <http://cdm.ccchina.gov.cn>

Where:

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh).

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

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh).

m = Power units included in the build margin.

y = Most recent historical year for which power generation data is available.

However, even for those built most recently power plants that comprise 20% of the system generation, it is also difficult to obtain the specific data regarding to fuel consumption and electricity generation additions by each power sources as confidential reason, the BM calculation in this PDD adopts the modifications methods agreed by the CDM EB. First, calculate the newly added installed capacity and the various component technologies, then calculation of the weight of newly added installed capacity of each power generation technology. Finally the commercial and efficient level of each power generation technology is adopted to calculate BM emission factor.

Because the generating capacity of the coal-fired, oil-fired and gas-fired technology can not be separated from the existing statistical data, the BM calculation in this PDD adopts the following method: First, use the available data in the energy balance tables on the most recent year, then calculate the proportion of CO₂ emissions from solid, liquid and gaseous fuels corresponding to the total emissions of CO₂ emissions. Second, the proportion used as the weight, based on the emission factors of the optimal efficient and commercial technologies, calculate the emission factor of the thermal power in each grid. Finally, this thermal emission factor is multiplied by the proportion of thermal power added capacity in the additional 20% capacity. The result is BM emission factor²³.

According to “Tool to calculate the emission factor for an electricity system” and clarifications by EB, the main steps for BM calculation are as following:

Sub-step 5-1: Calculation of weights of CO₂ emissions by coal-fired, oil-fired and gas-fired plants in total CO₂ emissions of NEPG .

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}} \quad (10)$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}} \quad (11)$$

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,j} \times EF_{co2,i,j}} \quad (12)$$

Where:

²³ <http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2008/200887164119674.pdf>

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

$NCV_{i,j}$ = Net calorific value (energy content) of fossil fuel type i consumed by province j (GJ / mass or volume unit).

$EF_{co2,i,j}$ = CO₂ emission factor of fossil fuel type i consumed by province j (tCO₂/GJ).

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

Sub-step 5-2: Calculation of emission factor of thermal power (EF thermal power) of NEPG

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \quad (13)$$

Where: $EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ represent the efficiency level of the best coal-based, oil-based and gas-based power generation technology commercially available in China.

Sub-step 5-3: Calculation of Build Margin (BM) emission factor of NEPG

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (14)$$

Where

CAP_{Total} is total capacity additions while

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

Base on the formulas above, the result is:

$$EF_{grid,BM,y} = 0.5987 \text{ tCO}_2/\text{MWh}$$

For the detailed information, please see the Annex 3.

Step 6: Calculate the combined margin (CM) emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (15)$$

Where:

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/MWh)

w_{OM} = Weighting of operating margin emissions factor (%)

w_{BM} = Weighting of build margin emissions factor (%)

3. Leakage (LE_y)

Leakage emission is calculated as follows:

$$LE_y = LE_{FC,y} + LE_{EC,y} \quad (16)$$

Where:

- LE_y = Leakage emissions in year y, (tCO₂e)
 $LE_{FC,y}$ = Leakage emissions due to fossil fuels consumption after point F in figure B3-2 in year y (tCO₂e)
 $LE_{EC,y}$ = Leakage emissions due to electricity consumption after point F in figure B3-2 in year y (tCO₂e)

Leakage emissions due to fossil fuel consumption

After point F in Figure B3-2, the project does not consume fossil fuel. Therefore, no Leakage emission from the consumption of fossil fuel is considered.

Leakage emissions due to electricity consumption

According to the latest approved version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, $LE_{EC,y}$ is calculation as follows:

$$LE_{EC,y} = \sum_j EC_{LE,l,y} \times EF_{EL,l,y} \times (1 + TDL_{l,y}) \quad (17)$$

Where:

- $LE_{EC,y}$ = Leakage emissions due to electricity consumption after point F in figure B3-2 in year y (tCO₂e)
 $EC_{LE,l,y}$ = Net increase in electricity consumed of source l in year y (MWh/y);
 $EF_{EL,l,y}$ = Emission factor for electricity generation for source l in year y (tCO₂/MWh).
 $TDL_{l,y}$ = Average technical transmission and distribution losses for providing electricity to source l in year y;
 l = Leakage source of electricity consumption.

According to the latest approved version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”, $TDL_{l,y}=20\%$.

Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the version 02.2.1 of the “Tool to calculate the emission factor for an electricity system”,

$$EF_{EL,j,y} = EF_{grid,CM,y} \quad (18)$$

Therefore,

$$LE_{EC,y} = \sum_j EC_{LE,j,y} \times EF_{grid,CM,y} \times (1 + TDL_{l,y}) \quad (19)$$

Where:

- $LE_{EC,y}$ = Leakage emissions due to electricity consumption after point F in figure B3-2 in year y (tCO₂e)
- $EC_{LE,j,y}$ = Net increase in electricity consumed of source *l* in year y (MWh/y);
- $EF_{grid,CM,y}$ = The emission factor for electricity generation for source *j* in year y (tCO₂/MWh).
- $TDL_{l,y}$ = Average technical transmission and distribution losses for providing electricity to source *l* in year y;
- l* = Leakage source of electricity consumption..

4. Emission reductions (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \tag{20}$$

Where:

- ER_y = Emission reductions in year y, (tCO₂e)
- BE_y = Baseline emissions in year y, (tCO₂e)
- PE_y = Project emissions in year y, (tCO₂e)
- LE_y = Leakage emissions in year y, (tCO₂e)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{CO_2,Methane}$		
Unit	tCO ₂ /TJ		
Description	CO ₂ emission factor for methane		
Source of data	Calculated in line with procedures and data presented in ISO 6976:		
	Unit	Value	Source
	Carbon Content of Methane	12,011 kg/kmol	ISO 6976: Table 1
	CO ₂ Emission Factor for Methane	44.01 kg/kmol	ISO 6976: Table 1
	NCV of Methane (at 25 °C)	802.60 kJ/mol	ISO 6976: Table 3
Value(s) applied	54.834		
Choice of data or Measurement methods and procedures	--		
Purpose of data	Calculation of baseline emissions		
Additional comment	--		



Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO ₂ /MWh
Description	Combined margin emission factor of the NEPG during the period y
Source of data	Notification on Determining 2011 Baseline Emission Factors for Regional Power Grids in China issued by China's DNA CDM official, and please see the Website: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2720.pdf
Value(s) applied	0.84195
Choice of data or Measurement methods and procedures	--
Purpose of data	Calculation of leakage emissions
Additional comment	--

Data / Parameter	EG_y
Unit	MWh
Description	Power Generation in each province of NEPG
Source of data	China Electric Power Yearbook 2008-2010
Value(s) applied	See Annex 4
Choice of data or Measurement methods and procedures	China Electric Power Yearbook is published by the editorial board of China Electric Power Yearbook. It is authorized.
Purpose of data	Calculation of leakage emissions
Additional comment	--

Data / Parameter	Self- consumption rate of electricity
Unit	%
Description	Self- consumption rate of electricity in each province of NEPG
Source of data	China Electric Power Yearbook 2008-2010
Value(s) applied	See Annex 4
Choice of data or Measurement methods and procedures	China Electric Power Yearbook is published by the editorial board of China Electric Power Yearbook. It is authorized.
Purpose of data	Calculation of leakage emissions
Additional comment	--



Data / Parameter	Installed Capacity
Unit	MW
Description	Installed Capacity in each province of NEPG
Source of data	China Electric Power Yearbook 2008-2010
Value(s) applied	See Annex 4
Choice of data or Measurement methods and procedures	China Electric Power Yearbook is published by the editorial board of China Electric Power Yearbook. It is authorized.
Purpose of data	Calculation of leakage emissions
Additional comment	--

