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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

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Southern District Heating Network in Urumqi City
Version 06.2
16/09/2012

A.2. Description of the project activity:

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Southern District Heating Network project (referred to as the proposed project activity hereinafter) is located in Urumqi City, Capital of Xinjiang Uygur Autonomous Region. The proposed project activity will be constructed and implemented by Urumqi Heating Supply Co., Ltd (referred to as the project owner hereinafter). The proposed project activity will supply space heat for 17,490,000 m^2 of buildings. The total heating supply capacity is 1,445 MW.

The existing scenario prior to the implementation of the proposed project activity is that the space heating area for existing buildings in southern district of Urumqi city area[1] was 14,130,000 m^2. Of which 8,559,500 m^2 areas is supplied by small isolated heating network which consists of 142 small inefficient boiler houses with 333 boilers and 5,570,500 m^2 area is supplied by 3 heat only large boiler houses (No.140, No.144 and No.145) with 15 boilers. Detailed information is provided in Annex 3. The existing Xinjiang Huadian Hongyanchi Power Plant with 4×200MW (referred to as the CHP plant hereinafter) has been in electricity operation in condensing mode for more than 3 years prior to the start of the implementation of the proposed activity, which was in Oct. 2005.

The project scenario is aimed at introducing a new primary district heating system to replace the existing isolated small heating system. The main heat sources are delivered from extraction condensing power units for cogeneration (CHP) plus four heat-only boilers as supplementary heat sources (three of them were existing large boiler houses as mentioned above, i.e. No.140,No.144 and No.145, the other one was put into operation after extracting heat from the CHP, i.e. Weihuliang Boiler House). As a result, the project activity will largely improve the thermal energy efficiency for space heating in the target area and reduce the serious urban air pollution caused by coal-combustion in the small isolated heating network. In particular it will also effectively mitigate the CO_2 emissions from coal based space heating system.

The baseline scenario as identified in the Section B.4.of the PDD consists of two parts: for existing buildings the baseline scenario is continued operation of the isolated small boilers; for new buildings, the baseline scenario is establishment of a new isolated district heating networks with small coal fired boilers.

The civil construction work of the proposed project activity will be implemented step by step. The heat extraction started in 2005. Along with the progress of the heating network construction those existing small inefficient coal fired boiler houses as mentioned above will be demolished accordingly.

The proposed project activity will increase energy efficiency in the following two ways:

[1] In the FSR, the existing building area was originally sum up as 14,090,000m^2, however it was found during the PDD development that the summing up was wrong resulting two existing building groups with 40000m^2 of building areas in total missing, so it was corrected as 14,130,000m^2, the same as below.

1) Replace the isolated district heating networks supplied by low efficient small coal fired heating boilers with a new high efficient primary district heating system mainly sourced from the CHP plant;
2) Increase power plant efficiency by converting the operation of the existing power plant from condensing mode to extraction mode with heat extraction.

Therefore, with the equivalent electricity generation and heating service level as in the baseline scenario the fuel coal consumed by the project activity will be effectively reduced due to the energy efficiency improvement, so the CO_2 emission from the project activity will be reduced accordingly. The average annual emission reductions are estimated as 1,155,074 t CO_2.

The contributions of the project to sustainable development are as follows**:**

1. Environmental benefits:
Air quality improvement: The serious air pollution caused by coal based space heating will be significantly decreased by removing 142 small heating boiler houses and associated chimneys due to the proposed project activity.

2. Energy benefits:
Considerable energy conservation will be realized by introducing high efficient heat source from the CHP plant instead of the isolated inefficient boilers. It corresponds with the state's emission reduction strategies.

3. Social benefits:
By providing clear and convenient central heating, the project activity will significantly improve the residents' living standards and promote the local economic development.

A.3. Project participants:

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Table A.3. -1: Names of the project participants

Name of Party involved((host) indicates a host Party)	Private and/or public entity(ies) project participants (*)(as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (host)	Urumqi Heating Supply Co., Ltd.	No
United Kingdom of Great Britain and Northern Ireland	Carbon Resource Management Ltd	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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People's Republic of China

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

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Xinjiang Uygur Autonomous Region

A.4.1.3. City/Town/Community etc.:

>>
Urumqi City

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

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The project is located in Urumqi City, Xinjiang Uygur Autonomous Region, P. R. China, north to Hongshan Road, west to Hetan Road, east to the Eastern Cross-border Road and south to the railway of Xinjiang Huadian Hongyanchi Power Plant Co., Ltd.. It is about 8 km to the centre of Urumqi City, with a geographical coordinate E87°36’20”~ E87°39’25” and N43°43’56”~N43°49’31”.

Geographical location of the project is shown in the Figure A-1, Figure A-2 and Figure A-3.

Figure A-1: The location of Xinjiang, China

Figure A-2: The location of Urumqi, Xinjiang

Figure A-3: The location of the project activity

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

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Sectoral scope: 01 energy industry (non-renewable sources) Primary District Heating

The proposed project will supply space heating to residential and commercial buildings, where the heating source is predominantly from the CHP plant. Therefore the sectoral scope of the proposed project is energy industry.

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

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The technology employed in the scenario existing prior to the start of the implementation of the project activity is small isolated district heating network for existing residential and commercial buildings with area of 14,130,000 m^2 in total. The heat capacity of 333 boilers of small isolated boiler houses and 15 large boilers of 3 HOBs was listed in the annex 3 of PDD, and the amount heat supply for existing buildings was 10,804,357GJ. The heat for recently constructed buildings with total area of 840,000 m^2, which would be supplied by the existing isolated boiler houses in the absence of the Project, and the amount of heat supply for these buildings are 583,907GJ.The heat for new buildings with total area of 2,520,000 m^2 would be supplied by new isolated district heating network in the absence of the project activity, and the amount of heat supply for new buildings would be 1,751,720GJ. The information regarding the capacity, efficiency, construction time and remain lifetime for the existing heating boiler houses are provided in Annex 3. The maximum annual power generation, prior to the implementation of the project, provided by Xinjiang Huadian Hongyanchi Power plant (4*200MW) was 4,526,364 MWh. The main greenhouse gas is CO_2 sourced from coal consumption in boiler houses for heat supply and coal consumption in power plant for electricity production. The scenario existing prior to the start of the implementation of the project activity is as same as the baseline scenario identified in Section B.4.

The technology to be employed in the scenario of project activity is a new primary district heating system to replace the existing isolated small heating system. The main heat sources are delivered from the CHP plant with grid connected 4×200MW extraction condensing power units for cogeneration plus four heat-only boilers as supplementary heat sources. The total heating supply capacity of the primary district heating network is 1,445 MW, in which 754MW is from the CHP plant and 691MW is from the four heat only boilers, the 142 small inefficient boiler houses were replaced in the project. The project activity will provide the heat service with comparable quality level as the baseline scenario. It is estimated that when the project completed, the total area of 17,490,000 m^2 need 13,139,983 GJ heat annually, including 9,387,948 GJ from CHP plant, 3,752,035 GJ from the HOBs. The main emission sources involved in the project activity are sourced from coal consumption for generation of heat and electricity by CHP plant and coal consumption in heat only boilers that supply heat to the district heating system, and the main greenhouse gas emitted by the project activities is CO_2, as listed in Section B.3 in detail. The average annual CO_2 emission reductions are estimated as 1,155,074 t CO_2.

Figure A-4 below illustrates the structure of the primary heating network and the heating energy flows as well as the measurement points for heating supply from the CHP plant and heat only boilers to buildings ($Q_{j,i}$).

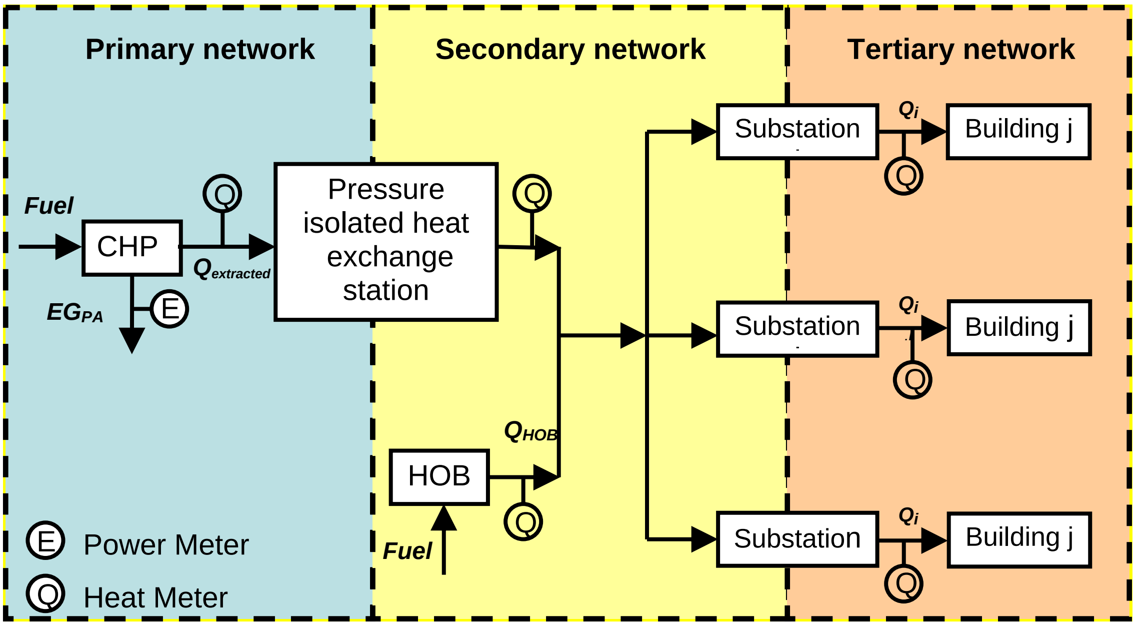

Figure A-4: Illustration of the southern district primary heating network

The Project employs an advanced and complex three level heating network. The southern district primary heating network consists of boiler thermal power system, heat supply and distribution network system, heat pipeline network monitoring and control system, etc. The major equipment includes the primary station (primary heat exchange station), the steam extraction device and pipeline, the pressure isolated heat exchange station, substations, frequency variable and speed adjusted monitoring and control system.

1. Boiler thermal power system (Primary network):

Primary heat source system: The primary heat source is extracted from an existing grid connected CHP with 4×200MW, and the steam extraction units installed in Xinjiang Huadian Hongyanchi Power Plant Co. Ltd. with 754MW of thermal power output, and also from four modern heat only boilers[2] to supplement heat from the CHP plant, as listed in Table A.4.3.-1.

Table A.4.3.-1 The installed capacity of the heat sources and their heat power output

Name	Xingjiang Huadian Hongyanchi Power Plant Co., Ltd.	Xingfu Road Boiler House	Guangming Road Boiler House	Xinsheng Boiler House	Weihuliang Boiler House
Installed capacity	4×200MW extrac-tion & condensing CHP units	6×29MW Heating boiler*	1×29MW, 5×46MW Heating boiler*	2×29MW, 1×14MW Heating boiler*	2×70MW,1×46MW Heating boiler*
Heating capacity	754MW	174MW	259MW	72MW	186MW

[2] Four large heat only boilers are identified as supplementary heat sources in the project. Among of them, Xingfu Road Boiler House, Guangming Road Boiler House and Xinsheng Boiler house were operated prior to the implementation of the project, i.e these three HOBs were existed in the baseline scenario. Weihuliang Boiler House was put into operation after extracting heat from the CHP, therefore, which is not baseline boiler house, i.e. it is not involved in the calculation of baseline emission reduction.

*: All boilers used in the HOB houses of project are hot water boilers.

The primary station (primary heat exchange station): equipped with steam-water heat exchanger, circulating water pump for the primary network, make-up water pump for the primary network, the water softened facility for the primary and secondary networks.

Steam extraction devices and pipes: Steam is extracted from steam turbine by the steam devices for heat supply, with steam parameter as: extracted steam pressure 0.294Mpa (1# and 2# Unit) and 0.6Mpa (3# and 4# Unit), extracted steam temperature 265℃. The extracted steam is connected, via the steam pipe, to the primary station (primary heat exchange station) installed in the CHP plant.

2. Heat supply and distribution network system (Secondary network):

Two level network systems are adopted in the supply and distribution network system, i.e. primary network system from outlet of the primary station (primary heat exchange station) to the pressure isolated heat exchange station, and the secondary network system from the pressure isolated heat exchange station to substations. Reason for adopting such two level heat supply mode is to isolate the adverse impact of static water pressure due to high altitude difference (163 m) between the primary heat exchange station and the end users on the distribution pipeline and substations. Technologically advanced pre-insulated tube (pipe) is used in the construction of the primary and secondary network, in which the primary network is 3.7 km long using DN1200 pipe; and the secondary network is 40.04 km long using DN 150 up to DN1200 pipe.

The heat exchange station:, The proposed primary district heating system is located in southern district of Urumqi where the altitude difference from the primary station to the end users is as large as 163 m which causes an technically adverse impact on material performance of the station facilities and the pipeline system and as well as on the stable operation of the whole system. Therefore, the pressure isolated heat exchange station has to be employed due to 163 m altitude difference, which is a project with largest altitude difference in China. It is installed in such a way so that their altitude difference from the primary station is 86 m and the rest altitude difference from the heat exchange station to the substation is 77 m accordingly.

Substation: This project is planned to install 193 substations, with total heat supply capacity 1445 MW. Within each substation, normally two or three heat exchangers are equipped in parallel. The major equipment in the substations, i.e. water pumps, will use efficient frequency variable and speed adjusted devices instead of low efficient one. (The exact number of substations installed will be updated depending on the real progress of the project implementation)

3. Heat pipeline network monitoring and control system (Tertiary network)

Three level monitoring system will be established for the heat pipeline network monitoring and control system, i.e. the main control center (MCC) will be set up at the dispatching center at the Company level; And the sub control center (SCC) will be set up at the pressure isolated heat exchange station; While the local control and monitor station (LCM) will be set up at the key branch point of the district heating network and at the substations. The computerized heating monitoring and control system (SCADA) will be installed to implement on-line heat transmission and regulatory, based on off-door ambient temperature and users demand.

The project involves technology transfer from abroad, since a pressure isolated heat exchange station equipment and dynamic hydraulic analysis software are imported from Denmark. Therefore, the implementation of the proposed project will promote the advanced technology transfer.

The technical parameters for the equipment involved in the project activity are listed in Table A.4.3.-2, A.4.3.-3, and Table A.4.3.-4.