Data / Parameter	$NCV_{i,y}$
Unit	GJ/ mass or volume unit
Description	The net calorific value (energy content) of fossil fuel type i in year y
Source of data	China Energy Statistics Yearbook 2010
Value(s) applied	See Annex 4
Choice of data or Measurement methods and procedures	China Electric Power Yearbook is published by the editorial board of China Electric Power Yearbook. It is authorized.
Purpose of data	Calculation of leakage emissions
Additional comment	--

Data / Parameter	$FC_{i,y}$
Unit	Mass or volume unit
Description	Amount of fossil fuel type i consumed in the project electricity system in year y
Source of data	China Energy Statistics Yearbook 2008-2010
Value(s) applied	See Annex 4
Choice of data or Measurement methods and procedures	China Energy Statistics Yearbook is published by China Statistics Press. It is authorized.
Purpose of data	Calculation of leakage emissions
Additional comment	--

Data / Parameter	$EF_{CO_2,i,y}$
Unit	tCO ₂ /GJ
Description	CO ₂ Emission Factor of fossil fuel type <i>i</i> in year <i>y</i>
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 2, Chapter 1, p1.21)
Value(s) applied	See Annex 4
Choice of data or Measurement methods and procedures	The default value of IPCC
Purpose of data	Calculation of leakage emissions
Additional comment	--

Data / Parameter	$TDL_{j,y}$ and $TDL_{l,y}$
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to the project from the grid NEPG (source <i>j</i> or <i>l</i>) in year <i>y</i> .
Source of data	Electricity consumption by the project activity is from the grid only, which belongs to Scenario A. As the electricity consumption by project and leakage electricity consumption sources, the default value of 20% is applied, as per the “Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”.
Value(s) applied	20%
Choice of data or Measurement methods and procedures	It should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.
Purpose of data	Calculation of project emissions ($TDL_{j,y}$) Calculation of leakage emissions ($TDL_{l,y}$)
Additional comment	--

B.6.3. Ex ante calculation of emission reductions

>>

According to the methodology AM0009 Version 06.0.0, the emissions reduction by the project is calculated as follows:

Based on the Feasibility Study Report of the project, the volume of recovered gas expected is shown as below:

Period y	Total Volume of Recovered Gas (Point F) $V_{F,y}$ (10^4Nm^3)
01/01/2013-31/12/2013	26,384
01/01/2014-31/12/2014	28,528
01/01/2015-31/12/2015	24,599
01/01/2016-31/12/2016	19,801
01/01/2017-31/12/2017	15,912
01/01/2018-31/12/2018	12,273
01/01/2019-31/12/2019	9,309
01/01/2020-31/12/2020	6,923
01/01/2021-31/12/2021	5,104

$$EF_{CO_2, \text{Methane}} = 54.834 \text{ tCO}_2/\text{TJ}$$

$$NCV_{RG,F,y} = 0.0000403 \text{ TJ/Nm}^3$$

Baseline emissions (BE_y)

$$BE_y = V_{F,y} \cdot NCV_{RG,F,y} \cdot EF_{CO_2, \text{Methane}}$$

Based on the calculation above, baseline emissions for each specific year are summarized below:

Period y	Baseline emissions BE_y (tCO_2/year)
01/01/2013-31/12/2013	583,036
01/01/2014-31/12/2014	630,415
01/01/2015-31/12/2015	543,591
01/01/2016-31/12/2016	437,565
01/01/2017-31/12/2017	351,625
01/01/2018-31/12/2018	271,210
01/01/2019-31/12/2019	205,711
01/01/2020-31/12/2020	152,985
01/01/2021-31/12/2021	112,789

Project emissions (PE_y)

$$PE_y = PE_{CO_2, \text{fossilfuel}, y} + PE_{CO_2, \text{elec}, y}$$

Project emissions from the consumption of fossil fuels

$$PE_{CO_2, \text{fossilfuel}, y} = \sum_j PE_{FC, j, y} = \sum_j \sum_i FC_{i, j, y} \times COEF_{i, y}$$

$$COEF_{i, y} = NVC_{NG, y} \times EF_{CO_2, NG, y}$$

The quantity of natural gas combusted in process per year is as follows:

Period y	Total Volume of Natural Gas combusted $FC_{NG,D,y}$ (10^4Nm^3)
01/01/2013-31/12/2013	107.01
01/01/2014-31/12/2014	115.52
01/01/2015-31/12/2015	99.71
01/01/2016-31/12/2016	80.26
01/01/2017-31/12/2017	64.45
01/01/2018-31/12/2018	49.86
01/01/2019-31/12/2019	37.70
01/01/2020-31/12/2020	27.97
01/01/2021-31/12/2021	20.67

$$NCV_{NG,y}=0.00003238 \text{ TJ/m}^3$$

$$EF_{CO_2,NG,y}=58.3 \text{ tCO}_2/\text{TJ}$$

Based on the calculation above, project emissions from the consumption of fossil fuels for each specific year are summarized below:

Period y	Project emissions from the consumption of fossil fuels $PE_{CO_2,fossilfuel,y}$ (tCO ₂ /year)
01/01/2013-31/12/2013	2,020
01/01/2014-31/12/2014	2,181
01/01/2015-31/12/2015	1,882
01/01/2016-31/12/2016	1,515
01/01/2017-31/12/2017	1,217
01/01/2018-31/12/2018	941
01/01/2019-31/12/2019	712
01/01/2020-31/12/2020	528
01/01/2021-31/12/2021	390

Project emissions from consumption of electricity

$$PE_{CO_2,ele,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,CM,y} \times (1 + TDL_{j,y})$$

Quantity of electricity generated and consumed by the project electricity consumption source j year y (MWh/year) are as follows:

Period y	Total Volume of Electricity combusted $EC_{PJ,j,y}$ (MWh)
01/01/2013-31/12/2013	21,300.00
01/01/2014-31/12/2014	21,300.00
01/01/2015-31/12/2015	21,300.00
01/01/2016-31/12/2016	21,300.00
01/01/2017-31/12/2017	21,300.00
01/01/2018-31/12/2018	21,300.00
01/01/2019-31/12/2019	21,300.00
01/01/2020-31/12/2020	21,300.00
01/01/2021-31/12/2021	21,300.00

$$EF_{grid,CM,y}=0.84195\text{tCO}_2/\text{MWh}$$

$$TDL_{j,y}=20\%$$

Based on the calculation above, Project emissions due to electricity consumption for each specific year are summarized below:

Period y	Project emissions from consumption of electricity $PE_{CO_2,elec,y}$ (tCO ₂ /year)
01/01/2013-31/12/2013	21,520.24
01/01/2014-31/12/2014	21,520.24
01/01/2015-31/12/2015	21,520.24
01/01/2016-31/12/2016	21,520.24
01/01/2017-31/12/2017	21,520.24
01/01/2018-31/12/2018	21,520.24
01/01/2019-31/12/2019	21,520.24
01/01/2020-31/12/2020	21,520.24
01/01/2021-31/12/2021	21,520.24

Based on the calculation above, project emissions for each specific year are summarized below:

Period y	Project emissions PE_y (tCO ₂ /year)
01/01/2013-31/12/2013	23,540
01/01/2014-31/12/2014	23,701
01/01/2015-31/12/2015	23,403
01/01/2016-31/12/2016	23,035
01/01/2017-31/12/2017	22,737
01/01/2018-31/12/2018	22,461
01/01/2019-31/12/2019	22,232
01/01/2020-31/12/2020	22,048
01/01/2021-31/12/2021	21,910

Leakage (LE_y)

$$LE_y = LE_{FC,y} + LE_{EC,y}$$

Leakage emissions due to electricity consumption

$$LE_{EC,y} = \sum_j EC_{LE,l,y} \times EF_{grid,CM,y} \times (1 + TDL_{l,y})$$

Quantity of electricity generated and consumed by the project electricity consumption source j year y (MWh/year) are as follows:

Period y	Total Volume of Electricity combusted $EC_{LE,l,y}$ (MWh)
01/01/2013-31/12/2013	64,671.20
01/01/2014-31/12/2014	69,815.50
01/01/2015-31/12/2015	60,261.80
01/01/2016-31/12/2016	48,503.40
01/01/2017-31/12/2017	38,949.70
01/01/2018-31/12/2018	30,130.90
01/01/2019-31/12/2019	22,781.90
01/01/2020-31/12/2020	16,902.70
01/01/2021-31/12/2021	12,493.30

$$EF_{grid,CM,y} = 0.84195 \text{ tCO}_2/\text{MWh}$$

$$TDL_{l,y} = 20\%$$

Based on the calculation above, Leakage emissions due to electricity consumption for each specific year are summarized below:

Period y	Leakage emissions due to electricity consumption $LE_{EC,y}$ (tCO ₂ /year)
01/01/2013-31/12/2013	65,340
01/01/2014-31/12/2014	70,537
01/01/2015-31/12/2015	60,885
01/01/2016-31/12/2016	49,005
01/01/2017-31/12/2017	39,352
01/01/2018-31/12/2018	30,442
01/01/2019-31/12/2019	23,017
01/01/2020-31/12/2020	17,077
01/01/2021-31/12/2021	12,622

Leakage emissions due to the consumption of fossil fuels

$$LE_{CO_2,fossilfuel,y} = 0$$

Based on the calculation above, Leakage emissions for each specific year are summarized below:

Period y	Total Volume of Natural Gas combusted <i>LECO_{2,fossilfuel,y}</i> (tCO ₂ /year)
01/01/2013-31/12/2013	65,340
01/01/2014-31/12/2014	70,537
01/01/2015-31/12/2015	60,885
01/01/2016-31/12/2016	49,005
01/01/2017-31/12/2017	39,352
01/01/2018-31/12/2018	30,442
01/01/2019-31/12/2019	23,017
01/01/2020-31/12/2020	17,077
01/01/2021-31/12/2021	12,622

Emission reductions (ER_y)

$$ER_y = BE_y - PE_y - LE_y$$

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
01/01/2013-31/12/2013	583,036	23,540	65,340	494,156
01/01/2014-31/12/2014	630,415	23,701	70,537	536,176
01/01/2015-31/12/2015	543,591	23,403	60,885	459,304
01/01/2016-31/12/2016	437,565	23,035	49,005	365,524
01/01/2017-31/12/2017	351,625	22,737	39,352	289,536
01/01/2018-31/12/2018	271,210	22,461	30,442	218,306
01/01/2019-31/12/2019	205,711	22,232	23,017	160,462
01/01/2020-31/12/2020	152,985	22,048	17,077	113,859
01/01/2021-31/12/2021	112,789	21,910	12,622	78,256
Total	3,288,927	205,068	368,279	2,715,579
Total number of crediting years	9			
Annual average over the crediting period	365,436	22,785	40,920	301,731

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$V_{F,y}$																				
Unit	Nm ³																				
Description	Volume of the total recovered gas measured at point F in figure B3-2 in year y																				
Source of data	On site measurement using flow meter																				
Value(s) applied	<p>The data used in the ex-ante calculation of the emission reductions are sourced from the feasibility study report:</p> <table border="1"> <thead> <tr> <th>Period y</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>01/01/2013-31/12/2013</td> <td>26,384</td> </tr> <tr> <td>01/01/2014-31/12/2014</td> <td>28,528</td> </tr> <tr> <td>01/01/2015-31/12/2015</td> <td>24,599</td> </tr> <tr> <td>01/01/2016-31/12/2016</td> <td>19,801</td> </tr> <tr> <td>01/01/2017-31/12/2017</td> <td>15,912</td> </tr> <tr> <td>01/01/2018-31/12/2018</td> <td>12,273</td> </tr> <tr> <td>01/01/2019-31/12/2019</td> <td>9,309</td> </tr> <tr> <td>01/01/2020-31/12/2020</td> <td>6,923</td> </tr> <tr> <td>01/01/2021-31/12/2021</td> <td>5,104</td> </tr> </tbody> </table>	Period y	Value	01/01/2013-31/12/2013	26,384	01/01/2014-31/12/2014	28,528	01/01/2015-31/12/2015	24,599	01/01/2016-31/12/2016	19,801	01/01/2017-31/12/2017	15,912	01/01/2018-31/12/2018	12,273	01/01/2019-31/12/2019	9,309	01/01/2020-31/12/2020	6,923	01/01/2021-31/12/2021	5,104
Period y	Value																				
01/01/2013-31/12/2013	26,384																				
01/01/2014-31/12/2014	28,528																				
01/01/2015-31/12/2015	24,599																				
01/01/2016-31/12/2016	19,801																				
01/01/2017-31/12/2017	15,912																				
01/01/2018-31/12/2018	12,273																				
01/01/2019-31/12/2019	9,309																				
01/01/2020-31/12/2020	6,923																				
01/01/2021-31/12/2021	5,104																				
Measurement methods and procedures	Data should be measured using calibrated flow meter. Measurements should be taken at the point(s) where recovered gas exits the pre-treatment plant																				
Monitoring frequency	Continuously measurement and monthly recording.																				
QA/QC procedures	<p>Volume of gas should be completely metered with regular calibration of metering equipment as per relative national or industry standard. The measured volume should be converted to the volume at normal temperature and pressure using the temperature and pressure at the time to measurement.</p> <p>If there is any exceptional situation occurs on the project site, the technician will notify the CDM manager. And for calculating a conservative estimation, the recovered gas flared will not involved calculating emission reduction.</p>																				
Purpose of data	Calculation of baseline emissions																				
Additional comment	--																				



Data / Parameter	$NCV_{RG,F,y}$
Unit	TJ/Nm ³
Description	Average net calorific value of recovered gas at point F in Figure B3-2 in year <i>y</i>
Source of data	On site measurement (Chemical analysis of gas samples taken at point F in Figure B3-2)
Value(s) applied	0.0000403 The data used in the ex-ante calculation of the emission reductions are sourced from the feasibility study report.
Measurement methods and procedures	Measurements should be undertaken in line with national or international fuel standards Gas samples should regularly be taken at point F in Figure B3-2 and the molar composition of each gas sample should be determined through chemical analysis following the procedures for QA/QC. Based on the molar composition, the Net Calorific Value on a volumetric basis should be determined for each sample in line with ISO 6976 or an equivalent standard for a combustion reference temperature of 25 °C and the same metering reference condition used for parameter $V_{F,y}$. The average NCV during the period <i>y</i> is defined as the arithmetic average of NCVs for the samples taken during the same period.
Monitoring frequency	Sampling and compositional analysis and calculation of net calorific value at least monthly.
QA/QC procedures	Sampling in accordance with ISO10715 or equivalent standard. Compositional analysis in accordance with ISO6974 or equivalent standard. Routine maintenance and calibration in accordance with ISO10723 or equivalent standard. GC calibration gases certified to ISO6141 or equivalent standard. Annual manufacturer servicing and calibration to ISO17025 or equivalent standard. In case third party laboratories are used, these should as a minimum The laboratories performing NCV measurements should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of baseline emissions
Additional comment	For the purpose of this methodology, the qualifier “net” is synonymous with “lower” and “inferior”, and the term “calorific value” is synonymous with “heating value”.