Table A.4.3.-2: Equipment information of the CHP plant

Parameters	Unit	Indicators
Boiler		
Type	-	WGZ670/13.7-10 DG670/13.7-21
Manufacturer	-	Wuhan Boiler Co.,Ltd Dong Fang Boiler Group Co., Ltd
Number	-	4
Installed capacity	tonne steam/h	670
Efficiency of heating generation	%	91.2
Load factor	%	68.5
Age	Year	5
Lifetime	Year	30
Steam Turbines		
Type	-	N(C)200/160－12.75/535/535 C135/N200－12.7/535/535
Manufacturer	-	Harbin Turbine Co., Ltd Beijing Heavy Electric Machinery Works
Number	-	4
Power rating	MW	200
Heat output	tonne steam/h	613
Efficiency of electricity generation	%	43.94
Load factor	%	68.5
Age	Year	5
Lifetime	Year	30
Generator		
Type	-	QFSN-200-2
Manufacturer	-	Harbin Electric Machinery Co., Ltd Beijing Heavy Electric Machinery Works
Number	-	4
Power rating	MW	200
Rated speed of rotation	r/min	3,000
Efficiency of electricity generation	%	39.27
Load factor	%	68.5
Age	Year	5
Lifetime	Year	30
Primary heat exchange station		
Hot water circulating pumps		
Type	-	KQSN450 - N9/673T
Manufacturer	-	Shanghai Kaiquan Pump (Group) Co.
Number	-	4
Pump head	M	121
Heat output	m^3/h	2,500
Rated speed of rotation	r/min	1,480
Efficiency	%	85

Table A.4.3.-3: Heat only boilers information

Name	Total heating capacity	Type	Installed capacity of boiler	Number of boilers	Load factor	Efficiency	Age	Manufacture
Xingfu Road boiler house	174MW	DHL29-1.57/130//70-AIII	29MW	6	0.31	66.63%[3]	10	Shanghai Si Fang Boiler Works
Guangming Road boiler house	259MW	DHL29-1.57/130//70-AIII	29MW	1	0.19	71.84%[3]	8	Shanghai Si Fang Boiler Works
		DHL46-1.6/130//70-AIII	46MW	5				
Xinsheng boiler house	72MW	QXL29-1.25/130/70-AII	29MW	2	0.08	71.41%	10	Shenyang Boiler Works
		DZL14-1.0/130/90-AII	14MW	1				Shanghai Si Fang Boiler Works
Weihuliang boiler house	186MW	DHL70-1.6/130//70-AIII	70MW	2	0.05	87.00%	4	Shanghai Si Fang Boiler Works
		DHL46-1.6/130//70-AIII	46MW	1				

Table A.4.3.-4: Equipment information of pressure isolated heat exchange station

Name	Type	Number	Manufacturer
Plated heat exchanger	S188-IS20-345	12	SONDEX, Denmark

The primary district heating network consists of 193 substations at the designing stage on Sketch Map of the project. Because the project covers buildings with a large area, the amount of substations may be adjusted in the actual implementation of the project. The ex post calculation of emission reduction is based on the actual monitored number of substations.

Detailed information of monitoring equipments is described in B.7.

The baseline scenario is consists of two parts: for existing buildings the baseline scenario is continued operation of the isolated small coal fired boilers; for new buildings, the baseline scenario is establishment of a new isolated district heating networks with small coal fired boilers.

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

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The project applies the fixed 10 years crediting period from 15th October, 2011 to 14th October, 2021. The total emission reductions of CO_2 is estimated as 11,550,740tCO_2e over the crediting period, and

the annual average emission reductions during the crediting period is 1,155,074tCO_2e. Further information is given in Table A.4.4.-1.

Table A.4.4.-1: Estimated emission reductions during the crediting period

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
2011	1,097,647
2012	1,129,320
2013	1,165,472
2014	1,165,472
2015	1,165,472
2016	1,165,472
2017	1,165,472
2018	1,165,472
2019	1,165,472
2020	1,165,472
Total estimated reductions in tones of CO_2e	11,550,740
Total number of crediting years	10
Annual average of over the crediting period of estimated reductions in tones of CO_2e	1,155,074

*The period is in year wise, and starting and end date depending on the actual crediting period

A.4.5. Public funding of the project activity:

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No official development assistances from Annex I countries is involved in the proposed project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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(a) The following approved baseline and monitoring methodology is used:

- AM0058 Introduction of a new primary district heating system, version 03.1

(b) The following approved tools are used:

- Tool for the demonstration and assessment of additionality, version 05.2
- Combined tool to identify the baseline scenario and demonstrate additionality, version 02.2
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion, version 02
- Tool to determine the remaining lifetime of equipment, version 01

For more information regarding the methodologies, please refer to the following web link:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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

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The project complies with the applicability conditions of the methodology AM0058 "Introduction of a new district heating system" version 03.1. Details are as follows:

First of all, Southern District Heating Network in Urumqi City is a new primary district heating network which will supply space heating to residential and commercial buildings without supplying heat to industrial production in place of the small isolated heating network with inefficient boilers.

The heating source is predominantly from Xinjiang Huadian Hongyanchi Power Plant connected to Northwest China Power Grid with no heat extraction prior to the implementation of the Project, supported with four large heat only boiler houses as supplement. It is estimated that when the project completed, the CHP plant will supply 9,387,948GJ/y, the HOB will supply 3,752,035 GJ/y. Therefore, 71.45%, which is more than 50%, of the heat would be supplied predominantly from the CHP plant than from the four heat-only boilers.

The methodology is applicable to the project activity because it meets the applicability conditions as follows:

1. The geographical extent of the project boundary is clearly established, including the locations of existing and new buildings connected to the Urumqi Southern primary district heating system, and the boilers and the substations and connected isolated heating networks as well as the location and interconnections of heat extraction units at Xinjiang Huadian Hongyanchi Power Plant with 4×200MW are clearly identified, as described in Section B.3.

2. The power plant which supplies heat to the district heating network has been in operation for more than 3 years prior to the start of the project implementation. And there was no heat extraction from the power plant prior to the implementation of the Project. The power plant start operation in Sep. 2000 and the heat extraction started in Oct. 2005, the historic annual amount of electricity over the 3 most recent years prior to the implementation of the Project were 1,916,680 MWh, 2,077,238 MWh and 4,526,364 MWh in year of 2002, 2003 and 2004 respectively. The power plant operates in accordance with the following applicability conditions of AM0058 ver. 03.1:

(1) The heat is extracted from this coal fired CHP plant connected to the Xinjiang power grid which is a part of Northwest China Power Grid.
(2) Only coal is fired (less than 1% of auxiliary diesel is used for start-up, etc.) both in the baseline and project scenarios.
(3) The power plant start operation in Sep. 2000 and the heat extraction started in Oct, 2005. The technical lifetime of the CHP plant is 30 years before and after the implementation of project activity. After the implementation of the project activity, the heat is simply extracted from the steam turbine, which does not result in any major integrated production changes at the power plant. Therefore, the project activity does not lead to the increase in the technical lifetime of the CHP plant and does not result in any major integrated production changes at the CHP plant.

3. All fossil fuel fired heat only boilers operate according to the following conditions:

(1) The heat supplied to the district heating system is only used for space heating of buildings in the residential and commercial sector, but not for production processes.
(2) Only one type of fuel is used in each of the boilers included in the project boundary (less than 1% of auxiliary fuel is used for start-up, etc.).

The methodology does not account for the following potential emission reductions:

- Emission reductions resulting from the supply of hot tap water through the district heating system;
- Emission reductions resulting from the inclusion in the district heating system those areas, where in the baseline scenario heating was provided on an individual basis, e.g. by coal-fired stoves, electric appliances or boilers in individual apartments;
- Emission reductions resulting from heat supply to new residential areas, in cases where more than 50% of the annual heat production originates from heat-only boilers and less than 50% of heat comes from the power plant within the primary district heating system;
- Emission reductions resulting from a decrease in heat losses due to the water losses or from demand-side measures (e.g. insulation of buildings, use of thermostatic valves, behavioral changes due to billing practices).

For the emission reductions resulting from heat supply to new residential areas, more than 50% of the annual heat production originates from power plant within the Southern District Heating Network, thus the emission reductions resulting from heat supply to new residential areas should be claimed. The actual heat extracted from CHP and HOBs will monitored ex-post, in case where more than 50% of the annual heat production originates from heat-only boilers and less than 50% of heat comes from the power plant within the primary district heating system, the emission reductions for new residential buildings in that year can not be claimed.

In a word, the proposed project activity complies with the applicability conditions required by the approved baseline methodology AM0058, version 03.1.

In addition, the project activity also complies with the applicability conditions in the tools relevant to the approved baseline methodology AM0058.

B.3. Description of the sources and gases included in the project boundary:

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According to the approved baseline methodology AM0058, the physical delineation of the project boundary includes:

- The site of the CHP plant, including the 4×200MW cogeneration units and all interrelated production units, such as primary heat exchange station, extraction devices;
- The four heat only boiler houses that supply heat to southern district heating network as supplementary heat sources;
- The district heating network, including pipes, substations and buildings that are or will be connected to the district heating network.

The illustration of the project boundary delineation, and the heat measuring points of heat supply for substations (Q_i) and heat supplied by the CHP plant and large heat only boiler houses to the primary district heating system are shown in Fig. A-4 of Section A 4.3.

All heat supplied to final consumers will be measured at each substation i as part of the monitoring plan. For this purpose, each area that is supplied from a substation will have a unique identifier j.

The classification of the buildings about final consumers is shown in “B.4 baseline identification”.
The emission sources of GHG in the project boundary are described in Table **B.3.-1**.

Table **B.3.-1**: The emission sources of GHG in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Fossil fuel consumption for electricity production	CO_2	Included	Major emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption in boiler houses for heating supply	CO_2	Included	Major emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	Fossil fuel consumption for generation of heat and electricity	CO_2	Included	Major emission source.
		CH_4	Excluded	Minor emission source. Excluded for simplification.
		N_2O	Excluded	Minor emission source. Excluded for simplification.
	Fossil fuel consumption in heat-only boilers that supply heat to the district heating system	CO_2	Included	Major emission source.
		CH_4	Excluded	Minor emission source. Excluded for simplification.
		N_2O	Excluded	Minor emission source. Excluded for simplification.

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

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According to the approved baseline methodology AM0058 Ver.03.1, the steps for determination of baseline scenario prescribed by the latest version of "Combined tool to identify the baseline scenario and demonstrate additionality" (version 02.2) are applied as follows:

At first, under the building category *j*, the heat demand of which are met by existing isolated district heating network or by new isolated coal-fired boiler houses, is identified and described as follows[4]:
Category 1: 14,130,000 m^2 of the existing building area supplied by a sub-station that were connected to an existing isolated heat distribution network before the start of the project activity;

Category 2: 840,000 m^2 of building area, which were recently constructed buildings that are connected to sub-stations that replace old boiler houses, treated as existing buildings;

[4] Once an accurate and clear classification of categories *j* has been done on the basis of the baseline attributes, these categories *j* shall be assigned to specific points of heat measurement *i* corresponding to sub-stations introduced as result of the project activity. In particular, one small heating boiler houses in baseline scenario may be corresponding either to one building group j in one to one manner, or to several building group j(s). Also one substation i in project scenario may be corresponding either to one baseline small boiler house in one to one manner, or to several boiler houses (one vs. more) or *vice versa* (more vs. one) alternatively. The determination of baseline scenario shall describe the structural correspondence between the small isolated heating network in baseline scenario and the substation/secondary network in the project scenario, and the quantitative balance of thermal energy flow between them to secure that for given building group j the same end use space heating service level would be provided in both baseline scenario and the project scenario.

Category 3: 2,520,000 m^2 of new building area, which are constructed after the start of the implementation of the project activity, and they are connected to substations within the project activity boundary. These buildings are constructed in an area which prior to the project activity did not have any heat distribution network. So these buildings would have been supplied by establishment of new isolated coal-fired boiler houses in absence of the project activity.

All of these building categories mentioned above and the associated existing isolated district heating network (both existing and new buildings can be connected to an existing network) and establishment of a new isolated district heating networks (for new buildings) cover all buildings within the project boundary without the introduction of a primary heating network. And therefore they meet the criteria of the methodology. These building categories and associated isolated district heating network can be demonstrated by official documents, such as Heat Supply Boundary Sketch Map. Detailed information of the category of the buildings is provided in Annex 3. Dedicated document regarding the correspondence of buildings and substations as required by the methodology has been submitted to the DOE.

Step 1: Identification of alternative scenarios

Sub-step 1a: Define alternative scenarios to the proposed CDM project activity

According to methodology AM0058, all alternative scenarios that are available to the project participants and that provide outputs or services (such as space heating service) with comparable quality as the proposed CDM project activity, should be identified.

- The heating area of building category 1 is 14,130,000 m^2, the area of building category 2 is 840,000m^2, the area of building category 3 is 2,520,000m^2, the total heating area is 17,490,000m^2.
- The mean temperature during heating period is -7.4℃, the total heating period is 181 days, and heating target for the indoor temperature is not lower than 18℃.

For this purpose an overview of other technologies or practices used for generation of heat that have been implemented prior to the start of the project activity or are currently underway in the relevant geographical area, is summarized as follows:

The all plausible baseline alternatives for heat supply to buildings or sub-areas within the proposed project boundary, that can provide space heating services with comparable characteristics and quality as the proposed CDM project activity are assessed as following:

(1) Introduction of a new integrated district heating system(s) connected by a new primary network:
   (a) The proposed project activity undertaken without being registered as a CDM project activity;
   Undoubtedly, as the same engineering configuration, this is a realistic and credible alternative scenario remained for further analysis.
   (b) The introduction of a new district heating system, but with a different configuration for heat generation;
   As in China, the technologically possible configuration of the primary district heating network for heat generation is either large scale heat only boiler houses or CHP plants. Given that there has already been 4×200MW extractive condensing mode heat source in the Xinjiang Huadian Hongyanchi Power Plant sufficiently available for Southern district heating system, it is not reasonable economically to build another large scale heat only boiler houses to replace the existing CHP power plant. Also in view of fuel configuration, it would not be acceptable for the southern district heating system, as a kind of public utility, to use expensive oil or gas to

replace coal, considering the fuel resources and the heat supply cost. Other heat generation configurations, such as ground source heat pump or geothermal resources, are not commercially available or attractive in Urumqi to provide large scale district heating service[5] So (b) is not a realistic and credible alternative scenario.

(c) The replacement of the heat-only boilers in the existing network(s) by new heat-only boilers. The average remaining lifetime of the heat-only boilers in the existing network(s) is 14.92 years (refer to Annex 3 of PDD), exceeding the length of the crediting period of the proposed project activity (10 years). Therefore, it is not necessary for project owner to incur additional investment for new heat-only boilers to replace the heat-only boilers which still have a remaining life of more than 10 years. So case c) is not reasonable.

(2) Continued operation or rehabilitation of an existing [isolated] district heating network(s) (both existing and new buildings can be connected to an existing network) or establishment of a new isolated district heating network(s) (for new buildings) covering all buildings within the project boundary without the introduction of a primary heating network.

In general, the alternative (2), i.e. continued operation of the existing isolated district heating network(s) or establishment of a new isolated district heating network covering all buildings within the project boundary without the introduction of a primary heating network, is currently just the existing operation practice that of course is a realistic and reliable alternative scenario. In particular, such isolated district heating network(s) may employ the following technology options:

(a) Coal fired boilers in boiler houses, supplying several buildings through a small heat distribution network;
In southern district of Urumqi, there already exists such a small heat distribution network, and the common operation is also appropriate for the new buildings in further future. So (a) is a realistic scenario remained for further analysis.

(b) Natural gas fired boilers in boiler houses, supplying several buildings through a small heat distribution network;

(c) Oil fired boilers in boiler houses, supplying several buildings through a small heat distribution network;
For (b) and (c), there is a few individual oil-fired or gas-fired boilers used for specific heat purpose, such as for hospital needs for the whole year, etc, prior to the start of the project implementation, and hence they will not be connected to the primary heating network in the project scenario, and is outside of the project boundary. In general, they are not commonly used for heating supply, due to their much higher fuel prices than coal price. Therefore, oil or gas based space heating supply cost can not be accepted by consumers[6]. Actually the coal based heating system is the most common practice in Xinjiang and other cities in China.
For the establishment of a coal-fired new isolated district heating network without the introduction of a primary heating network is also reasonable for new buildings for the same reason as explained as above, So (b) and (c) are not realistic scenarios.

(d) Small decentralized cogeneration plants;
In the recent years, as the cost of coal continues to increase, while the electricity tariff and heat price are strictly regulated by the relevant government agencies, the small decentralized cogeneration plants are pushed into the plight of lacks of competitiveness which resulting in

[5] http://www.wlmqx.gov.cn/gov/ShowInfoContent.aspx?Info_ID=bc714a98-873a-4808-a63e-059cc3d96c0b

[6] Present condition and prospects for the heat system of gas. Li Xianrui, Liu Xiao, 2000.

Analysis of the thermal efficiency of natural gas and oil fired boilers and heat supply cost, Li Yingjian, Li Qun. Chemical engineering of oil and gas,2003.

occurrence of deficit, and even close-down of small cogeneration plants[7]. So (d) is not a realistic and credible scenario.