Data / Parameter	$FC_{NG,D,y}$																				
Unit	Nm ³ /yr																				
Description	The quantity of dry gas combusted in processes before point F in figure B3-2 during the year y																				
Source of data	On site measurement using flow meter																				
Value(s) applied	<p>The data used in the ex-ante calculation of the emission reductions are sourced from the feasibility study report:</p> <table border="1"> <thead> <tr> <th>Period y</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>01/01/2013-31/12/2013</td> <td>107.01</td> </tr> <tr> <td>01/01/2014-31/12/2014</td> <td>115.52</td> </tr> <tr> <td>01/01/2015-31/12/2015</td> <td>99.71</td> </tr> <tr> <td>01/01/2016-31/12/2016</td> <td>80.26</td> </tr> <tr> <td>01/01/2017-31/12/2017</td> <td>64.45</td> </tr> <tr> <td>01/01/2018-31/12/2018</td> <td>49.86</td> </tr> <tr> <td>01/01/2019-31/12/2019</td> <td>37.70</td> </tr> <tr> <td>01/01/2020-31/12/2020</td> <td>27.97</td> </tr> <tr> <td>01/01/2021-31/12/2021</td> <td>20.67</td> </tr> </tbody> </table>	Period y	Value	01/01/2013-31/12/2013	107.01	01/01/2014-31/12/2014	115.52	01/01/2015-31/12/2015	99.71	01/01/2016-31/12/2016	80.26	01/01/2017-31/12/2017	64.45	01/01/2018-31/12/2018	49.86	01/01/2019-31/12/2019	37.70	01/01/2020-31/12/2020	27.97	01/01/2021-31/12/2021	20.67
Period y	Value																				
01/01/2013-31/12/2013	107.01																				
01/01/2014-31/12/2014	115.52																				
01/01/2015-31/12/2015	99.71																				
01/01/2016-31/12/2016	80.26																				
01/01/2017-31/12/2017	64.45																				
01/01/2018-31/12/2018	49.86																				
01/01/2019-31/12/2019	37.70																				
01/01/2020-31/12/2020	27.97																				
01/01/2021-31/12/2021	20.67																				
Measurement methods and procedures	Data should be measured using calibrated flow meter. Measurements should be taken at the point(s) where recovered gas exits the pre-treatment plant																				
Monitoring frequency	Continuously measurement and monthly recording.																				
QA/QC procedures	Volume of gas should be completely metered with regular calibration of metering equipment as per relative national or industry standards. The measured volume should be converted to the volume at normal temperature and pressure using the temperature and pressure at the time to measurement.																				
Purpose of data	Calculation of project emissions																				
Additional comment	--																				



Data / Parameter	$NCV_{NG,y}$
Unit	TJ/m ³
Description	Average net calorific value of natural gas combusted in processes before point F in figure B3-2 during the year y
Source of data	On site measurement (Chemical analysis of gas samples taken at point D in Figure B3-2)
Value(s) applied	0.00003238 The data used in the ex-ante calculation of the emission reductions are sourced from the feasibility study report.
Measurement methods and procedures	Measurements should be undertaken in line with national or international fuel standards Gas samples should regularly be taken at point F in Figure B3-2 and the molar composition of each gas sample should be determined through chemical analysis following the procedures for QA/QC. Based on the molar composition, the Net Calorific Value on a volumetric basis should be determined for each sample in line with ISO 6976 or an equivalent standard for a combustion reference temperature of 25 °C and the same metering reference condition used for parameter $V_{F,y}$. The average NCV during the period y is defined as the arithmetic average of NCVs for the samples taken during the same period.
Monitoring frequency	Sampling and compositional analysis and calculation of net calorific value at least monthly.
QA/QC procedures	Sampling in accordance with ISO 10715 or equivalent standard. Compositional analysis in accordance with ISO 6974 or equivalent standard. Routine maintenance and calibration in accordance with ISO 10723 or equivalent standard. GC calibration gases certified to ISO 6141 or equivalent standard. Annual manufacturer servicing and calibration to ISO17025 or equivalent standard. In case third party laboratories are used, these should as a minimum The laboratories performing NCV measurements should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions
Additional comment	For the purpose of this methodology, the qualifier “net” is synonymous with “lower” and “inferior”, and the term “calorific value” is synonymous with “heating value”.



Data / Parameter	$EF_{CO_2,NG,y}$
Unit	tCO ₂ /TJ
Description	CO ₂ emission factor of natural gas before point F in figure B3-2 during the year y
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter I of Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value(s) applied	58.3
Measurement methods and procedures	--
Monitoring frequency	--
QA/QC procedures	During implementing verification period for the project, the latest IPCC-value is applied.
Purpose of data	Calculation of project emissions
Additional comment	--

Data / Parameter	$EC_{PJ,j,y}$																				
Unit	MWh/y																				
Description	Quantity of electricity consumed by the project activity source j in year y																				
Source of data	On site measurement																				
Value(s) applied	The data used in the ex-ante calculation of the emission reductions are sourced from the feasibility study report: <table border="1" data-bbox="568 1102 1099 1424"> <thead> <tr> <th>Period y</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>01/01/2013-31/12/2013</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2014-31/12/2014</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2015-31/12/2015</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2016-31/12/2016</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2017-31/12/2017</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2018-31/12/2018</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2019-31/12/2019</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2020-31/12/2020</td> <td>21,300.00</td> </tr> <tr> <td>01/01/2021-31/12/2021</td> <td>21,300.00</td> </tr> </tbody> </table>	Period y	Value	01/01/2013-31/12/2013	21,300.00	01/01/2014-31/12/2014	21,300.00	01/01/2015-31/12/2015	21,300.00	01/01/2016-31/12/2016	21,300.00	01/01/2017-31/12/2017	21,300.00	01/01/2018-31/12/2018	21,300.00	01/01/2019-31/12/2019	21,300.00	01/01/2020-31/12/2020	21,300.00	01/01/2021-31/12/2021	21,300.00
Period y	Value																				
01/01/2013-31/12/2013	21,300.00																				
01/01/2014-31/12/2014	21,300.00																				
01/01/2015-31/12/2015	21,300.00																				
01/01/2016-31/12/2016	21,300.00																				
01/01/2017-31/12/2017	21,300.00																				
01/01/2018-31/12/2018	21,300.00																				
01/01/2019-31/12/2019	21,300.00																				
01/01/2020-31/12/2020	21,300.00																				
01/01/2021-31/12/2021	21,300.00																				
Measurement methods and procedures	Data should be measured using calibrated electricity meters.																				
Monitoring frequency	Continuously measured and monthly recorded																				
QA/QC procedures	The electricity meters will be calibrated by a qualified third party according to the national standard.																				
Purpose of data	Calculation of project emissions																				
Additional comment	--																				

Data / Parameter	$EC_{LE,l,y}$																				
Unit	MWh/y																				
Description	Net increase in electricity consumption of source l during the year y																				
Source of data	On site measurement																				
Value(s) applied	<p>The data used in the ex-ante calculation of the emission reductions are sourced from the feasibility study report:</p> <table border="1"> <thead> <tr> <th>Period y</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>01/01/2013-31/12/2013</td> <td>64,671.20</td> </tr> <tr> <td>01/01/2014-31/12/2014</td> <td>69,815.50</td> </tr> <tr> <td>01/01/2015-31/12/2015</td> <td>60,261.80</td> </tr> <tr> <td>01/01/2016-31/12/2016</td> <td>48,503.40</td> </tr> <tr> <td>01/01/2017-31/12/2017</td> <td>38,949.70</td> </tr> <tr> <td>01/01/2018-31/12/2018</td> <td>30,130.90</td> </tr> <tr> <td>01/01/2019-31/12/2019</td> <td>22,781.90</td> </tr> <tr> <td>01/01/2020-31/12/2020</td> <td>16,902.70</td> </tr> <tr> <td>01/01/2021-31/12/2021</td> <td>12,493.30</td> </tr> </tbody> </table>	Period y	Value	01/01/2013-31/12/2013	64,671.20	01/01/2014-31/12/2014	69,815.50	01/01/2015-31/12/2015	60,261.80	01/01/2016-31/12/2016	48,503.40	01/01/2017-31/12/2017	38,949.70	01/01/2018-31/12/2018	30,130.90	01/01/2019-31/12/2019	22,781.90	01/01/2020-31/12/2020	16,902.70	01/01/2021-31/12/2021	12,493.30
Period y	Value																				
01/01/2013-31/12/2013	64,671.20																				
01/01/2014-31/12/2014	69,815.50																				
01/01/2015-31/12/2015	60,261.80																				
01/01/2016-31/12/2016	48,503.40																				
01/01/2017-31/12/2017	38,949.70																				
01/01/2018-31/12/2018	30,130.90																				
01/01/2019-31/12/2019	22,781.90																				
01/01/2020-31/12/2020	16,902.70																				
01/01/2021-31/12/2021	12,493.30																				
Measurement methods and procedures	Data should be measured using calibrated electricity meter.																				
Monitoring frequency	Continuously measured and monthly recorded																				
QA/QC procedures	The electricity meter will be calibrated by a qualified third party according to the national standard.																				
Purpose of data	Calculation of leakage emissions																				
Additional comment	--																				

B.7.2. Sampling plan

>>

As per the “Standard for sampling and surveys for CDM project activities and programme of activities”, the requirements for sampling in the applicable methodology are having precedence. Hence sampling plan for NCV as described in the AM0009 version 06.0.0 is used.