(e) Renewable energy sources, such as biomass or solar thermal collectors, connected to a small heat distribution network.
In the southern district of Urumqi City there is no existing renewable energy sources connected to the small heat distribution network, since Urumqi city is surrounded with Gobi desert without rich biomass sources or those far away which need expensive transport costs. And the solar thermal technology for heating is not commercialized due to their immature technology and therefore rather expensive for small heat distribution network. So (e) is not a realistic and credible scenario.

(3) Continued use or introduction of building isolated heating networks using:
(a) Coal fired boilers for individual buildings;
(b) Natural gas fired boilers for individual buildings;
(c) Oil fired boilers for individual buildings.

Prior to the implementation of proposed project activity, the isolated boiler houses were employed to supply heat for several buildings through a small heat distribution network rather than only for individual building. And it is confirmed by Heat Supply Administrative Office of Urumqi City that individual buildings using coal fired boilers, natural gas fired boilers and oil fired boilers for heating do not exist within project boundary. Thus, continued use or introduction of building isolated heating networks using boilers for individual buildings is not realistic one.

(4) Continued use or introduction of individual heat supply solutions:
(a) Coal fired stoves for individual apartments;
(b) Natural gas fired stoves for individual apartments;
(c) Oil fired stoves for individual apartments;
(d) Electricity (e.g. off-peak storage heating);
(e) Individual heating devices using renewable energy sources, e.g. solar thermal collectors;
(f) Individual heating devices using non-renewable biomass.

For 4 (a), (b), (c) using stoves for individual apartments are not realistic and reliable scenarios for the following reasons:

1) The consumers of the proposed project activity are public buildings, commercial buildings and residential buildings, and it is uncommon to use stoves for individual apartments at a large scale taking into account of influence on environment and safety and capacity of heat supply;

2) The coal fired stoves have lower efficiency, bring serious air pollution. Thus, in fact, the coal fired stoves for individual apartments are imposed restriction and only located in urban-rural integration area of Urumqi City. Moreover, the consumers using coal fired stoves for heating are characterized by scattered distribution, and whose houses are mainly one-story house, so such area is unlikely to meet the requirements of district heating, such as distribution of pipe network. Therefore, this alternative should be excluded.

3) The individual apartments are not allowed by the government regulation to use natural gas fired stoves for heating[8], thus, this alternative is not a realistic one.

4) It is economically impossible for households to use oil fired stoves for heating due to its high cost comparing with coal. Therefore, this alternative is not a realistic one.

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[7] *http://www.ndrc.gov.cn/xxfw/hyyw/t20051012_44968.htm*

[8] http://www.wszw.gov.cn/uploadimages/2007625162419106.doc

For (4) (d), the cost of individual electricity space heating will be too expensive[9] i.e. 50~70 Yuan/m^2 to users in comparison with coal based district heating cost 18~20 Yuan/m^2. So (4) (d) alternative is not a realistic scenario.

For (4) (e), i.e. individual heating devices using renewable energy sources, there is no commercialized individual space heating devices using solar thermal collectors and geothermal energy resource available in market in Xinjiang Urumqi. Also Urumqi city is surrounded with Gobi desert without rich biomass sources. Therefore (4) (e) alternative is not a realistic scenario.

For (4) (f), i.e. individual heating devices using non-renewable biomass is not ecologically acceptable, because Urumqi is surrounded by Gobi desert where ecological environment is rather poor, lack of green vegetation and non-renewable biomass resources. Therefore (4) (f) alternative is not a realistic scenario.

In summary, alternatives (3) and (4) are not realistic and credible alternative scenarios.

Outcome of Sub-step 1a:
According to the assessment as above, two realistic and credible alternative scenarios are identified as follows:

- 1(a): The proposed project activity undertaken without being registered as a CDM project activity. This alternative will employ coal based technology, i.e. a new primary district heating system with the main heat sources from the grid connected CHP plant plus four heat-only boilers as supplementary heat sources.
- 2(a) Continued operation or rehabilitation of the existing isolated district heating networks (both existing and new buildings can be connected to an existing network) or establishment of a new isolated district heating networks (for new buildings) covering all buildings within the project boundary without the introduction of a primary heating network. Such isolated district heating networks will employ coal based technology such as coal fired boilers in boiler houses, supplying several buildings through a small heat distribution network.

Sub-step 1b: Consistency with applicable laws and regulations

Introducing a primary district heating system with CHP plant as the main heat source that improves the energy efficiency of heating system and protects the environment is encouraged and promoted by the relevant national energy and environment policies and social-economic development plans in China, but is not subject to be mandatory under the applicable law and regulations. On the other hand, coal-fired small isolated district heating networks are still the prevailing technology in China which is not prohibited by the relevant applicable laws or regulations although its energy and environment performance is much less than introducing primary district heating system.

Outcome of Sub-step 1b:
Two scenarios, i.e. the proposed project activity undertaken without being registered as a CDM project activity and continued operation of the existing isolated district heating networks without introduction of a primary heating network are identified as realistic and credible scenarios which are consistent with relevant applicable laws and regulations in China.

Step 2: Eliminate alternatives that face prohibitive barriers
(Step 2: Barriers analysis as in the combined tools)

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[9] http://www.cmwin.com/CBPResource/StageHtmlPage/A256/A25620081108036375.htm

According to AM0058 (version 03.1), the latest version of "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 02.2) is used for barriers analysis as following.

Sub-step 2a*: *Identify barriers that would prevent the implementation of alternative scenarios

Technological barriers

The layout of the southern district primary heating network is south-north long rectangle wise. Its altitude difference from the main heat source to substation with lowest altitude is 163m, which is unique in both Xinjiang Uygur Autonomous Region and China. The risks of heating network with large altitude difference focus on following three aspects[10], firstly, network at lower altitude bears significantly higher pressure, the strength reserve of the pipes is small, and pressure will surpass limits when the pressure fluctuates; Secondly, network at higher altitude bears lower pressure, pressure allowance is small, and high-temperature water will be gasified when pressure fluctuates and water hammer (i.e. a pressure surge or wave) will occur. Thirdly, potential energy of water in the heating network with large altitude difference is large, water hammer accidents are prone to take place due to increase of transient pressure. The occurrence of water hammer damage accidents can not be ignored for heating network due to its adverse impact on the network system and personal safety.

The main heat source of the project activity is located at the absolute elevation of 1029m, while the substation with the lowest altitude is located at the elevation of 866m, thus the altitude difference from the main heat source to substation with lowest altitude is 163m. If the project activity adopts a two-level heating network, which is commonly used in China, the substation with lowest altitude would bear 1.5 MPa static pressure resulting from large terrain altitude difference. Such a high static pressure would pose a threat to safe operation of equipment, and may result in destruction of equipment due to excess pressure. And it may cause greater social adverse impact, like personal injury by gush of high temperature hot water, stopping of heating supply in winter and etc.

Taking the altitude difference and safety into consideration, the design institute adopted a three-level heating network rather than two-level heating network commonly and maturely used heating technology in China. The pressure isolated heat exchange station is to be built amid main heat source and substations, which is able to reduce the pressure. The pressure isolated heat exchange station is located 3.7km away from the main heat source at the elevation of 943m, and static pressure of the substation with lowest altitude reduces to 0.77MPa, which alleviates impact of pipe network and substations caused by high static pressure[11].

Compared with conventional two-level heating network's design and construction, three-level heating network's design and construction is significantly more difficult, and the difficulty factor of the proposed project is 1.15, while the difficulty factor of two-level heating network is 0.85-1.0 according to the regulations of "*Charge Standard of Engineering Investigation and Design*", issued by the State

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[10] *Further Explanation on the Technical Barrier of the Southern District Heating Network in Urumqi City*, Beijing Gas and Heating Engineering Design Institute

[11] *Further Explanation on the Technical Barrier of the Southern District Heating Network in Urumqi City*, Beijing Gas and Heating Engineering Design Institute

Planning Commission and Ministry of Construction in 2002[12], which was also confirmed by design institute. There are three levels of difficulty factor for municipal engineering project, namely, easy (I level), normal (II level), complex (III level), and difficulty factor of them are 0.85, 1.0 and 1.15 respectively stipulated in the *Charge Standard of Engineering Investigation and Design*. Therefore, technical difficulty inevitably leads to an unacceptable high risk of construction and operation of the proposed project.

Moreover, it is confirmed by Xinjiang Heating Supply Association that the proposed project is the first and sole project with three-level heating network in Xinjiang Uygur Autonomous Region[13], which thus lacks prevailing practice.

Outcome of Sub-step 2a:
The barriers identified are listed as follows:

163m of altitude difference results in adoption of three-level heating network, and the difficulty factor of the proposed project is significantly larger than that of heating project with two-level heating network. Moreover, the proposed project is the first and sole project with three-level heating network in Xinjiang Uygur Autonomous Region, which lacks prevailing practice.

Technological barrier related to large altitude difference and three-level heating network still has uncertainty and unpredictable risk because the proposed project is the first and sole project with three-level heating network in Xinjiang Uygur Autonomous Region. An investment analysis does not cover the full extent of technological and prevailing practice barrier, and technological barrier related to large altitude difference and three-level heating network cannot be fully represented as a cost, thus, it is identified as a barrier for implementation of the proposed project while conducting the barrier analysis.

In conclusion, due to its uncommon use in Xinjiang Uygur Autonomous Region and even in China, the proposed project definitely faces realistic technological barrier resulting from large altitude difference, three-level heating network and barrier due to lack of prevailing practice. Therefore, it is more likely to prevent normal implementation of the proposed project in terms of risks, difficulty factor and lack of prevailing practice, comparing with the two-level heating network, which is commonly and maturely used in Xinjiang Uygur Autonomous Region.

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers

As the barrier identified above would prevent and delay the implementation of the proposed project activity without being registered as a CDM project activity. Therefore the alternative scenario, i.e. the proposed project activity undertaken without being registered as a CDM project activity should be eliminated.

For the alternative scenario 2(a) (continued operation or rehabilitation of the existing isolated district heating network or establishment of new isolated district heating network), because the existing isolated district heating networks connected to isolated boiler house, covering a small area, did not face the high altitude difference and need not to adopt three-level heating network, the technical

[12] Table 7.3-3, *Charge Standard of Engineering Investigation and Design,*2002, State Planning Commission and Ministry of Construction

[13] *District Heating Project list in Xinjiang*, Xinjiang Heating Supply Association

barrier result from large altitude difference did not affect the implementation of this alternative scenario.

Outcome of Sub-step 2b:
For the proposed project activity, the only remaining alternative scenario not affected by barrier identified above is scenario 2(a): the continued operation or rehabilitation of the existing isolated district heating networks and establishment of a new isolated district heating networks (for new buildings) covering all buildings within the project boundary without the introduction of a primary heating network.

Therefore this scenario 2(a) is identified as the baseline scenario.

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

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The project activity started on Jan 14th, 2005, i.e. the starting date of the project activity when the main equipment purchase agreement was signed, and it was earlier than the date of the PDD's submission for validation by DOE. The project participant provided the following evidences to prove that the CDM had seriously been considered as an important incentive during the decision-making process for proceeding with the project, and that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation, as per CDM EB 49, Annex 22, as seen in the timeline table below:

On November 20, 2003, the kick-off meeting on China's CDM capacity building jointly sponsored by NDRC and International Economic and Technical Exchange Center, Ministry of Commerce was held in Beijing, where the project owner established awareness on climate change and relevant CDM. After then, the project owner further learned from China's Climate Change Website that CDM could provide a new financing mechanism and technology transfer pattern as well as a new opportunity of development for the enterprise.

On January 16, 2004, the project owners further enhanced their understanding on CDM by learning about national policies and international progress on CDM at a conference titled "CDM: Review and Outlook" sponsored by Energy Research Institute (ERI) of NDRC, held in Beijing. Please refer to CDM website.

In March 2004, it was found as stated in the feasibility study report (Revised Edition) on southern district heating network project prepared by Beijing Gas & Heat Power Project Design Institute, that the project was facing prohibitive financial barriers. Therefore it was proposed that the concessive term on heat source purchase price and preferential policies and regulation on taxation exemption be provided by the local government. And on the other hand, it was also recommended in the FSR that CERs revenue from CDM cooperation opportunity could mitigate the financial barriers for the project.

On April 15, 2004, the Board of Directors reached a consensus on the CDM opportunity that if the proposed project is registered as CDM, then the CERs revenues, as an additional financial source, could mitigate the financial barriers, so that CDM may secure the project activity be completed by scheduled plan and implemented smoothly.

In May 2004, the Danish COWI Consultant Company submitted a proposal on new baseline methodology "Introduction of a new primary district heating system" (NM0058) based on Houma District Heating Project in Shanxi Province, China. Considering the similarities in technical

configuration and operational conditions and the financial barriers between two projects as well, the project owner decided to designate staff responsible for tracking the progress on the methodology proposal NM0058 considered by Meth. Panel.

On July 8, 2004, the CDM consultation cooperation agreement, titled "CDM consultation cooperation agreement on Urumqi Southern Primary District Heating Network Project", was signed between Urumqi Heating Supply Co., Ltd. and Beijing Huaxia Zhengtian International Info. Cons. Co., Ltd. by which the letter was entrusted as CDM consultation entity to develop the project activity as a CDM project.

During the period between 2005 and 2007, the initial development of the CDM PDD for the proposed project is ongoing continuously, as evidenced by meeting minutes available at that time, even though the proposed new baseline methodology was under consideration by the Meth. Panel. Meanwhile the experts of the project developer also keep close contact with the COWI Company regarding the status and progress of the proposed baseline methodology.

In October 2007, the proposed baseline methodology AM0058 based on Houma District Heating Project was approved at EB35 meeting. Since then, the CDM PDD development and associated CDM application for the proposed project were put on the agenda officially.

The timeline Table B.5.-1 is listed below which shows that the CDM as an important financial incentive was seriously considered by the project participant during the process of decision to proceed with the project, prior to the start of the proposed project activity, and continuing and real actions were taken as well to secure CDM status for the project in parallel with its implementation.