B.7.3. Other elements of monitoring plan

>>

The operational and management structure that will be implemented by the project developer in order to monitor emission reductions and any leakage generated by the project activity is described in the following figure:

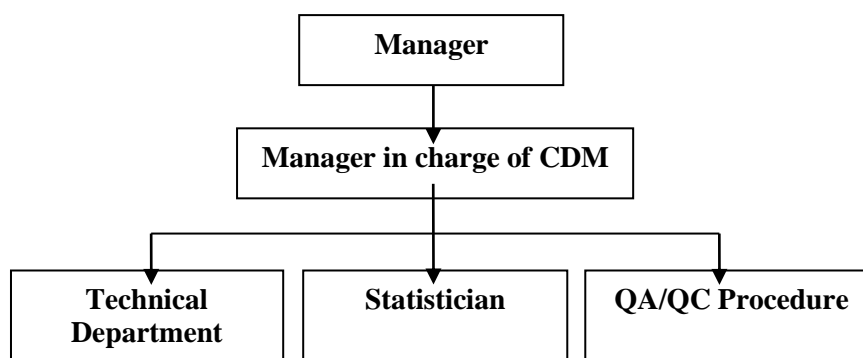


Figure B7-1 Monitoring organization chart.

Monitoring system, data collection and archiving

The monitoring points are distributed in the project site as shown in the figure below:

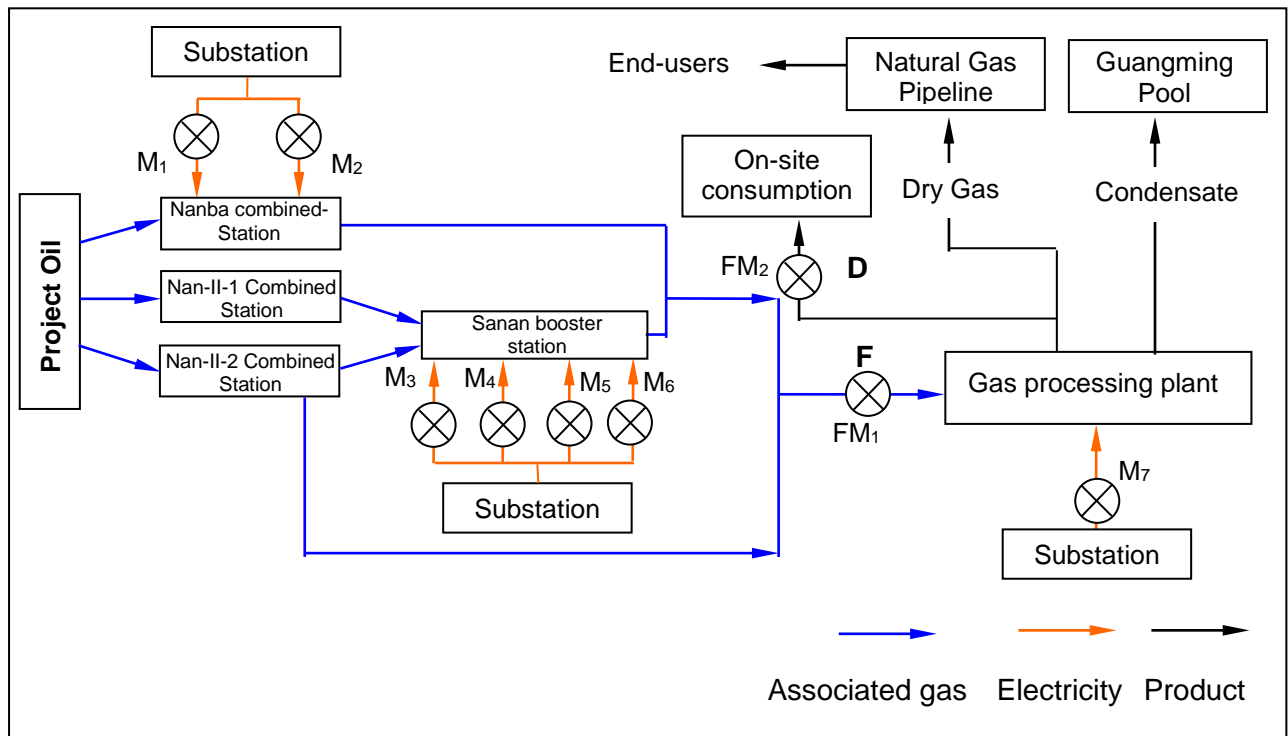


Figure B7-2 Monitoring system of the project.

The recovered gas monitoring point will be set up in the front of compressor inlet of the processing plant, where one gas flow meter (FM₁) and gas sampling point will be installed.

The dry gas combusted monitoring point will be set up at dry gas combusted of total main pipeline, where one gas flow meter (FM₂) will be installed. And the dry gas sampling point will be installed at the dry gas pipeline.

Two electricity meters (M₁ and M₂) will be installed at Sanan booster station, and they will only monitor the power imported from the grid.

Four electricity meters (M₃ M₄ M₅ and M₆) will be installed at Nanba combined-station, and they will only monitor the power imported from the grid.

The electricity meter (M₇) will be installed at Substation, and they will only monitor the power imported from the grid.

All data that need to be collected will be measured and recorded at the frequency as per details in B.7.1 by operating personnel and then reported to CDM project Manager. CDM project Manager will aggregate those data and then report them to Manager who will check and archive them, as well as manage the regular data back-up. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables above. All measurements should be conducted with calibrated measurement equipment according to national or industry standards.

Calibration of metering units

The accuracy of the gas flow meters (FM₁ and FM₂) is no less than 1.5. The accuracy of the electricity meters (M₁ and M₂) is no less than 2, the accuracy of the electricity meters (M₃ M₄ M₅ and M₆) is no less than 1. Calibration of the measurement equipment should be implemented according to relevant national standards. If there is doubt on the accuracy of the measurement equipment, recalibration of such measurement equipment shall be conducted. And all the records should be documented and maintained by the project owner for DOE's verification.

Projection and adjustment of project and baseline emissions on the basis of oil production

Project as well as baseline emissions depend on the quantity of recovered gas, which is linked to the oil production. Oil production is projected with the help of a reservoir engineering studies, reflecting the rock and fluid properties in the oil reservoir. The quantity of recovered gas is a function of the associated gas production which produced in the Second Oil Production Plant of Sanan Oilfield.

The production target of Second Oil Production Plant of Sanan Oilfield is showed on Table B7-1.