Table B.5.-1: Timeline of the Proposed Project Activity

Date	Key Events	Supporting Documents
20/11/2003	First time to consider CDM	The kick-off meeting on China's CDM capacity building
16/01/2004	CDM conference organized by ERINDRC	The news from the website
03/2004	Consider CDM support	P20 of the FSR Revised Edition
15/04/2004	Board meeting to reach an agreement on CDM project application	Minutes of meeting
05/2004	EIA	EIA submitted
06/2004	EIA approval	Approval of EIA issued by Xinjiang Environmental Protection Bureau
08/07/2004	Project owner signed consulting contract with Consultant	Framework Agreement
15/10/2004	Preliminary study on the feasibility of CDM project	Minutes of meeting
15/12/2004	Discuss the reasons of Houma project frustrated	Minutes of meeting
11/01/2005	Discuss the development of methodology baseline	Minutes of meeting
14/01/2005	Starting date of project activity	The first main equipment contract signed for southern district primary district heating network.
04/04/2005	Construction contract of pipe network was signed	Construction contract of pipe network
04/2005	Signed PDD development	Letter of appointment

	consultancy contract	
15/07/2005	Discuss the reasons of Houma project frustrated secondly	Minutes of meeting
15/10/2005	Started extracted heat from the CHP plant	Monthly operation records of the CHP plant
23/12/2005	Experts Workshop on Methodology	Minutes of meeting
28/03/2006	Discussion on primary heating system methodology for new ideas	Minutes of meeting
29/10/2006	Discuss new methods on heating network in Urumqi CDM project and track the latest developments of the proposed methodology	Minutes of meeting
20/12/2006	Project progress and data collection	Minutes of meeting
05/01/2007	Term sheet with Arreon Carbon UK	Letter of intent signed with Arreon Carbon
14/03/2007	Experts Meeting	Minutes of meeting
05/2007	Investigated the Houma project proposed under the methodology NM0181	E-mails
01/2008	Contact with CRM	Due diligence checklists
23/05/2008	ERPA	ERPA signed with CRM.
24/06/2008	Participate in the NDRC meeting for approval	http://cdm.ccchina.gov.cn/web/index.asp
22/08/2008	Received LoA from NDRC	LoA document
02/09/2008	The PDD was webhosted in EB's website for validation	website of EB http://cdm.unfccc.int/Projects/Validation/DB/H1BYZ2UEIVYE999VGCLRII7KDWW7VT/view.html
24/08/2009	Received LoA from UK's DNA	LoA

According to the approved baseline methodology AM0058, Ver. 03.1, the latest "Tool for the demonstration and assessment of additionality" (version 05.2) approved by the CDM EB is used as follows:

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

Define realistic and credible alternatives to the project activity through the following Sub-steps:

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

As described in Sub-step 1a of B.4. Section of the PDD, two realistic and credible alternative scenarios was identified as follows:

1) The proposed project activity, without being registered as a CDM project;
2) The continued operation or rehabilitation of the existing isolated district heating networks and establishment of a new isolated district heating networks (for new buildings) covering all buildings within the project boundary without the introduction of a primary heating network

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

Also as described in Sub-step 1b of Section B.4 of the PDD, two scenarios, i.e. the proposed project activity undertaken without being registered as a CDM project activity and continued operation of the existing isolated district heating networks without introduction of a primary heating network are identified as realistic and credible scenarios which are consistent with relevant applicable laws and

regulations in China. Therefore the proposed project activity without being registered as CDM is not only one remained that is in compliance with applicable mandatory laws and regulations in China.

Step 2: Investment analysis

This Step 2 will demonstrate the proposed activity is not financially feasible, without the revenue from the sale of CERs, and when applying this Step 2, the guidance provided by the Board on investment analysis is taken into account as below.

Sub-step 2a: Determine appropriate analysis method
The three analysis methods are suggested by "Tools for the demonstration and assessment of additionality".
Option I. Simple cost analysis;
Option II. Investment comparison analysis;
Option III. Benchmark analysis.

Since the proposed project will generate financial benefits from sale of the space heating supply, other than the CDM related income, then the simple cost analysis method is not applicable.

The baseline scenario is the continued operation of existing isolated small heating network by using coal-fired boiler houses, belonging to different owners covering all buildings within the project boundary, which can provide the same service as the Project. For the Project Owner, there was the choice to invest or not to invest. Therefore benchmark analysis would be applicable according to *Guidelines on The Assessment of Investment Analysis* (Annex 58, EB51)

Sub-step 2b: Option III. Apply benchmark analysis
The financial indicator, project Internal Rate of Return (project IRR), is identified as most suitable one for the project type and decision context, because IRR is widely used for assessing the investment performance for the capital construction project in the infrastructure field like the district heating project. In fact, IRR has been used in the FSR for the proposed project.

Given that the government/official approved benchmark is not available during the FSR development period, the commercial loan rate (5.76%) at the time of FSR was prepared was adopted as benchmark in consideration of conservative principle for the investment analysis.
Sub-step 2c: Calculation and comparison of financial indicators:
The calculation and comparison of financial indicator IRR of the proposed project are based on the major data and parameters as listed in Table B.5.-2.

Table B.5.-2: Main parameters for calculation of financial indicators

No.	Item	Unit	Amount	Source
1	Total static investment	10000Yuan	118,457	FSR P28
2	Heat purchase price	Yuan/GJ	15	FSR P81
3	Heating price (for annual heating season)	Yuan/m^2	22	FSR P82
4	Total heating area	m^2	17,490,000	FSR P8
5	Heating period	day	181	FSR P12
6	Annual heat purchase cost (in full operation)	10000Yuan	15,870	FSR P30
7	Annual O&M cost (excluding the heat purchase cost)	10000Yuan	8,621.3	FSR P30

8	Depreciation rate of the fixed assets	%	4.75	FSR P81
9	Project life time	year	22	FSR P81
10	VAT rate	%	13%	FSR P81
11	Urban maintenance and construction rate	%	7%	FSR P81
12	Surtax rate for education	%	3%	FSR P81
13	Income tax rate	%	33%	FSR P82
14	The payment rate of heat fee	%	90%	FSR 19
15	Bank loan rate	%	5.76%	FSR P80
16	Expected CERs price	€/t CO_2	9.8	Assumed

Comparison of IRR with the benchmark value for the proposed project

According to benchmark analysis in the absence of CDM, the financial indicator, i.e. project IRR is calculated as 3.56% which is lower than the IRR benchmark value 5.76 %. Therefore the proposed project activity is considered to be not financially attractive.

In case the CDM CERs revenue is considered, then the calculated project IRR is increased to 8.74% which is higher than the IRR benchmark value 5.76%. Therefore the proposed project activity would become financially attractive as shown in Table B.5.-3 below.

Table B.5.-3: Financial indicator IRR of the proposed project

Item	Project IRR
Benchmark value	5.76 %
IRR without CDM CERs revenue	3.56 %
IRR with CDM CERs revenue	8.74%

Sub-step 2d: Sensitivity analysis

As per the guidance on assessment of investment analysis, parameters that constitute more than 20% of either total project costs or total project revenues shall be included in the sensitivity analysis and the proposed project activity which is a public service utility for space heating, is capital and energy intensive project with prices being highly sensitive to the project owner, therefore the following six parameters are identified as critical variables for sensitivity analysis:

1) Total static investment
2) Heating price
3) Heat purchase price
4) Heating area
5) O & M costs (excluded the heat purchase cost)
6) Quantity of heat purchased

Detailed results of sensitivity analysis for the six key parameters are shown in Table B-5 and Figure B-2 as follows.

Table B.5.-4 Sensitivity of total investment IRR to different financial parameters

Range / Parameter	-10%	-5%	0%	5%	10%

Total static investment	4.71%	4.11%	3.56%	3.06%	2.59%
Heating price	0.33%	2.12%	3.56%	4.90%	6.19%
Heat purchase price from the CHP plant	4.73%	4.15%	3.56%	2.95%	2.30%
Heating area	2.54%	3.24%	3.56%	3.86%	4.18%
O & M costs*	4.81%	4.19%	3.56%	2.92%	2.27%
Quantity of heat purchased	4.33%	3.95%	3.56%	3.16%	2.76%

* excluding the heat purchase cost

Alternatively, when the project IRR is equal to the benchmark, the variations of critical parameters are shown in the table B.5.-5 below:

Table B.5.-5 Parameter variation when proposed project IRR is equal to the benchmark

Parameters	Total static investment	Heating price	Heat purchase price from the CHP plant	Heating area	O & M costs*	Quantity of heat purchased
Parameter variation	**-17.8%**	**8.3%**	**-19.3%**	**35.1%**	**-17.8%**	**-29.3%**

* excluding the heat purchase cost

As for total static investment, it is unlikely to decrease by 17.8% due to the continuous increase in material and labor costs etc. in China. According to the National Bureau of Statistics of China, the procurement price index for material, fuel and power was increased by 8.3%[14], 6.0%[15] and 4.4%[16] nationwide during the year 2005, 2006, and 2007, respectively. As the same, decreasing the heat purchase price from the CHP plant almost by 17.8% is unreasonable and impossible. In fact, the actual heat purchase price keeps consistent with that in FSR, which is confirmed on the heat purchase invoice, thus it is unlikely for heat purchase price to be dropped down.

When the annual O&M cost reduces by 17.8%, the IRR will reach to the benchmark. The annual O&M cost composes of material fee, repairing fee and the payment for the workers etc. All these elements are the basic expenditure for operation and maintain of the project activity. Therefore, decreasing the O & M costs by 17.8% is not practical reality.

When heating price increases by 8.3% in the whole operational lifetime, the project IRR will reach to 5.76%. However, the heating price to the consumers are carefully formulated and strictly controlled by the government. Once the heating price is defined, it is not allowed for heating company to raise the heating price[17]. Actually, during the past eight years (2003-2010), the heating price keeps fixed[18]. Moreover, According to a latest control measures announced by the State Council on 14th January 2008 regarding monitoring of the price control and management[19], the price in the certain fields (including heat supply) is not expected to be increased in the near future. Therefore, it is very unlikely that the heating price will be fluctuated by 8.3%.

When heating area increases by 35.1% in the whole operational lifetime, the IRR will reach to

[14] http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20060227_402307796.htm
[15] http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20070228_402387821.htm
[16] http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20080228_402464933.htm

[17] http://www.sdpc.gov.cn/zfdj/jggg/zyfw/t20070613_141196.htm
[18] http://www.xjpi.gov.cn/zcfg/new111.php?id=81; http://urumqidrc.gov.cn/uploadfiles/2010-9/2010914164828376.xls

[19] http://www.gov.cn/ldhd/2008-01/14/content_857704.htm

benchmark. The total heating capacity of all heat sources involved in the Project is 1445MW, while the total design heating load of the Project is 1323 MW. The heating load will be beyond the total heating capacity of all heat sources when heating area increases by 35.5%. Therefore, it is unlikely to enlarge the heating area with increased area of 35.1%.

When quantity of heat purchased from CHP decreases by 29.3%, the IRR will reach to the benchmark. However, the total heating capacity of the Project is 1445MW, and the total design heating load is 1323 MW. The total heating capacity is only 9.2% higher than the design load. It is estimated that the project is to need 13,139,983 GJ heat after its full completion, including 9,387,948 GJ from CHP plant and 3,752,035 GJ from HOBs. Taking 29.3% of decrease of heat purchase into account, the heat from HOBs would be increased by 73.3%, it is impossible for HOBs to increase heat supply to a large extent considering coal price, thus the quantity of heat purchased is unlikely to decrease by 29.3%.

In sum, the above sensitivity analysis by altering six critical parameters clearly demonstrates that without CDM support, the proposed project are not financial attractive.

Step 3: Barriers analysis

It is not applied.

Step 4: Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity:

The other activities similar to the proposed activity in Xinjiang should in according with the conditions below:

1) They use the broadly similar technology, i.e.: primary district heating system network using heat from cogeneration power plant;

2) Xinjiang is decided as the geographical boundary for common practice analysis. The reasons are as follows:

The investment environment for each province in China is different. This is due to a variation of available natural resources (including coal), the economic development level, the industrial structure, the fundamental infrastructure, development strategy and the policy framework. These all affect the demand for heating service in terms of the service level, the types of heating service and heating technologies. As such a number of key economic factors vary from province to province, including tariff rates of heat supply, the cost of materials including coal fuel, the cost of electricity and other utilities such as water, the cost of labor and services and the types of loan that can be obtained. These all vary between provinces. Therefore China cannot be considered to be a homogeneous country and Xinjiang whose area takes up about one-sixth of China is decided as the geographical boundary.

3) They are of the similar scale in terms of the heating supply building areas in the range of 6 million m^2 to 27 million m^2.

Based on the above principles, there are 2 projects listed below similar to the proposed activity[20]:

Table B.5.-6 Similar projects to the proposed activity

[20] Evidence from Xinjiang Heating Supply Association

No.	Enterprise	Space heating area million m^2)
1	Western district heating project in Shihezi City	6
2	Southern district heating project in Shihezi City	7

The proposed project is the largest primary district heating network using cogeneration plant in Xinjiang, and space heating service for 17.49 million m^2 building areas.

Sub-step 4b Discuss any similar Options that are occurring:

The essential distinctions between the project and the identified similar projects are specified as following:

The proposed project is the first and only project with a three-level heating network in Xinjiang Uygur Autonomous Region, which lacks prevailing practice, while the two projects identified adopted two-level heating network, which is commonly and maturely used in Xinjiang Uygur Autonomous Region.

The proposed primary district heating system is located in southern district of Urumqi where the altitude difference from the main heat source to the substation with lowest altitude is as large as 163 m which causes technically adverse impact on substations and the pipeline system as well as on the stable operation of the whole system. Therefore, in order to avoid occurrence of water hammer damage accidents, the three-level heating network has to be employed, while other two projects adopted two-level heating network due to no existence of large altitude difference. Compared with conventional two-level heating network's design and construction, three-level heating network's design and construction is more difficult, and the difficulty factor of the proposed project is 1.15, which is only project with highest difficulty factor in heat supply sector in Xinjiang Uygur Autonomous Region, while the difficulty factor of other projects is 0.85-1.0. The difficulty factor of the proposed project is larger than that of other two similar projects. Thus, technical difficulty inevitably leads to an unacceptable high risk of construction and operation of the proposed project.

Therefore, the proposed project is not a common practice.

In summary, it is concluded that the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Baseline emissions

The proposed project activity is introduction of the Urumqi southern district primary district heating system with the major heating source supplying from the CHP plant. According to the applicable baseline methodology AM0058 (version 03.1), the identified baseline scenario is continuation of current space heating service by existing isolated small coal fired boiler heating system and existing electricity generation by the CHP plant under the pure condensing condition. Therefore baseline emissions of the proposed project activity include CO_2 emissions from small coal fired boilers for the heat generation and CO_2 emissions from the CHP plant for electricity generation. The detailed formulas for calculation of the same are as follows:

$$BE_y = BE_{HG,y} + BE_{EL,y} \tag{1}$$

Where:
BE_y Baseline emission during the year y, (tCO_2e);
$BE_{HG,y}$ Baseline emissions from the generation of heat during the year y (tCO_2e);
$BE_{EL,y}$ Baseline emissions from the generation of electricity during the year y (tCO_2e).

For the estimation of baseline emissions from the generation of heat the following stepwise approach is applied.

Step 1: Baseline emissions from heat generation

Baseline emissions from heat generation are estimated as follows:

$$BE_{HG,y} = \sum_i \sum_{j\in 1} Q_{j,i,y} \times EF_{BL,HG,j,i} + \sum_i \sum_{j\in 2} Q_{j,i,y} \times EF_{BL,HG,j,i} + \sum_i \sum_{j\in 3} Q_{j,i,y} \times EF_{BL,HG,j,i} \quad (2)$$

Where:
$BE_{HG,y}$ Baseline emissions from the generation of heat during the year y (tCO_2e);
$Q_{j,i,y}$ Estimated quantity of heat supplied from substation i to buildings in category j in the year y (GJ);
$EF_{BLHG,j,i}$ CO_2 emission factor for heat generation for building category j connected to substation i in the absence of the project activity (tCO_2/GJ);
j All categories included in the project boundary defined as combination of building type /technology of boiler/fuel used in boiler/boiler house as described in B.4 Section;
i All substations included in the project boundary, the detailed information could be found in Annex 3.

The value of heat supplied in the project activity in year y to category j buildings supplied by substation i is estimated as follows:

$$Q_{j,i,y} = \frac{A_{j,i}}{\sum_j A_{j,i}} \times Q_{i,y} \quad (3)$$

Where:
$A_{j,i}$ Carpet area of buildings in category j connected to substation i, the detailed information about carpet areas of buildings are listed in Annex 3.

$Q_{i,y}$ The measured quantity of heat supplied by substation i in year y (GJ).

In case estimating the baseline emissions from heat generation in the PDD, the $Q_{i,y}$ is calculated ex-ante as follows[21]:

$$Q_{i,y} = \sum_j A_{j,i} \times W_{j,i,y} \times T_y \times 3.6 \quad (3.1)$$

Where:
$Q_{j,i,y,cal}$ The estimated quantity of space heating demand to be supplied by substation i for category j in year y (GJ);
$W_{j,i,y}$ The index of mean load for heating of building for category j buildings connected to substation i (W/m^2).;
T_y The space heating supply period in year y (hr); the proposed project is located in Urumqi city, according to the local regulation, the space heating supply period begin from 15th Oct. to the next 15th Apr., amounting to 181 days, i.e. 4344 hours.