Table B7-1 Production target of Second Oil Production Plant of Sanan Oilfield^{24 25}

Period y	Oil Production (10 ⁴ t)	Gas-oil Ratio (m ³ /t)	associated gas production (10 ⁸ Nm ³)	Total Volume of Recovered Gas (Point F) (10 ⁴ Nm ³)
01/01/2013-31/12/2013	445	67	2.98	26,384
01/01/2014-31/12/2014	472	68.3	3.22	28,528
01/01/2015-31/12/2015	407	68.3	2.78	24,599
01/01/2016-31/12/2016	331	67.6	2.24	19,801
01/01/2017-31/12/2017	266	67.6	1.80	15,912
01/01/2018-31/12/2018	207	67	1.39	12,273
01/01/2019-31/12/2019	157	67	1.05	9,309
01/01/2020-31/12/2020	118	66.3	0.78	6,923
01/01/2021-31/12/2021	87	66.3	0.58	5,104

As projections of the oil production, the methane content²⁶ of the gas and other parameters involve a considerable degree of uncertainty, the quantity and composition of the recovered gas are monitored ex-post and baseline and project emissions are adjusted respectively during monitoring. The project developer provides comparative analysis of production data for oil and associated gas and the initial production target as per the information provided in survey used for defining the terms of the underlying oil production project.

If the oil production differs significantly from the initial production target, then the project developer will specify corresponding reasons.

Procedures of emergency or abnormal condition

If emergency or abnormal condition occurs at the project site, the technician will notify the CDM manager immediately and try to resolve the problem soon. For conservative purpose, the recovered associated gas during the abnormal period will be transmitted to flare system of the project and not be used for claim emission reductions.

SECTION C. Duration and crediting period**C.1. Duration of project activity****C.1.1. Start date of project activity**

>>

12/04/2011 (Signing date of the Equipment contract of regenerable adsorption type of dryer)

²⁴ Source: Oilfield development plan of the Sanan Oilfield and oil and associated gas expectation dated 23/01/2010

²⁵ Feasibility Study Report

²⁶ Estimation of average molar content in recovered gas in feasibility study report: 78.41%. The estimated emission reductions are calculated with the quantity of the recovered gas and its contents.



The starting date of a CDM project activity is the earliest of the date(s) on which the implementation or construction or real action of a project activity begins/has begun.

The Equipment contract of regenerable adsorption type of dryer has been signed on 12/04/2011, and the construction contract (Part 1) of the project has been signed on 12/05/2011. So the starting date of the project is 12/04/2011.

C.1.2. Expected operational lifetime of project activity

>>

10 years 0 months

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

The fixed crediting period is chosen for the project

C.2.2. Start date of crediting period

>>

01/01/2013 or date on which the complete request for registration is submitted, whichever is later

C.2.3. Length of crediting period

9 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

An Environmental Impact Assessment (EIA) for the project has been completed by Daqing Oilfield Engineering Co., Ltd, and was approved by the Environmental Protection Bureau of Daqing City in December 2010.

The summary of this evaluation is as following:

Air Pollution

During the construction period, construction and road dust pollution may cause some negative impacts on the air. However, such impacts are confined to a shorter distance and will last only a short time. During the project operation period, the major sources of air pollution will be flue gas from gas and hydrocarbon gases from equipment leakage. However, the project will avoid unnecessary combustion of associated gas to reduce CO₂ and SO₂ emissions further more than the emissions from the project activity. Hence, there will not have any significant impacts on the air under normal operating conditions.

Water Pollution

During the construction period, the water pollution sources will be the domestic sewage. The domestic sewage will be treated by septic tank and then used for gardening. During the operation period, the water pollution sources will be only the production effluent. After the treatment, the wastewater will be recycling utilization, both the industrial and domestic sewage from the project activity is unlikely to have any substantial impact on the underground water.

Noise Pollution

During the construction period, the noise will be mainly from construction machinery and vehicle, according to people habits, construction can be forbidden at night, and will be over as the construction completes. The negative effects will be mitigated or eliminated, through noise control measures. During the operation period, the noise source will be mainly from compressor. In order to reduce the environmental impacts of compressor, measures can be taken as follows:



- a) The compressor will be installed inside the room with vibration reduction base and sound absorption building materials.
- b) The trees and grass also will be planted after the construction.
Hence, there will not any significant impacts on the noise under normal operating conditions.

Solid Pollution

Waste solid and living waste will be generated during the construction and operation of the Project. All production waste solid will be treated by a sanitary landfill method. The negative effects of environment will be mitigated or eliminated, through these series of processing.

Ecology

(a) Construction period

The ecological impacts of the project during its construction period are mainly due to land occupation and damages to soil and vegetation. However, the project occupies a little productive land, and other is wasteland, which has little influences on the local people' life. When the construction finishes, the land will be recovered as the productive land by the project developer. Then, the negative effects of the ecology will be minimized.

(b) Operation period

The ecological impacts of the project activity during the operation period are primarily due to permanent land use or occupancy. However, the vegetation accounts for less than the evaluation area, thus the ecological impacts of the project activity will be very limited.

D.2. Environmental impact assessment

>>

The proposed project has not significant impacts on local environment and the EIA of the proposed project has been approved by the Environmental Protection Bureau of Daqing City on 08/12/2010.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

Local stakeholders of the Project are identified as local residents possibly impacted by the Project. On 25/03/2011 the notification on stakeholder consultation survey was posted at the gate of local village committee in which the project description and the date for the survey was provided.

In order to collect the stakeholder survey, the project developer carried out a survey of local residents in April 2011. The purpose of this survey was to understand the local government and other stakeholders' comments and suggestions for the project construction and operation. The project developer released 50 questionnaires which have all been recollectd. The result of the survey indicated the support to the project.

The questionnaire included a short summary of the project activity, questions about the responding stakeholder and a number of questions and the opportunity for further comments.

E.2. Summary of comments received

>>

◇ Are you familiar with this project?	Yes	No	Not Sure
	62%	38%	0%
◇ Will the impacts of the proposed project construction to the ecological environment?	Yes	No	Not Sure
	2%	98%	0%
◇ Will the proposed project cause noise, air pollution that could adversely affect your health?	Yes	No	Not Sure
	0%	98%	2%
◇ What impact do you think this project has on local economic	Yes	No	Not Sure



development?	100%	0%	0%
◇ Do you support the construction of this project?	Yes	No	Not Sure
	100%	0%	0%

No further comments were given.

E.3. Report on consideration of comments received

>>

The local stakeholders are supportive of the proposed project, and there have been no comments to be taken in account that could affect the project design. One stakeholder concern the impact on the ecological environment. However the impact on the ecological environment is addressed in the EIA and the measures required in the EIA can alleviate this impact.

SECTION F. Approval and authorization

>>

The letters of approval from DNA of China and from DNA of Australian are not available at the time of submitting the PDD to the validating DOE for GSP. The letters of approval from DNA of China has been issued by the National Development and Reform Commission in 08/2012; and the letter of approval from DNA of Australian has been issued by Australia's Designated National Authority on 15/08/2012. These have been submitted during the validation process.

**Appendix 1: Contact information of project participants**

Organization name	Daqing Oilfield Co., Ltd.
Street/P.O. Box	Longnan Ranghulu District Daqing City
Building	/
City	Daqing
State/Region	Ranghulu District
Postcode	163453
Country	People Republic of China
Telephone	+86 10-67802748-8008
Fax	+86 10-67802748-8007
E-mail	zhulin_dod@petrochina.com.cn
Website	http://dqyt.cnpc.com.cn/dq/
Contact person	ZhuLin
Title	Manager
Salutation	Mr
Last name	Zhu
Middle name	/
First name	Lin
Department	/
Mobile	13159812362; 13718458858
Direct fax	+86 10-67802748-8007
Direct tel.	+86 10-67802748-8008
Personal e-mail	zhulin_dod@petrochina.com.cn



Organization name	Macquarie Bank Limited
Street/P.O. Box	Level 6, Ropemaker Place, 28 Ropemaker Street
Building	28 Ropemaker Street
City	London
State/Region	/
Postcode	EC2Y 9HD
Country	United Kingdom
Telephone	+44 203 037 2000
Fax	+44 203 037 4301
E-mail	carbontrading@macquarie.com
Website	www.macquarie.com
Contact person	John Marlow
Title	Head of Environmental Financial Products
Salutation	Mr
Last name	Marlow
Middle name	/
First name	John
Department	Fixed Income, Currency and Commodities Group
Mobile	+44 7786 362 069
Direct fax	+44 207 065 2181
Direct tel.	+44 203 037 4176
Personal e-mail	carbontrading@macquarie.com



Appendix 2: Affirmation regarding public funding

No public funding from Annex I Parties is involved in the Project.