[21] Please refer to footnote #2.

The index of mean load for heating of building ($W_{j,i,y}$)is determined by the following formula:

$$W_j = \frac{T_N - T_P}{T_N - T_W} \times w_j \qquad (3.2)$$

Where:

T_N The indoor mean air temperature in the period of heat supply (18℃ according to national standard and local regulation)

T_P The mean outdoor temperature in the period of heat supply(-7.4℃ for Urumqi city from FSR)

T_W The outdoor design temperature in the period of heat supply(-22℃ for Urumqi city from FSR)

w_j The index of design load for heating of building (77w/m^2 for existing buildings(Building Category 1), 70w/m^2 for new constructed buildings and new buildings(Building Category 2 and Category 3) sourced From FSR)

Thus, it is calculated that the index of mean load for heating of building for Building category 1 and for Building category 2 and category 3 are 48.895w/m^2 and 44.45w/m^2 respectively.

(a) For the cases where the category j consists of existing buildings, as per the definition provided earlier in the procedure for the identification of the baseline scenario, the quantity of heat supplied to this category from substation i should be estimated as follows:

$$Q_{i,y} = min\ \{Q_{inst\_cap,j,i}, Q_{i,y}\} \qquad (4)$$

Where:

$Q_{inst\_cap,j,i}$ Maximum quantity of heat that could have been supplied per year by existing boiler(s) supplying to category j building within the area supplied by substation *i* in the absence of the project activity, (GJ), where '*j*' belongs to set of all categories of 'existing buildings' within the substation i.

The detailed definitions of existing buildings and new buildings in the project activity are listed in B.4 Section.

The maximum quantity of heat $Q_{inst\_cap,j,i}$ is determined by multiplying a nameplate capacity value $CAP_{j,i}$ of the boiler supplying to building type j at substation i with *T*, the number of operational hours per year.

$$Q_{inst\_cap,j,i} = CAP_{j,i} \times T \qquad (4a)$$

The detail calculation for the $Q_{i,j,y}$ can be found in Table 3 of Annex 3.

The nameplate capacity value of the boiler reflects the maximum heating supply capacity of the boilers on supply side. And the $\boldsymbol{Q_{j,i,y}}$ reflects the space heating load demand by the connected buildings on demand side, either in *ex post* measured value or weighted average value calculated *ex ante*. Formula (4) secures the energy balance, i.e. the space heating load demand shall be restricted with the boiler's maximum heating capacity.

There are four situations regarding the corresponding relationship of baseline boiler houses and substations for the existing buildings, the quantity of heat supplied by substation i and corresponding capacity of boiler houses is determined as follows:

a. Substation in the project connected to existing buildings supplied by only one boiler house in

baseline scenario (one vs one): $Q_{i,y}$ equals the quantity of heat supplied by the substation. *CAP* should be the sum of nameplate capacity of all boilers in the boiler house.

b. Substation in the project connected to buildings supplied by several boiler houses separately in baseline scenario (one vs more): $Q_{i,y}$ equals the quantity of heat supplied by the substation. *CAP* should be the sum of nameplate capacity of all boilers in the corresponding boiler houses.

c. Substation in the project connected to partial buildings supplied by one boiler house in baseline scenario (more vs one): $Q_{i,y}$ equals the sum of quantity of heat supplied by the corresponding substation. *CAP* should be the sum of nameplate capacity of all boilers in the boiler house.

d. Substation in the project connected to partial buildings supplied by several boiler houses in baseline scenario (more vs more): $Q_{i,y}$ equals the sum of quantity of heat supplied by the corresponding substation. *CAP* should be the sum of nameplate capacity of all boilers in the corresponding boiler houses.

(b) For the cases where category j consists of new buildings, as per the definition provided earlier in the procedure for the identification of the baseline scenario, the quantity of heat supplied to this category is estimated as follows:

If $Q_{extracted,y} < Q_{HOB,y}$, *then* $Q_{j,i,y} = 0$;

If $Q_{extracted,y} > Q_{HOB,y}$, *then* $Q_{j,i,y}$ *is calculated by the formula (3)as above.*

Where:

$Q_{extracted,y}$ = Quantity of heat extracted from the CHP plant during the year *y*, (GJ)

$Q_{HOB,y}$ = Total quantity of heat extracted from all heat-only boilers supplying to the area covered by primary network during the year *y*, (GJ)

In the case of proposed project, according to the evidence of Beijing Gas & Heat Power Project Design Institute, the total quantity of heat extracted, i.e. $Q_{extracted,y}$ supplying to the area covered by primary network, is estimated as 9,387,948 GJ. The maximum total quantity of heat extracted from those HOBs, i.e. $Q_{HOB,y}$, would be 3,752,035 GJ. Therefore $Q_{extracted,y}>Q_{HOB,y}$, and $Q_{j,i,y}$ is estimated as per equation (3) as above. The estimated annual heat extraction for each sub-station is listed in Table 3 of Annex 3.

Step 2: CO_2 emission factor for heating supply in the baseline

CO_2 emission factor for the heat generation in the baseline ($EF_{BLHG,j,i}$) are identified for each category j. The CO_2 emission factor is influenced by the following factors:

- The efficiency of the identified baseline technology, i.e. coal fired space heating boilers ($\varepsilon_{HG,BLj,i}$);
- Coal is identified as the baseline fuel type, the CO_2 emission factor of this fuel is $COEF_{BL,HG,j,i}$.

$EF_{BL,HG,j,i}$ is determined as follows:

$$EF_{BL,HG,j,i} = \frac{COEF_{BL,HG,j,i}}{\varepsilon_{BL,HG,j,i}} \tag{5a}$$

Where:

$EF_{BL,HG,j,i}$ CO_2 emission factor for the heat generation system corresponding to substation *i* for category *j* in terms of technology and fuel type in the absence of the project activity, (tCO_2/GJ);

$COEF_{BL,HG,j,i}$ CO_2 emission factor of the fuel coal used in the absence of the project activity in the heat generation system corresponding to substation *i* (tCO_2/GJ);

$\varepsilon_{HG,BL,j,i}$ Energy efficiency of the space heating boiler system *i* that would be used in the absence of the project activity for buildings in category *j*.

Sub-Step 2a: Emission factor of fuel(s) used

For all categories *j*, the identified baseline scenario is continued operation of the existing isolated district heating networks (both existing and new buildings can be connected to an existing network) or establishment of a new isolated district heating networks (for new buildings) using coal as fuel, covering all buildings within the project boundary without the introduction of a primary heating network. Thus $COEF_{BL,HG,j,i}$ is determined corresponding to the identified fuel coal.

For all new buildings *j* within the project boundary, the major heat source is extracted from the CHP plant, supplemented by coal fired peak load heat only boilers. Based on common and prevailing practice in China, their baseline scenario remains isolated coal fired boiler based small district heat distribution network, therefore their emission factor is coal emission factor ($COEF_{BL,HG,j,i}$), in tCO_2/GJ. IPCC default value of emission factor of coal will be used as per the methodology.

Sub-Step 2b: Efficiency of boilers used in the absence of the project activity

The efficiency of the boilers that would have been used in the absence of the project activity in boiler houses ($\varepsilon_{HG,BLj,i}$) is determined for each category j and each substation i and once determined, $\varepsilon_{HG,BLj,i}$ remains fixed for the duration of the crediting period.

According to AM0058, Ver.03.1,$\varepsilon_{BL,HG,j,i}$ can be determined using the following approaches:

- Conduct a representative number of sample measurements of $\varepsilon_{BL,HG,j,i}$ for similar boiler types;
- Use documented manufacturer's data on the boiler efficiency;
- Use the default values;
- Determine based on historical fuel consumption data.

Based on the historical survey for small heating boilers available from the Attachment of FSR[22], where historical data regarding the boiler capacity, fuel consumption and the building area connected for each boiler category *j* are provided, the $\varepsilon_{BL,HG,j,i}$ can be determined using following formula:

$$\varepsilon_{BL,HG,j,i} = \frac{Q_{out,j}}{Q_{in,j}} = \frac{W_j \times A_j \times T \times 3.6 \times 10^{-6}}{FC_{fuel,j} \times NCV_{fuel,j}} \quad (5b)$$

Where:

$\varepsilon_{BL,HG,j,i}$ Energy efficiency of the space heating boiler system *i* that would be used in the absence of the project activity for buildings in category *j*.

$Q_{out,j}$ The space heating supplied to the building category *j* (GJ)

$Q_{in,j}$ The quantity of heat from coal consumption by the boiler category *j* (GJ)

W_j The index of mean load for heating of building for building category *j* (W/m^2), it is calculated as per formula 3.2 that the average heating load for existing buildings is 48.895w/m^2.

[22] Usually, there are several boilers in one boiler house, it is impossible to calculate the efficiency of individual boiler because the coal consumption and the heat supplied was not monitored separately for each boiler. Hence, annual total heat supplied and consumed coal of boiler house can be used for determination of efficiency of boiler house. Two boiler houses No. 144 and 145 were determined by the actual monitored total heat and actual total coal consumption. And for the other small boiler houses and the Boiler house No. 140, because there were no heat meters to monitor the actual total supplied heat in the baseline scenario, supplied heat by boiler houses is able to be calculated based on its heating area. Then the efficiency of other small boiler houses and Boiler house No.140 can be determined as per formula 5b.

A_j	Building area (carpet area) for the building category *j* (m^2)
T	Operation hours of the boiler category *j* during the space heating period (4344 hours)
$FC_{fuel,j}$	Historical coal consumption by boiler category *j* (t)
$NCV_{fuel,j}$	Net calorific value of standard coal equivalent, which is 29.27GJ/t[23]

According to Heating Supply Engineering published by China Machine Press in 2008, calculation of heat supplied by boiler by using formula 5b is extremely reasonable and accurate, with the error less than 1%. Therefore, the efficiency of boilers of the Project is to time conservative factor of 101% for calculating the baseline emission reduction in a conservative way, which is as follows.

$$\varepsilon_{BL,HG,j,i} = \frac{Q_{out,j}}{Q_{in,j}} = \frac{W_j \times A_j \times T \times 3.6 \times 10^{-6} \times 1.01}{FC_{fuel,j} \times NCV_{fuel,j}}, j \in i, fuel = coal \quad (5c)$$

The efficiencies for each boiler house are calculated and listed in Annex 3 of the PDD. The detailed calculation refers to ER spreadsheet.

For existing building category 1 and category 2, because one substation in the project may be corresponding either to one baseline boiler house in one to one manner, or to several boiler houses (one vs. more) or vice versa (more vs. one) alternatively, in order to calculate$\varepsilon_{BL,HG,j,I}$ clearly and transparently, it will be classified based on the correspondence between substation in the project and baseline boiler house:

a. Substation in the project connected to existing buildings supplied by only one boiler house in baseline scenario (one vs one): $\varepsilon_{BL,HG,j,I}$ equals to the efficiency of each corresponding boiler house;

b. Substation in the project connected to buildings supplied by several boiler houses separately in baseline scenario (one vs more): $\varepsilon_{BL,HG,j,I}$ should be determined by maximum efficiency of involved boiler houses based on conservative consideration;

c. Substation in the project connected to partial buildings supplied by one boiler house in baseline scenario (more vs one): $\varepsilon_{BL,HG,j,I}$ equals to the efficiency of such boiler house;

d. Substation in the project connected to partial buildings supplied by several boiler houses in baseline scenario (more vs more): $\varepsilon_{BL,HG,j,I}$ should be determined by maximum efficiency of two boiler houses based on conservative consideration.

For category 3, buildings supplied by a substation which prior to project activity did not have any heat distribution network, is treated as new buildings. Thus, the default value with boiler efficiency of 85% will be used in line with the methodology.

For detailed determination of existing buildings and new buildings, please see Table 3, Annex 3 of PDD and ER spreadsheet.

Step 3. Lifetime of existing heat only boilers

According to the methodology AM0058 (Version 03.1), the remaining lifetime of existing boilers in the baseline scenario is estimated as follows:

1) Estimate the typical lifetime of boiler of each category *j*

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[23] China Energy Statistical Yearbook 2008

The baseline boilers were operated and maintained well under the relevant regulation. Thus, according to the Annex 2 of EB22 and the latest "Tool to determine the remaining lifetime of equipment" (Annex 15 of EB 50), the 25 years of lifetime could be applicable for all similar existing boilers under the same operation condition.

2) The average age of boiler of each category *j*

For the given category *j* supplied by 142 isolated small coal fired boiler houses in the baseline scenario,, their annual coal consumption, boiler efficiency and their ages are provided in the FSR's Attachment, based on historical survey. There were 3 large heat only boiler houses (No. 140, No. 144 and No. 145) existing prior to the implementation of the Project will be left for supplementary heat source of the Project. For the boiler houses No. 140, their annual coal consumption, heating area, and age are provided by its former owner. Therefore, in line with the methodology AM0058 (Version 03.1), the average age of existing boiler houses can be calculated as 10.08 years weighted by their annual heat generation.

3) The average remaining lifetime of boiler of each category *j*

As a result, the average remaining lifetime of existing boiler houses is the difference between 25 years and 10.08 years, i.e. 14.92 years. Therefore the minimum calculated average remaining lifetime of boilers exceeds the length of the crediting period of the proposed project activity (10 years).

The detail information on the existing boilers regarding the installed capacity, typical technical lifetime, ages, average remaining lifetime and energy efficiencies are listed in Annex 3 of the PDD.

Baseline emissions from the power generation

According to AM0058 (Version 03.1), page 13, "the ex-post calculation of baseline emissions from the power generation is based on the actual monitored electricity generated and supplied to the (Xinjiang power) grid in the project activity and limited by the maximum historic annual amount of electricity supplied to the grid over the three most recent years prior to the start of implementation of project activity":

$$BE_{EL,y} = min\{EG_{max,\ hist}\ ;\ EG_{PA\ ,\ y}\}\ \times EF_{BL,\ EL} \qquad (6)$$

Where:

$BE_{EL,y}$ Baseline emissions from the generation of electricity during the year y, (tCO_2e);

$EF_{BL,\ EL}$ Baseline emission factor for the electricity production, (tCO_2/MWh);

$EG_{PA\ ,\ y}$ Monitored actual quantity of electricity supplied to the grid in the year y, for the calculation of estimated emission, here is the theoretical annual electricity amount production which will be instead by the monitored value (MWh);

$EG_{max,\ hist}$ Maximum historic annual amount of electricity production over the three most recent years prior to the start of the implementation of the project activity, (MWh).

Given that the Xinjiang Huadian Hongyanchi Power Plant was put into operation from Sep. 2000, and the project started its project implementation for both district heating by the Southern District Heating Network System and heat extraction by the CHP plant since Oct. 2005, so $EG_{max,hist}$ is determined by the maximum historic annual amount of electricity generated over the three most recent years (10/2002-09/2005) which is 4,526,364 MWh occurred during 10/2004-9/2005, as shown in Table B-8.

$$EF_{BL,EL} = \frac{44}{12} * 3.6 * \frac{EF_{FF,BL,EL}}{NCV_{FF,BL,EL} * \eta_{BL,EL}} \quad (7)$$

Where:

$EF_{FF,BL,EL}$ — CO_2 emission factor for the fuel coal fired in the CHP plant used prior to the start of the implementation of the project activity;

$NCV_{FF,BL,EL}$ — Net calorific value for fuel coal fired in the power plant used prior to the start of the implementation of the project activity;

$\eta_{BL,EL}$ — Electricity supply efficiency of the Xinjiang Huadian Hongyanchi Power Plant used prior to the start of the implementation of the project activity. According to the methodology, there are two sources for this value. The efficiency is 38.31% provided by Xinjiang Huadian Hongyanchi Power Plant, which was the efficiency at optimum load, taken from the manufacture manual. The measured value is 38.307% according to the manufacturer's procedures at the commissioning of the Xinjiang Huadian Hongyanchi Power Plant. (Source: Test Report at the commissioning of the power plant conducted by State Electric Power Corporation Thermal Power Research Institute in 2001.). Taking into conservative principle account, 38.31% is to be used in this PDD.

$\frac{44}{12} * \frac{EF_{FF,BL,EL}}{NCV_{FF,BL,EL}}$ =0.0997 t CO_2/GJ, defined as CO_2 emission factor of coal fired in the power plant used prior to the start of the implementation of the project activity, this value is sourced from IPCC default value at the upper limit of the uncertainty at a 95% confidence interval according to the AM0058.

Thus, $EF_{BL,EL}$ is calculated as 0.9369 t CO_2/MWh.

If during the crediting period a technical measure is taken to improve efficiency of the project power plant and the efficiency increases by x percentage point, then the efficiency of the baseline power plant should also be increased by the same x percentages point.

Project emissions

Project emissions PE_y comprise:

- CO_2 emissions from fuel coal combustion associated with the production of heat and electricity in the CHP plant; and
- CO_2 emissions from fuel coal combustion in heat only boilers, as supplement heat source.

These emissions are calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02).

$$PE_y = \sum_j PE_{FC,j,y} \quad (8)$$

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (9)$$

Where:

$PE_{FC,j,y}$ — Project CO_2 emissions from fuel coal combustion in process j during the year y (tCO_2/y);

$FC_{i,j,y}$ — Quantity of fuel type i (i=coal) combusted in process j (Xinjiang Huadian Hongyanchi Power Plant and the four HOBs) during the year y (t/y), the value for ex-ante determination of emission reduction was estimated by the historic data

based on the 4years operation since 2005,which will be monitored;

$COEF_{i,y}$ The CO_2 emission coefficient of fuel type i in year y (tCO_2/t);

i The fuel types combusted in process j during the year y, the CHP plant and the heat only boilers all consume coal;

j Process j, j=a the CHP plant and j=b the heat only boilers respectively.

Due to data unavailable, according to the Tool to calculate project or leakage CO2 emissions from fossil fuel combustion, Option A is not applicable to the Project, and, the Option B in is selected to calculate $COEF_{i,y}$ as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad (10)$$

Where:

$COEF_{i,y}$ The CO_2 emission coefficient of fuel coal in year y (tCO_2/tcoal);

$NCV_{i,y}$ The net caloric value for fuel type i in process j in year y (GJ/t coal). The value of $NCV_{i,y}$ (20.591GJ/t) was sourced from records of CHP for ex-ante calculation and will be monitored ex-post during the monitoring period;

$EF_{CO2,i,y}$ The weighted average CO_2 emission factor of fuel coal in year y (tCO_2/GJ); 2006 IPCC default value 0.0997tCO_2/GJ is used in the PDD according to "tool to calculate project or leakage CO2 emissions from fossil fuel combustion";

i The fuel types combusted in process j during the year y.

Leakage

Leakage emissions are calculated as follows:

$$LE_y = LE_{EL,y} + LE_{FS,y}$$

Where:

LE_y =Leakage emissions in the year *y*, (tCO_2e)

$LE_{EL,y}$ =Leakage emissions from the decrease in the electricity supply to the grid during the year *y*, (tCO_2e)

$LE_{FS,y}$ =Leakage emissions from fuel switch during the year *y*, (tCO_2e)

Leakage due to decrease in electricity supply to the grid from the power plant

If $EG_{PA,y} < EG_{\min,hist}$

And

$EF_{grid} > EF_{BL,EL}$

Then

$$LE_{EL,y} = \left(EG_{\min,hist} - EG_{PA,y}\right) \times \left(EF_{grid} - EF_{BL,EL}\right)$$

Where:

$LE_{EL,y}$ = Leakage emissions from the decrease in the electricity supply to the grid during the year *y*, (tCO_2e)

$EG_{min,hist}$ = Minimum historic annual amount of electricity supplied to the grid over the three most recent years prior to the start of the project activity, (MWh)

$EG_{PA,y}$ = Monitored actual quantity of electricity supplied by the project activity to the grid in the year *y*, (MWh)

EF_{grid} = Emission factor of the electricity grid system (tCO_2/MWh) $EF_{BL,EL}$ = Baseline emission factor for the electricity production, as calculated in the baseline emissions section (tCO2/MWh)

In all other cases $LE_{EL,\ y} = 0$.

The EF_{grid} is to be calculated using the "Tool to calculate the emission factor for an electricity system (version 02)", all the data employed in the calculation in the project is based on the available data from Northwest China Power Grid. According to the *Notification on Determining Baseline Emission Factors of China Power Grid* renewed by the Director Office of National Climate Change Coordination of NDRC (Chinese DNA) on July 18, 2008[24], the Combined Baseline Emission Factor of the Northwest China Power Grid corresponds to 0.8712 tCO_2e/MWh.

For more information on the published OM and BM emission factors, please refer to:

- Calculation result of the baseline emission factor of China Regional Grid: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2008/20081230102527637.pdf
- Calculation process of the baseline OM emission factor of China Regional Grid: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1888.pdf
- Calculation process of the baseline BM emission factor of China Regional Grid: http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2008/20081231101111351.pdf

The tool provides procedures to determine the following parameters:

Parameter	SI Unit	Description
$EF_{grid,CM,y}$	tCO_2e/MWh	Combined margin CO_2 emission factor for the project electricity system in year y
$EF_{grid,BM,y}$	tCO_2e/MWh	Build margin CO_2 emission factor for the project electricity system in year y
$EF_{grid,OM,y}$	tCO_2e/MWh	Operating margin CO_2 emission factor for the project electricity system in year y

$EF_{grid,OM,y}$, $E_{Fgrid,BM,y}$, $EF_{grid,CM,y}$ calculation for the Northwest China Power Grid is calculated as follows:

STEP 1. Identify the relevant electricity systems.
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Identify the group of power units to be included in the build margin (BM).
STEP 6. Calculate the build margin emission factor.
STEP 7. Calculate the combined margin (CM) emissions factor.

Step 1. Identify the relevant electricity systems

The DNA of China has published a delineation of the project electricity system and connected electricity systems, so the project adopt the delineation of project electricity system and connected electricity system published by NDRC. The power generated by the project will be transmitted to the

[24] http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2008/20081230102527637.pdf

Northwest China Power Grid through the Xinjiang Grid. The Northwest China Power Grid is a larger regional grid, which consists of 5 sub-grids: Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang grid. NWPG exports power to Central China Power Grid, but do not import power from other grids.

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

The following two options to calculate the operating margin and build margin emission factor:
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.
Option I is selected to calculate the operating margin and build margin emission factor.

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

The "Tool to calculate the emission factor for an electricity system" (version 02) offers four options for the calculation of the Operating Margin emission factor(s) ($EF_{grid,OM,y}$):
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

For the proposed project activity, the simple OM calculation should be used, because from 2002 to 2006 the proportion of low-cost/must-run resources in the total grid electricity of the NWPG 22.82% in 2002, 18.77% in 2003, 21.21% in 2004, 27.44% in 2005, and 24.71% in 2006[25] respectively, which is far lower than 50%. Thus, the method (a) Simple OM can be used to calculate the baseline emission factor of operating margin ($EF_{OM,y}$) for the Project.

For simple OM, the emission factor can be calculated using either of the two following data vintages:

- Ex ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or
- Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emission factor to be updated annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y.

The "ex-ante option" will be used for OM calculation of the project, without requirement to monitor and recalculate the emissions factor during the fixed crediting period.

Step 4. Calculate the operating margin emission factor according to the selected method (Simple OM)

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2e/MWh) of all generation power plants serving the system, not including low-cost/must-run power plants/units. The simple OM may be calculated:

[25] China Power Yearbook 2003~ 2007

Option A: Based on the electricity generation and a CO_2 emission factor of each power unit;[26] 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.

Option B can only be used if:

(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

In China, the related data of each power plant / unit is not available from the official; therefore the Option A is unavailable. Furthermore, 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 these sources is known. So the Option B is available for calculating OM emission factor ($EF_{OM,y}$). Under this option, 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:

$$EF_{grid,OM,simple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (11)$$

Where,

$EF_{grid,OM,simple,y}$	= Simple operating margin CO_2 emission factor in year y (tCO_2e/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)
$EF_{CO_2,i,y}$	= CO_2 emission factor of fossil fuel type i in year y (tCO2e/GJ)
EGy	= 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 relevant year as per the data vintage chosen in Step 3

The Operating Margin emission factors for 2004, 2005 and 2006 are calculated. The three-year average is calculated as a 3-year generation-weighted average of the emission factors.

Step 5. Identify the group of power units to be included in the build margin

[26] 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.

The sample group of power units *m* used to calculate the build margin consists of either:
(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently

Project participants should use from these two options that sample group that comprises the larger annual generation.

However, in China it is very difficult to obtain the data of the five existing power plants built most recently or the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that were built most recently. Therefore, a deviation[27] approved by the EB is applied here in the calculation that is to calculate the new capacity additions and the proportion of each technology of power generation. Then the weighing of capacity additions of different technologies will be worked out. Finally the emission factor will be calculated by employing the efficiency factor representing the best technology commercially available.

1) Capacity addition from one year to another is used as basis for determining the build margin, i.e. the capacity addition over 1-2 years, whichever results in a capacity addition that is closest to 20% of total installed capacity.
2) Use proportional weights that correlate to the distribution of installed capacity in place during the selected period above, using plant efficiencies and emission factors of commercially available best practice technology in terms of efficiency. It is suggested to use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

In terms of vintage of data, project participants can choose between one of the following two options:

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.

The PDD chooses Option 1, which requires the project participant to calculate the Build Margin emission factor $EF_{grid,BM,y}$ ex-ante based on the most recent information available already built for sample group m at the time of PDD submission.

Step 6. Calculate the build margin emission factor

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http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ

The build margin emission factor is the generation-weighted average emission factor (tCO_2e/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (12)$$

Where

$EF_{grid,BM,y}$	= Build margin CO_2 emission factor in year y (tCO_2e/MWh)
$EG_{m,y}$	= Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	= CO_2 emission factor of power unit m in year y (tCO_2e/MWh)
m	= Power units included in build margin
y	= Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per the guidance in step 4 (a) for the simple OM, using options A1, A2 or A3, using for y the most recent historical year for which power generation data is available.

Since there is no way to separate the different generation technology capacities as fuel coal, fuel oil, fuel gas etc from thermal power based on the present statistical data, the following calculating measures will be taken:

- First, according to the statistical data of the most recent one year, use option A1 to determine the ratio of CO_2 emissions produced by coal, oil and gas fuels consumption for power generation;
- Second: multiply this ratio by the respective emission factors based on commercially available best practice technology in terms of efficiency, and use option A2 to determine the respective emission factors;
- Finally, this emission factor for thermal power is multiplied with the ratio of thermal power identified within the approximation for the latest 20% installed capacity addition to the grid. The result is the BM emission factor of the grid.

Sub-step 1: Calculate the proportion of CO_2 emissions related to consumption of coal, oil and gas fuel used for power generation as compared to total CO_2 emissions from the total fossil fuelled electricity generation (sum of CO_2 emissions from coal, oil and gas).

$$\lambda_{Coal} = \frac{\sum_{i \in coal,m} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}} \quad (13)$$

$$\lambda_{Gas} = \frac{\sum_{i \in gas,m} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}} \quad (14)$$

$$\lambda_{Oil} = \frac{\sum_{i \in oil,m} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}} \tag{15}$$

$FC_{i,m,y}$ = The amount of fuel i consumed by relevant power unit m in year y (Mass or Volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i (coal, oil and gas) in year y (GJ/Mass or Volume unit)

$EF_{CO_2,i,y}$ = CO_2 emission factor of fossil fuel type i (coal, oil and gas) in year y(tCO2e/GJ); Coal, Oil and Gas is solid fuel, liquid fuel and gas fuel respectively;

Sub-step 2: Calculate the emission factor of fuel-based generation:

$$EF_{EL,m,y} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \tag{16}$$

Where,

$EF_{Coal,Adv}$, $EF_{Oil,Adv}$, $EF_{Gas,Adv}$ are the emission factors for coal-fired, oil-fired and gas-fired generation technology according to commercially available best practice technology in terms of efficiency.

A coal-fired power plant with a total installed capacity of 600MW is assumed to be the commercially available best practice technology in terms of efficiency, the estimated coal consumption of such a National Sub-critical Power Station with a capacity of 600MW is 329.94gce/kWh, which corresponds to an efficiency of 37.28% for electricity generation.

For gas and oil power plants a 200MW combined cycle power plant with a specific fuel consumption of 252gce/kWh, which corresponds to an efficiency of 48.81% for electricity generation, is selected as commercially available best practice technology in terms of efficiency.

Sub-step 3: Calculate the Building Margin emission factor

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \tag{17}$$

Where,

CAP_{Total} is the total capacity addition, and $CAP_{Thermal}$ is the total thermal (coal, oil and gas) power capacity addition.

The data resources for calculating OM and BM are:

- Installed capacity, power generation and the rate of internal electricity consumption of thermal power plants
  Source: China Electric Power Yearbook (2002-2007);
- Fuel consumption and the net caloric value of thermal power plants
  Source: China Energy Statistical Yearbook (2005-2007);
- Carbon emission factor and carbon oxidation factor of each fuel
  Source: 2006 IPCC Guidelines for default values, Table 1.3 of Page 1.21-1.22 in Chapter one, Volume 2 Energy.

Step 7 Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y} \quad (18)$$

Where,

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2e/MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2e/MWh)

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

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

We calculate the result as follows: the Operating Margin Emission Factor ($EF_{grid, OM, y}$) of the Northwest China Power Grid is 1.1225 tCO_2e/MWh and the Build Margin Emission Factor ($EF_{grid, BM, y}$) is 0.6199 tCO_2e/MWh. According to the “Tool to calculate the emission factor for an electricity system” the default values of this project are:

w_{OM}=0.50 ; w_{BM}=0.50

Using above mentioned values the Combined Baseline Emission Factor of the Northwest China Power Grid corresponds to 0.8712 tCO_2e/MWh.

Leakage due to fuel switch

No calculation of leakage effect is required for project activities using the same fossil fuel type in the project activity and in the baseline scenario.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (19)$$

Where:

ER_y Emission reductions due to the project activity during the year y (tCO_2e);

BE_y Baseline emissions during the year y, (tCO_2e);

PE_y Project emissions during the year y, (tCO_2e);

LE_y Leakage emissions in the year y, (tCO_2e).