Appendix 3: Applicability of selected methodology

The applicability of the selected methodology is described in B.2.

Appendix 4: Further background information on ex ante calculation of emission reductions

Data recommended in the *Notification on Determining 2011 Baseline Emission Factors for Regional Power Grids in China*²⁷ (issued by Chinese DNA) for NEPG are adopted for the Project.

Table A1~A3 show the thermal power generation supplied to NEPG in 2008, 2009 and 2010.

Table A1. Thermal power generation data within the NEPG in 2007

Province	Thermal power generation (10 ⁸ MWh)	Auxiliary electricity consumption (%)	Thermal power supplied to the grid (MWh)
Liaoning	1065	7	99,045,000
Jilin	437	7.68	40,343,840
Heilongjiang	684	7.67	63,153,720
Total			202,542,560

Data source: *China Electric Power Yearbook 2008*.

Table A2. Thermal power generation data within the NEPG in 2008

Province	Thermal power generation (10 ⁸ MWh)	Auxiliary electricity consumption (%)	Thermal power supplied to the grid (MWh)
Liaoning	1085	7.18	100,709,700
Jilin	464	7.76	42,799,360
Heilongjiang	715	7.53	66,116,050
Total			209,625,110

Data source: *China Electric Power Yearbook 2009*.

Table A3. Thermal power generation data within the NEPG in 2009

Province	Thermal power generation (10 ⁸ MWh)	Auxiliary electricity consumption (%)	Thermal power supplied to the grid (MWh)
Liaoning	1153	6.94	105,623,100
Jilin	473	7.89	43,568,030
Heilongjiang	694	7.29	64,340,740
Total			213,531,870

Data source: *China Electric Power Yearbook 2010*

Table A4 shows the low calorific values and emission factors of fuels consumed for electricity generation that are to be used in the following OM emission factor calculation and BM emission factor calculation.

²⁷2011 Baseline Emission Factors for Regional Power Grids in China

Table A4. Data of fuels consumed for electricity generation

Fuel type	Low calorific value	Emission factor (tc/TJ)
Raw coal	20,908	87,300
Cleaned coal	26,344	87,300
Briquette	20,908	87,300
Other washed coal	8,363	87,300
Coke	28,435	95,700
Crude oil	41,816	71,100
Gasoline	43,070	67,500
Diesel	42,652	72,600
Fuel oil	41,816	75,500
Other Coking products	41,816	72,200
Natural gas	38,931	54,300
Coke Oven gas	16,726	37,300
Other coal gas	5,227	37,300
LPG	50,179	61,600
Refinery gas	46,055	48,200

Data sources: China Energy Statistical Yearbook 2010 Edition; “2006 IPCC Guidelines for National Greenhouse Gas Inventories”, Volume2, Chap 1, Table 1.2, Table 1.4

Table A5~A7 show the calculation of the simple OM emission factor of NEPG in 2007, 2008 and 2009.



Table A5. Calculation of simple OM emission factor of NEPG in 2007

Fuel type	Unit	Liaoning	Jilin	Heilongjiang	Total	Carbon	Carbon	Fuel	NCV	CO ₂ emissions (tCO ₂ e) I=D*G*H/100000 (mass unit) I=D*G*H/10000 (volume unit)
		A	B	C	D=A+B+C	(tC/TJ) E	oxidation rate (%) F	emission factor (kgCO ₂ /TJ) G	(MJ/t,km ³) H	
Raw coal	10 ⁴ t	4869.32	2873.45	3736.11	11478.88	25.8	100	87,300	20,908	209,520,369
Clean washed coal	10 ⁴ t				0	25.8	100	87,300	26,344	0
Other washed coal	10 ⁴ t	747.85	16.52	106.81	871.18	25.8	100	87,300	8,363	6,360,397
Briquette	10 ⁴ t				0	26.6	100	87,300	20,908	0
Coke	10 ⁴ t	4.99			4.99	29.2	100	95,700	28,435	135,789
Coke oven gas	10 ⁸ m ³	5.53	1.44	1.89	8.86	12.1	100	37,300	16,726	552,758
Other gas	10 ⁸ m ³	68.38	9.06		77.44	12.1	100	37,300	5,227	1,509,825
Crude oil	10 ⁴ t	0.24			0.24	20	100	71,100	41,816	7,135
Gasoline	10 ⁴ t				0	18.9	100	67,500	43,070	0
Diesel	10 ⁴ t	0.96	0.39	0.47	1.82	20.2	100	72,600	42,652	56,357
Fuel oil	10 ⁴ t	8.43	0.45	1.48	10.36	21.1	100	75,500	41,816	327,076
LPG	10 ⁴ t				0	17.2	100	61,600	50,179	0
Refined gas	10 ⁴ t	7.33		1.99	9.32	15.7	100	48,200	46,055	206,890
Natural gas	10 ⁸ m ³		0.02	2.03	2.05	15.3	100	54,300	38,931	433,360
Other petroleum products	10 ⁴ t	0.01			0.01	20	100	72,200	41,816	302
Other coking products	10 ⁴ t	0.46			0.46	25.8	100	95,700	28,435	12,518
Other energy	10 ⁴ t	12.41	2.43	51.35	66.19	0	0	0	0	0
Total emissions of NEPG (tCO₂)										219,122,778
Thermal power supplied to NEPG (MWh)										202,542,560

Data sources: China Energy Statistical Yearbook 2008 Edition; China Electric Yearbook 2008 Edition.



Table A6. Calculation of simple OM emission factor of NEPG in 2008

Fuel type	Unit	Liaoning	Jilin	Heilongjiang	Total	Carbon	Carbon	Fuel	NCV	CO ₂ emissions (tCO ₂ e) I=D*G*H/100000 (mass unit) I=D*G*H/10000 (volume unit)
		A	B	C	D=A+B+C	(tC/TJ) E	oxidation rate (%) F	emission factor (kgCO ₂ /TJ) G	(MJ/t,km ³) H	
Raw coal	10 ⁴ t	4973.05	3289.16	3873.45	12135.66	25.8	100	87,300	20,908	221,508,367
Clean washed coal	10 ⁴ t				0	25.8	100	87,300	26,344	0
Other washed coal	10 ⁴ t	791.96	15.58	112.97	920.51	25.8	100	87,300	8,363	6,720,551
Briquette	10 ⁴ t				0	26.6	100	87,300	20,908	0
Coke	10 ⁴ t	5.77			5.77	29.2	100	95,700	28,435	157,015
Coke oven gas	10 ⁸ m ³	4.12	1.06	5.54	10.72	12.1	100	37,300	16,726	668,799
Other gas	10 ⁸ m ³ t	61.11	7.63		68.74	12.1	100	37,300	5,227	1,340,204
Crude oil	10 ⁴ t	0.37			0.37	20	100	71,100	41,816	11,001
Gasoline	10 ⁴ t	0.02			0.02	18.9	100	67,500	43,070	581
Diesel	10 ⁴ t	0.84	1.07	0.37	2.28	20.2	100	72,600	42,652	70,601
Fuel oil	10 ⁴ t	10.64	1.06	1.29	12.99	21.1	100	75,500	41,816	410,108
LPG	10 ⁴ t				0	17.2	100	61,600	50,179	0
Refined gas	10 ⁴ t	7.54		3.77	11.31	15.7	100	48,200	46,055	251,065
Natural gas	10 ⁸ m ³		0.39	1.85	2.24	15.3	100	54,300	38,931	473,526
Other petroleum products	10 ⁴ t				0	20	100	72,200	41,816	0
Other coking products	10 ⁴ t				0	25.8	100	95,700	28,435	0
Other energy	10 ⁴ t	16.9	3.04	68.19	88.13	0	0	0	0	0
Total emissions of NEPG (tCO₂)										231,611,818
Thermal power supplied to NEPG (MWh)										209,625,110

Data sources: China Energy Statistical Yearbook 2009 Edition; China Electric Yearbook 2009 Edition.