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

Data / Parameter:	Average remaining lifetime of boilers for each category j
Data unit:	Years
Description:	Average remaining lifetime of boilers
Source of data used:	Documented boiler information based on historic surveys.
Value applied:	Exceed 10 years as shown in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	The typical technical lifetime of boilers for each identified category j is documented and justified. Prior to the implementation of the project activity, the age of each boiler within each category j that is replaced by the project district heating system, is calculated based on year of its installation and/or operation, and the average age of the boilers per category j is calculated weighted by their annual heat generation (in

	GJ). From this, the average remaining lifetime of the boilers for each category j is calculated as the difference between the typical technical lifetime in j and the average age of boilers in category j.
Any comment:	

Data / Parameter:	$CAP_{j,1}$
Data unit:	GJ/year
Description:	Nameplate capacity of existing boilers in category j at substation i
Source of data used:	Attachment of project FSR
Value applied:	Shown in Table 1 of Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	In line with AM0058 methodology (Version 03.1)
Any comment:	

Data / Parameter:	$EG_{max,hist}$
Data unit:	MWh
Description:	Maximum historic annual amount of electricity generated by the power plant used over the three most recent years prior to the start of implementation of the project activity
Source of data used:	Historic data of last 3 years (10/2002-09/2005) from the CHP plant
Value applied:	4,526,364MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	In line with AM0058 Version 03.1 on the maximum historic annual amount of electricity generated by the power plant used over the three most recent years prior to the start of implementation of the project activity
Any comment:	

Data / Parameter:	$EG_{min,,hist}$
Data unit:	MWh
Description:	Minimum historic annual amount of electricity generated by the power plant used over the three most recent years prior to the start of implementation of the project activity
Source of data used:	Historic data of last 3 years (10/2002-09/2005) from the CHP plant
Value applied:	1,916,680 MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	In line with AM0058 Version 03.1 on the maximum historic annual amount of electricity generated by the power plant used over the three most recent years prior to the start of implementation of the project activity
Any comment:	

Data / Parameter:	$COEF_{BL,HG,j,i}$
Data unit:	tCO_2/GJ
Description:	CO2 emission factor of the fuel coal used in the absence of the project activity in the heat generation system corresponding to substation i
Source of data used:	IPCC default values as provided in table 1.4 of Chapter 1 of vol. 2 (Energy) of 2006 IPCC Guidelines on National GHG Inventories.
Value applied:	Coal: 0.0997
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to the AM0058 (Version 03.1), due to no CO_2 emission factor is provided, then the condition (d) applies i.e. IPCC default values at the upper limit of the uncertainty at the 95% confidence interval as provided above.
Any comment:	

Data / Parameter:	$\varepsilon_{BL,HG,j,i}$
Data unit:	%
Description:	Efficiency of the heating supply system that would have been used in the absence of the project activity for category *j* and substation *i*
Source of data used:	Based on historic survey data for 142 small boiler houses and No.140 large heat only boiler house, existing boiler house information are available on FSR Attachment, including historical annual coal consumption, space heating building area, etc. . For the No.144 and No. 145, their actual coal consumption and actual heat supplied were provided by Urumqi Heating Supply Co., Ltd.
Value applied:	Shown in Table 3 of Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to AM0058, Ver.03.1, the efficiency of boiler heating supply system, $\varepsilon_{BL,HG,j,i}$ may be determined using the following approaches: i) Conduct sample measurements for similar boiler types; ii) Use documented manufacturer's data on the boiler efficiency; iii) Use the default values from Table 2 below; iv) Based on historical fuel consumption data. Here the option iv) is chosen, due to these data are available from the FSR of the proposed project. Then εBL,HG,j,i= Qout,j/Qin,y represents the boiler heating supply system efficiency. Please see section B.6.1., sub-step 2c, in detail.
Any comment:	

Data / Parameter:	$EF_{FF,BL,EL}$
Data unit:	t C/t
Description:	CO_2 emission factor for the fossil fuel fired in the Urumqi Hongyanchi CHP Plant used prior to the start of the implementation of the project activity
Source of data used:	
Value applied	Combination use of $EF_{FF,BL,EL}$ and $NCV_{FF,BL,EL}$, $\frac{44}{12} * \frac{EF_{FF,BL,EL}}{NCV_{FF,BL,EL}}$ is adopted with the IPCC default value.
Justification of the	

choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$NCV_{FF,BL,EL}$
Data unit:	GJ/t coal
Description:	Net calorific value of fossil fuel fired in the power plant used prior to the start of the implementation of the project activity
Source of data used:	
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied:	See $\frac{44}{12} * \frac{EF_{FF,BL,EL}}{NCV_{FF,BL,EL}}$ below
Any comment:	

Data / Parameter:	$\frac{44}{12} * \frac{EF_{FF,BL,EL}}{NCV_{FF,BL,EL}}$
Data unit:	t CO_2/GJ
Description:	CO_2 emission factor of coal fired in the power plant used prior to the start of the implementation of the project activity
Source of data used:	default value at the upper limit of the uncertainty at a 95% confidence interval of 2006 IPCC Guidelines on National GHG Inventories
Value applied	0.0997
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	*j*
Data unit:	
Description:	Categories grouped by (i) type of buildings (new/existing), (ii) type of technology used and (iii) fuel type used in the absence of the project activity. For each category j, all connected buildings should be clearly identified.
Source of data used:	Urumqi City Urban Planning Bureau or Urumqi Heating Supply Co., Ltd. show map
Value applied:	3
Justification of the	N/A

choice of data or description of measurement methods and procedures actually applied:	
Any comment:	Data shall be stored in a database/excel sheet and checked during first monitoring report.

Data / Parameter:	*i*
Data unit:	
Description:	Substation
Source of data used:	Urumqi City Urban Planning Bureau or Urumqi Heating Supply Co., Ltd. show map
Value applied:	193
Justification of the choice of data or description of measurement methods and procedures actually applied:	N/A
Any comment:	Data shall be stored in a database/excel sheet and checked during first monitoring report.

Data / Parameter:	T_N
Data unit:	℃
Description:	The indoor mean air temperature in the period of heat supply
Source of data used:	FSR
Value applied:	18
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	T_P
Data unit:	℃
Description:	The mean outdoor temperature in the period of heat supply in Urumqi City
Source of data used:	FSR
Value applied:	-7.4
Justification of the choice of data or description of measurement methods and procedures actually applied:	

Any comment:	

Data / Parameter:	T_W
Data unit:	℃
Description:	The outdoor design temperature in the period of heat supply in Urumqi City
Source of data used:	FSR
Value applied:	-22
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	w_j
Data unit:	w/m^2
Description:	The index of design load for heating of building
Source of data used:	FSR
Value applied:	77 w/m^2 for existing buildings (Building Category 1), 70w/m^2 for new constructed buildings and new buildings (Building Category 2 and Category 3)
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	EF_{grid}
Data unit:	tCO_2/MWh
Description:	Emission factor of the electricity grid system
Source of data used:	Notification on Determining Baseline Emission Factors of China Power Grid published on 18 July,2008
Value applied:	0.8712
Justification of the choice of data or description of measurement methods and procedures actually applied:	Determined ex-ante according to the Tool to calculate the emission factor for an electricity system
Any comment:	Official data, which is fixed in the crediting period.

B.6.3. Ex-ante calculation of emission reductions:

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Step 1 Baseline emissions from heat generation

The estimated $Q_{i,y}$ is calculated ex-ante by using formula (3.1) as follows:

$$Q_{i,y} = \sum_j A_{j,i} \times Q_{j,i,y,cal} = \sum_j A_{j,i} \times W \times T_y \times 3.6 \times 10^{-6}$$

The average heating load per unit of building area (W) is determined by formula 3.2. It is calculated that the average heating load for Building Category 1 and for Category 2 and Category 3 are 48.895w/m^2 and 44.45w/m^2 respectively.

$A_{i,y}$ The buildings area (Carpet area)in category *j* connected to substation *i*, which is listed in the Table 1 of Annex 3, as provided in FSR.

Hence in the baseline scenario, the estimated quantity of space heating demand supplied by isolated district heating boiler houses under category *j*, connected to the substation *i* are calculated using formula (3) as follows:

$$Q_{j,i,y} = \frac{A_{j,i}}{\sum_j A_{j,i}} \times Q_{i,y}$$

Here:
The resulted $Q_{j,i,y}$ are listed in Table 3 of Annex 3.
According to formula (4), $Q_{j,i,y}$ should be capped by

$$Q_{j,i,y} = min\ \{ Q_{inst\_cap,j,i,} Q_{j,i,y} \}$$

In which $Q_{inst\_cap,j,i}$ is calculated by $Q_{inst\_cap,j,i} = CAP_{j,i} * T_y$
Here $CAP_{j,i}$ and $Q_{inst\_cap,j,i}$ as well as the minimum $Q_{j,i,y}$ are listed in Table 3 in Annex 3 provided by FSR.

The detailed information on existing buildings and new buildings in the project activity are shown in Table 3 of Annex 3.

Step 2: CO_2 emission factor for heating supply in the baseline

Sub-Step 2a: Emission factor of fuel(s) used

$COEF_{BL,HG,j,i}$ is determined corresponding to the identified fuel coal.

For $COEF_{BL,HG,,j,i}$, i.e. CO_2 emission factor of the fuel coal used in the absence of the project activity in the heat generation system corresponding to substation i, according to the AM0058 (Version 03.1), due to the condition (a), i.e. the value is not available from the fuel supplier in invoices, then the condition (d) applies i.e. IPCC default values as provided in table 1.4 of Chapter 1 of vol. 2 (Energy) of 2006 IPCC Guidelines on National GHG Inventories. Therefore $COEF_{BL,HG,,j,i}$ is 0.0997 tCO_2/GJ.

Sub-step 2b: Efficiency of boilers used in the absence of the project activity
In line with the methodology AM0058 (Version 03.1), the energy efficiencies for each existing boiler house category j in the baseline scenario $\varepsilon_{BL,HG,j,j}$ are calculated based on historical fuel coal consumption data provided in the FSR. The detailed information is listed in Table 3 Annex 3.

For new buildings, default efficiency 85% is adopted in line with the methodology.

$EF_{BL,HG,j,i}$ is determined by using formula (5) as follows:

$$EF_{BL,HG,j,i} = \frac{COEF_{BL,HG,j,i}}{\varepsilon_{BL,HG,j,i}}$$

Here:
The resulted $EF_{BL,HG,j,i}$ are listed in Table 3 in Annex 3. (tCO_2/GJ).

Step 3. Lifetime of existing heat only boilers

As stated in the Section B.6.1, the average remaining lifetime of boiler houses is 14.92 years. Therefore the minimum calculated average remaining lifetime of boilers exceeds the length of the crediting period of the proposed project activity (10 years).

As a consequence the existing boilers operated prior to the implementation of the proposed project would not be replaced, retrofitted or modified in the absence of the proposed project.

The detail information on the existing boilers regarding the nameplate capacity, typical technical lifetime, ages, average remaining lifetime and energy efficiencies are listed in Table 2 Annex 3.

According to the emission factors and heating supply listed in Table 3 in Annex 3, the baseline emissions from heat generation are estimated by using formula (2) as follows:

$$BE_{HG,y} = \sum_i \sum_j Q_{j,i,y} \times EF_{BL,HG,j,i}$$

The ex-ante baseline emissions from heat generation are shown in the following Table B-7:

Table B-7: The baseline CO_2 emission from heat supplied in the baseline scenario

Year	$BE_{HG,y}$ (tCO_2)
2011	1,927,999
2012	2,021,161
2013	2,082,225
2014	2,082,225
2015	2,082,225
2016	2,082,225
2017	2,082,225
2018	2,082,225
2019	2,082,225
2020	2,082,225

Baseline emissions from the power generation

As explained in B.6.1, as per AM0058 (version 03.1), the historical annual electricity generations prior to the project implementation are shown in the table below. As a result, the maximum historic annual amount of electricity $EG_{max,hist}$ over these three most recent years prior to the start of the implementation of the project activity is 4,526,364 MWh.

Table B-8 The historical electricity generation for the three most recent years

Year	10/2002-9/2003	10/2003-9/2004	10/2004-9/2005
Historical Electricity	1,916,680	2,077,238	4,526,364

Generation (MWh)			

Source: Xinjiang Huadian Hongyanchi Power Plant Co., Ltd.

$EG_{PA,y}$ i.e. quantity of electricity supplied to the grid in year y in the project activity (MWh), is estimated ex-ante as 4,800,000MWh based on CHP plant FSR.

Thus $EF_{BL,EL}$ is calculated by using formula (7) as follows:

$$EF_{BL,EL} = 3.6 \times 0.0997 / 38.31\% = 0.9369\ (tCO_2/MWh)$$

Then $BE_{EL,y}$ is determined by using formula (6) as follows:

$$BE_{EL,y} = min\{EG_{max,hist}; EG_{PA,y}\} \times EF_{BL,EL}$$

$$= \min\{4,526,364;\ 4,800,000MWh\} \times 0.9369tCO_2/MWh = 4,240,675\ tCO_2e$$

Then the total baseline emission BE_y after fully commission is calculated by using formula (1), as shown in the following table:
$BE_y = BE_{HG,y} + BE_{EL,y} = 2,082,225 + 4,240,675 = 6,322,900\ tCO_2e$

Project emissions

Project emissions (PE_y) comprise:

- CO_2 emissions from fuel coal combustion associated with the production of heat and electricity in the CHP plant; and
- CO_2 emissions from fuel coal combustion in heat-only boilers.

These project emissions are calculated by using following formula based on the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02) as follows:

$$PE_y = \sum_j PE_{FC,j,y}$$

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

$COEF_{i,y}$, is calculated by using formula (10) as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Here:
$EF_{CO2,i,y}$ is 0.0997 tCO_2/GJ for coal, based on 2006 IPCC default value;
The value of NCV for coal is 20.591 GJ/t, which is used for ex-ante.

Thus $COEF_{i,y}$ is calculated as 2.0529 tCO_2/t. During the monitoring period, the weighted average value will be calculated ex-post based on $NCV_{i,y}$ data available from fuel coal suppliers.

The results of calculated $FC_{i,j,y}$ and project emissions $PE_{FC,j,y}$ during the year y (tCO_2/yr) are listed below:

Year	$FC_{i,j,y}$ (t/y)*	$COEF_{i,y}$ (tCO_2/t)	$PE_{FC,j,y}$ (tCO_{2e})
2011	2,470,150	2.0529	5,071,027
2012	2,500,102	2.0529	5,132,516
2013	2,512,237	2.0529	5,157,428

2014	2,512,237	2.0529	5,157,428
2015	2,512,237	2.0529	5,157,428
2016	2,512,237	2.0529	5,157,428
2017	2,512,237	2.0529	5,157,428
2018	2,512,237	2.0529	5,157,428
2019	2,512,237	2.0529	5,157,428
2020	2,512,237	2.0529	5,157,428

* Sourced from Design Institute

Leakage

According to the methodology, only fuel coal is used in both project activity and the baseline scenario without fuel switch, so the leakage effect from fuel switch is not required for project activity, thus $LE_y=LE_{EL,y}$.

$$LE_{EL,y} = \left(EG_{\min,hist} - EG_{PA,y}\right)\times\left(EF_{grid} - EF_{BL,EL}\right)$$

Where:

$EG_{min,hist}$ = Minimum historic annual amount of electricity supplied to the grid over the three most recent years prior to the start of the project activity, the value is 1,916,680, (MWh)

$EG_{PA,y}$ = Monitored actual quantity of electricity supplied by the project activity to the grid in the year *y* estimated as 4,800,000 MWh, (MWh)

EF_{grid} = Emission factor of the electricity grid system (tCO_2/MWh)

$EF_{BL,EL}$ = Baseline emission factor for the electricity production, as calculated in the baseline emissions section, the value is 0.9369 (tCO_2/MWh)

The estimated annual generation for the project activity ($EG_{PA,y}$) 4,800,000 MWh is more than the historical minimum generation ($EG_{\min,hist}$) 1,916,680 MWh over the past recent three years prior to the start of the project activity as listed in Table B-8 in Section B.6.3., Thus the electricity supplied to the grid is not decreased as consequences as the project activity, therefore, according to the AM0058 (version 03.1), the leakage is considered as zero.