Table A7. Calculation of simple OM emission factor of NEPG in 2009

Fuel type	Unit	Liaoning	Jilin	Heilongjiang	Total	Carbon	Carbon	Fuel	NCV	CO ₂ emissions (tCO ₂ e) I=D*G*H/100000 (mass unit) I=D*G*H/10000 (volume unit)
		A	B	C	D=A+B+C	(tC/TJ) E	oxidation rate (%) F	emission factor (kgCO ₂ /TJ) G	(MJ/t,km ³) H	
Raw coal	10 ⁴ t	5297.77	2999.09	3691.92	11988.78	25.8	100	87,300	20,908	218,827,413
Clean washed coal	10 ⁴ t				0	25.8	100	87,300	26,344	0
Other washed coal	10 ⁴ t	662.76	19.67	98.77	781.2	25.8	100	87,300	8,363	5,703,462
Briquette	10 ⁴ t			1.18	1.18	26.6	100	87,300	20,908	21,538
Coke	10 ⁴ t	4.19			4.19	29.2	100	95,700	28,435	114,020
Coke oven gas	10 ⁸ m ³	4.97	1.77	2.51	9.25	12.1	100	37,300	16,726	577,089
Other gas	10 ⁸ m ³	75.72	13.88	0.11	89.71	12.1	100	37,300	5,227	1,749,050
Crude oil	10 ⁴ t	0.79			0.79	20	100	71,100	41,816	23,488
Gasoline	10 ⁴ t				0	18.9	100	67,500	43,070	0
Diesel	10 ⁴ t	0.44	0.42	0.43	1.29	20.2	100	72,600	42,652	39,945
Fuel oil	10 ⁴ t	3.32	0.79	1.39	5.5	21.1	100	75,500	41,816	173,641
LPG	10 ⁴ t				0	17.2	100	61,600	50,179	0
Refined gas	10 ⁴ t	7.78		3.21	10.99	15.7	100	48,200	46,055	243,962
Natural gas	10 ⁸ m ³		1.97	1.86	3.83	15.3	100	54,300	38,931	809,644
Other petroleum products	10 ⁴ t	0.44			0.44	20	100	72,200	41,816	13,284
Other coking products	10 ⁴ t				0	25.8	100	95,700	28,435	0
Other energy	10 ⁴ t	18.24	15.93	107.82	141.99	0	0	0	0	0
Total emissions of NEPG (tCO₂)										228,296,535
Thermal power supplied to NEPG (MWh)										213,531,870

Data sources: China Energy Statistical Yearbook 2010 Edition; China Electric Yearbook 2010 Edition.

The Simple OM emission factor is the weighted average value of the Simple OM emission factors in the year 2007, 2008 and 2009, i.e.

$$EF_{grid,OM,y} = (219,122,778 + 231,611,818 + 228,296,535) / (202,542,560 + 209,625,110 + 213,531,870) = 1.0852 \text{ tCO}_2\text{e}$$

Calculation of BM Emission Factor of NEPG

Build Margin emission factor is calculated according to the steps and formulae described in Section B.6.1.

Table A8 is data of the efficiency level of the best electricity generation technologies commercially available in China and the corresponding emission factors with reference to the *Notification on Determining Baseline Emission Factors of China Power Grid* issued by Chinese DNA.

Table A8. The efficiency level of the best electricity generation technology commercially available in China

	Parameter	Efficiency of supplying electricity	Fuel emission factor (kgCO ₂ /TJ)	Oxidation rate	Emission factor (tCO ₂ /MWh)
		A	B	C	D=3.6/A/10,000*B*C
Coal-fired power plant	$EF_{Coal,Adv}$	39.45%	87,300	1	0.7967
Gas-fired power plant	$EF_{Oil,Adv}$	51.77%	75,500	1	0.5250
Oil-fired power plant	$EF_{Gas,Adv}$	51.77%	54,300	1	0.3776

Table A9. CO₂ emissions of NEPG in 2009

Fuel	Unit	Liaoning A	Jilin B	Heilongjiang D	Total E=A+...+D	Average Low Calorific Value F	Emission Factor (kgCO ₂ /TJ) G	Oxidation rate H	CO ₂ Emission (tCO ₂ e) I=E*F*G* 44/12/100
Raw Coal	10 ⁴ t	5,297.77	2,999.09	3,691.92	11,988.78	20,908	87,300	1	218,827,413
Cleaned Coal	10 ⁴ t	0	0	0	0	26,344	87,300	1	0
Other Washed Coal	10 ⁴ t	662.76	19.67	98.77	781.2	8,363	87,300	1	5,703,462
Briquette	10 ⁴ t	0	0	1.18	1.18	20,908	87,300	1	21,538
Coke	10 ⁴ t	4.19	0	0	4.19	28,435	95,700	1	114,020
Other coking products		0	0	0	0	28,435	95,700	1	0
Subtotal									224,666,433
Crude Oil	10 ⁴ t	0.79	0	0	0.79	41,816	71,100	1	23,488
Gasoline	10 ⁴ t	0	0	0	0	43,070	67,500	1	0
Diesel Oil	10 ⁴ t	0.44	0.42	0.43	1.29	42,652	72,600	1	39,945
Fuel Oil	10 ⁴ t	3.32	0.79	1.39	5.5	41,816	75,500	1	173,641
other Coking products	10 ⁴ t	0.44	0	0	0.44	41,816	72,200	1	13,284
Subtotal									250,358
Natural Gas	10 ⁷ m ³	0	19.7	18.6	38.3	38,931	54,300	1	809,644
Coke Oven Gas	10 ⁷ m ³	49.7	17.7	25.1	92.5	16,726	37,300	1	577,089
Other Gas	10 ⁷ m ³	757.2	138.8	1.1	897.1	5,227	37,300	1	1,749,050
LPG	10 ⁴ t	0	0	0	0	50,179	61,600	1	0
Refinery Gas	10 ⁴ t	7.78	0	3.21	10.99	46,055	48,200	1	243,962
Subtotal									3,379,744
Total									228,296,535

Data sources: China Energy Statistical Yearbook 2010 Edition..



Calculate with data provided in Table A9:

$$\lambda_{Coal}=98.41\%, \quad \lambda_{Oil}=0.11\%, \quad \lambda_{Gas}=1.48\%$$

Based on Table A8, the emission factor for thermal power is:

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} = 0.7902 \text{ tCO}_2/\text{MWh}.$$

	2007	2008	2009	2007-2009 increment	2008-2009 increment	Share in total capacity additions
	A	B	C	D	E	F
Fuel-fired power (MW)	41,380	44,820	49,840	10,772	6,646	75.76%
Hydro Power (MW)	6,170	6,260	6,300	130	40	0.91%
Nuclear Power (MW)	0	0	0	0	0	0.00%
Wind power (MW)	1,103	2,239	4,420	3,317	2181	23.33%
Total (MW)	48,653	53,319	60,560	14,219	8,867	100.00%
Ration compared to 2009				23.48%	14.64%	

BM emission factor of NEPG can be calculated as:

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal}$$

Where CAP_{Total} is total capacity additions while $CAP_{Thermal}$ is capacity additions of thermal power, therefore,

$$EF_{BM,y} = 0.7902 \times 75.76\% = 0.5987 \text{ tCO}_2/\text{MWh}$$



Appendix 5: Further background information on monitoring plan

Please refer to section B.7.1 and B.7.2. No need to complement more information here.

**Appendix 6: Summary of post registration changes**

Not applicable. The project activity is being proposed for registration.

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Registration		