Finally the baseline emissions, project emissions and emission reductions for the proposed project activities are calculated by using formula (11) accordingly and are listed in the following table:

Year	$BE_{HG,y}$ (tCO_2)	$BE_{EL,y}$ (tCO_2)	PE_y (tCO_2)	LE_y (tCO_2)	ER_y (tCO_2)
2011	1,927,999	4,240,675	5,071,027	0	1,097,647
2012	2,021,161	4,240,675	5,132,516	0	1,129,320
2013	2,082,225	4,240,675	5,157,428	0	1,165,472
2014	2,082,225	4,240,675	5,157,428	0	1,165,472
2015	2,082,225	4,240,675	5,157,428	0	1,165,472
2016	2,082,225	4,240,675	5,157,428	0	1,165,472
2017	2,082,225	4,240,675	5,157,428	0	1,165,472
2018	2,082,225	4,240,675	5,157,428	0	1,165,472
2019	2,082,225	4,240,675	5,157,428	0	1,165,472
2020	2,082,225	4,240,675	5,157,428	0	1,165,472

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

>>

The results of the *ex-ante* estimations of emission reductions for all years of the crediting period are summarized using the table below:

Year	baseline emissions (t CO_2e)	project emissions (t CO_2e)	leakage (t CO_2e)	emission reductions (t CO_2e)
2011	6,168,674	5,071,027	0	1,097,647
2012	6,261,836	5,132,516	0	1,129,320
2013	6,322,900	5,157,428	0	1,165,472
2014	6,322,900	5,157,428	0	1,165,472
2015	6,322,900	5,157,428	0	1,165,472
2016	6,322,900	5,157,428	0	1,165,472
2017	6,322,900	5,157,428	0	1,165,472
2018	6,322,900	5,157,428	0	1,165,472
2019	6,322,900	5,157,428	0	1,165,472
2020	6,322,900	5,157,428	0	1,165,472
Total (t CO_2e)	63,013,710	51,462,967	0	11,550,743

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

A detailed description of the application of the monitoring methodology AM0058 (Version 03.1) and a description of the monitoring plan, including an identification of the data to be monitored and the procedures that will be applied during monitoring are provided in the two sections B7.1 and B7.2.

B.7.1 Data and parameters monitored:

Data / Parameter:	Status of the district heating system and capacity
Data unit:	Number of substations and corresponding capacity MW_{heat}
Description:	Dates of commissioning and status of rated capacity of boilers
Source of data to be used:	Schematic-plan diagrams of the southern district heating system obtained at Urumqi Heating Supply Co., Ltd. and the map of the southern district heating system planning provided in FSR based on the urban construction plan by the responsible Urumqi Urban Planning Bureau
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Shown in Table 2 of Annex 3
Description of measurement methods and procedures to be applied:	Schematic-plan diagrams of the district heating system is updated on the basis of information available from catalogue references and SCADA systems provided by Urumqi Heating Supply Co., Ltd.
QA/QC procedures to	Data gathered monthly to establish starting date for each substation and

be applied:	monthly status of the scope of the district heating system.
Monitoring frequency	Recorded at start of the crediting period and whenever the newly installed substations start producing thermal energy.
Any comment:	

Data / Parameter:	$Q_{extracted,y}$
Data unit:	GJ
Description:	Quantity of heat extracted from the CHP Plant during the year *y*
Source of data to be used:	Heat meter at supply side of primary heat exchanger
Value of data applied for the purpose of calculating expected emission reductions in section B.6	9,387,948 GJ, calculated based on the heat extracted capacity and operation hours for space heating, provided in FSR.
Description of measurement methods and procedures to be applied:	Hourly measurement of in and out flow temperatures and water flow in m^3 with heat meter at primary heat exchange station.
Monitoring frequency	Hourly measurements, registered for the project on an annual basis.
QA/QC procedures to be applied:	The meter readings should be crosschecked against the meter readings of the point of heat supply as well as heat invoices to Urumqi Heating Supply Co., Ltd to ensure that the heat records are plausible and reliable. Moreover, the corresponding meters have to be subject to regular maintenance in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (Excel database).
Any comment:	

Data / Parameter:	$Q_{HOB,y}$
Data unit:	GJ
Description:	Quantity of heat extracted from all heat only boiler houses during the year *y*
Source of data to be used:	Heat meters at supply side of each heat only boiler house
Value of data applied for the purpose of calculating expected emission reductions in section B.6	3,752,035 GJ, calculated based on the all heat only boiler houses capacity and their operation hours for space heating, provided in FSR.
Description of measurement methods and procedures to be applied:	Hourly measurement of in- and out flow temperatures and water flow in m^3 with heat meters at the four HOB boiler houses.
Monitoring frequency	Hourly measurements, registered for the project on an annual basis.
QA/QC procedures to be applied:	The meter readings should be crosschecked against the meter readings of the point of heat supply as well as heat invoices to Urumqi Heating Supply Co., Ltd to ensure that the heat records are plausible and reliable. Moreover, the corresponding meters have to be subject to regular maintenance in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (Excel database).
Any comment:	

Data / Parameter:	$A_{j,i}$
Data unit:	m^2
Description:	Total carpet area of all the building in category j supplied by substation *i*
Source of data to be used:	Estimations available from approved FSR for existing buildings and new buildings within the Urumqi Southern District Heating Network, which are originally from Urumqi Heating Supply Co., Ltd.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	See Table 1 and Table 3 of Annex 3
Description of measurement methods and procedures to be applied:	Yearly updated.
Monitoring frequency	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$Q_{i,y}$
Data unit:	GJ
Description:	Quantity of heat supplied from substation *i* to category *j* buildings
Source of data to be used:	On site measurements of heat meters at substations
Value of data applied for the purpose of calculating expected emission reductions in section B.6	See Table 3 of Annex 3
Description of measurement methods and procedures to be applied:	Hourly measurement of in- and out flow temperatures and water flow in m^3 with heat meters at substation i.
Monitoring frequency	Hourly measurements, registered for the project on an annual basis.
QA/QC procedures to be applied:	The sum of all heat meter readings of substations should be crosschecked against the heat meter readings of the heat extracted from the CHP and the heat extracted from HOBs as well as against heat invoices to ensure that the heat records are plausible and reliable. Moreover, the corresponding meters have to be subject to regular maintenance in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (Excel database).
Any comment:	

Data / Parameter:	$EG_{PA,y}$
Data unit:	MWh
Description:	Actual quantity of electricity supplied to the grid in the year y
Source of data to be	Electricity meter at the CHP plant.

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.6	4,800,000
Description of measurement methods and procedures to be applied:	Continuous measurement with the electricity meter at the power grid company.
Monitoring frequency	Continuous, annual registration
QA/QC procedures to be applied:	Electricity meter readings of the CHP plant are crosschecked against electricity sale invoices available from the power grid company to ensure that the electricity records are reasonable and reliable. Moreover, the corresponding meters are subject to regular maintenance and calibration in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (Excel database).
Any comment:	The meters accuracy level is 0.2s in the registered PDD. In the project actual implementation stage, the monitoring equipment accuracy level is from 0.5 to 0.2s. According to the PPA signed between the CHP plant and the power grid company, the power grid company has the right to possess, operate and maintain the electricity meters, which means that the project owner has no right to settle or change the accuracy of the meters. Furthermore, PPs decided to discount 0.3% (which is the difference between the accuracy level of what in registered PDD and the actual one) of EG_y monitored by electricity meters for conservation.

Data / Parameter:	$FC_{i,j,y}$
Data unit:	ton/yr
Description:	Quantity of fuel coal combusted in process *j* during the year *y*
Source of data to be used:	Onsite measurements of the quantity of coal consumed for the boiler houses in the CHP plant and the four HOB boiler houses
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Refer to the Project Emission section PDD, B.6.1 and B.6.3
Description of measurement methods and procedures to be applied:	Use strap balance which onsite measuring the quantity of coal consumed for the boiler houses
Monitoring frequency	Continuously
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities is cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities is also cross-checked with available purchase invoices from the financial records.
Any comment:	

Data / Parameter:	***$NCV_{i,y}$* , *i*=coal**
Data unit:	GJ/ton
Description:	Weighted average net calorific value of fuel coal consumed in CHP and HOB Boiler House in year *y*
Source of data to be used:	The value sourced from the record of CHP
Value of data applied for the purpose of calculating expected emission reductions in section B.6	20.591
Description of measurement methods and procedures to be applied:	This parameter will be monitored by the following options: 1.Values provided by the fuel supplier in invoices (prefer option) 2.Measurements by the project participants (or owner of CHP) If the option 1 is available, then the option 1 will be used, if option 1 is unavailable, then option 2 will be used; in this case, the NCV of the CHP will be monitored by its owner in accordance with relevant industrial standard.
Monitoring frequency	The $NCV_{i,y}$ will be obtained for each fuel delivery, from which weighted average annual values will be calculated
QA/QC procedures to be applied:	Verify if the value is within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the value falls below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	

Data / Parameter:	***$EF_{CO2,i,y}$*, *i*=coal**
Data unit:	tCO_2 /GJ
Description:	Weighted average CO_2 emission factor of fuel type in year y
Source of data to be used:	IPCC default values, 2006 Neither the value provided by the fuel supplier and the project participant nor the national default value is available, so as per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", 2006 IPCC default value as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories is used.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Coal: 0.0997
Description of measurement methods and procedures to be applied:	
Monitoring frequency	Any future revision of the IPCC Guidelines will be taken into account
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$\eta_{BL,\ EL}$
Data unit:	%
Description:	Efficiency of the power plant used prior to the start of the implementation of the project activity
Source of data to be used:	Measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.6	38.31
Description of measurement methods and procedures to be applied:	Measured by the third party according to the manufacturer's procedures or taken from the manufacturer's specification.
Monitoring frequency	If during the crediting period a technical measure is taken to improve efficiency of the CHP plant.
QA/QC procedures to be applied:	
Any comment:	The efficiency is 38.31% provided by Xinjiang Huadian Hongyanchi Power Plant, which was the efficiency at optimum load, taken from the manufacture manual. The measured value is 38.307% according to the manufacturer's procedures at the commissioning of the Xinjiang Huadian Hongyanchi Power Plant. Taking into conservative principle account, 38.31% is used in this PDD. Shall in general remain fixed throughout the crediting period. However, if during the crediting period a technical measure is taken to improve efficiency of the project power plant and the efficiency increases by x%, then the efficiency of the baseline power plant $\eta_{BL,\ EL}$ should also be increased by the same x%.

B.7.2. Description of the monitoring plan:

>>

The monitoring plan is developed applying the AM0058 (Version 03.1) baseline and monitoring methodology. The overall objectives of the monitoring plan are to offer designated operational entities (DOE) complete, accurate, reliable and transparent monitoring results and emission reductions of the project activity during the verification and certification stage, and to report how the implementation of the monitoring plan comply with monitoring methodology, including monitoring organization with responsibilities allocation, monitoring objects, monitoring equipments and instruments with technical specification and installation layout, monitoring procedures, monitoring data processing and management, emission reductions calculation and QA/QC procedures etc., so that DOE can, according to monitoring reports, fully and effectively verify emission reductions and to report to CDM EB for issue of certified emission reductions (CERs).

Urumqi Heating Supply Co., Ltd. is the project entity, operator, and is also responsible for the monitoring plan and its implementation.

Monitoring in this methodology includes the monitoring of parameters used for calculation of both baseline emissions and project emissions.

All heat supplied to final consumers will be measured continuously at each sub-station i as part of the monitoring plan.

In line with the AM0058 monitoring methodology and the associated monitoring plan, the designed heat flow measurement points are shown in the Fig.B-4 in principle. The actual arrangement for the heat flow measurement points is subject to the actual progress of the heating network construction which is ongoing within the project boundary. So the actual arrangement of the measuring points and the resulted heat monitoring data will be covered in the monitoring report for the given monitoring period, and verified by the DOE ex-post.

All monitored data will be recorded in an electronic database (Excel sheets) with specifications of the points of measurement, the variable name and description, the corresponding value and unit as well as the time of measurement, the period for which the measurement is valid and the persons who are responsible for making the measurements and carrying out the records.

1. **The establishment of the monitoring executive organization**

A dedicated CDM project management group has established by the Urumqi Heating Supply Co., Ltd. The institutional structure and function of the group is shown in Figure B-3. Within the group a monitoring team is designated with their responsibilities allocated.

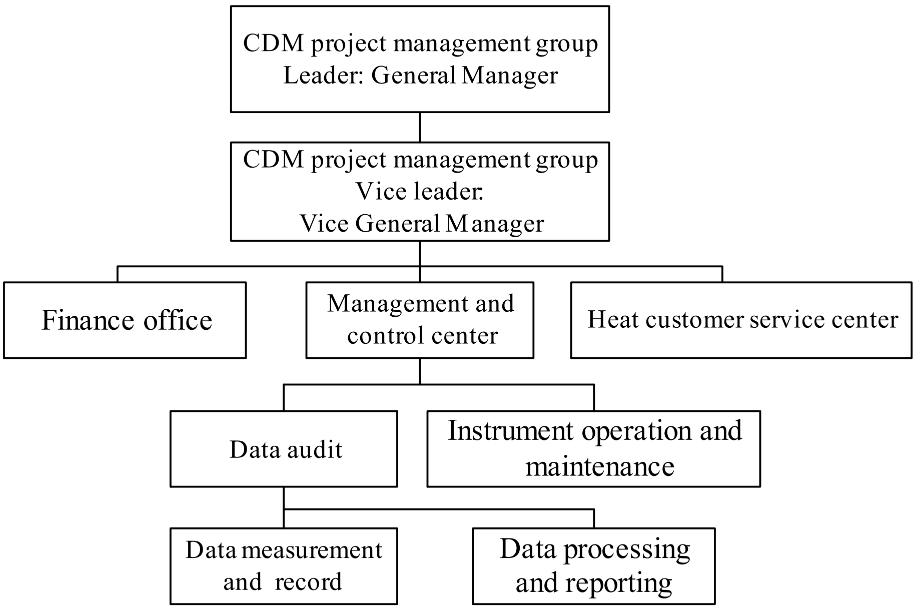

Figure B-3: Structure and function of CDM project management group

Responsibilities allocation

Group leader: responsible for the leadership, control for the CDM project management, and external coordination with CHP plant.

Vice group leader: responsible for daily supervision for the CDM project implementation, execution of the monitoring plan, coordination with other sectors within the company and CDM project operation security.

Management and control center: responsible for the daily implementation of the CDM project monitoring plan and reporting to the vice group leader.

Finance office: monitoring the financial status of the CDM project implementation, archiving the financial invoices of the energy and CERs sales, and reporting to the vice group leader.

Heat customer service center: responsible for heat sale contracts with final users, heat bill charging and clearance, reporting to the vice group leader.

Data audit: responsible for auditing of the original monitoring data and results of data processing and reporting, and crosschecking with energy invoices as well as QA/QC control, and reporting to management and control center.

Data measurement and record: responsible for daily data monitoring and recording according to the monitoring plan.

Data processing and reporting: responsible for the data processing including the calculation of baseline emissions, project emissions and emission reductions according to the monitoring plan in the registered CDM-PDD. And provide monitoring report to be submitted to DOE for verification and certification.

Instrument operation and maintenance: responsible for the installation and testing of the monitoring instruments, their routine operation, regular maintenance and calibrations, troubleshooting and emergency response, to ensure that their performances and accuracies of the installed monitoring instruments meet the standard as required by the registered monitoring plan and reporting to management and control center.

2. Data and parameters to be monitored

There are mainly following data and parameters to be monitored:

i) Coal consumption during the project implementation for district heating with main heat source from the CHP plant, including coal consumed by the CHP boilers $FC_{PA,CHP,y}$ and those by the four HOB boilers $FC_{PA,HOB,y}$;

ii) Quantity of heat supply during the project implementation, including the quantity of heat extracted from CHP plant $\boldsymbol{Q}_{extracted}$, the quantity of heat extracted from HOBs $\boldsymbol{Q}_{HOB,y}$ and the quantity of heat supplied by substation *i* $\boldsymbol{Q}_{i,y}$;

iii) Quantity of electricity delivered to the grid during the project implementation, the quantity of electricity supply from CHP EG_{PA}. In case the CHP plant import electricity from the grid, if any, the EG_{PA} is calculated as net electricity delivered to the grid by subtracting electricity imported.

iv) $NCV_{i,y}$, weighted average net calorific value of fuel coal for the CHP plant in year y. The value provided by the coal supplier shall be used (e.g available value in invoice).

v) $\boldsymbol{A}_{j,i}$, total carpet area of all the building in category j supplied by substation *i,* obtaining from estimations available from actual measurement or local authorities.

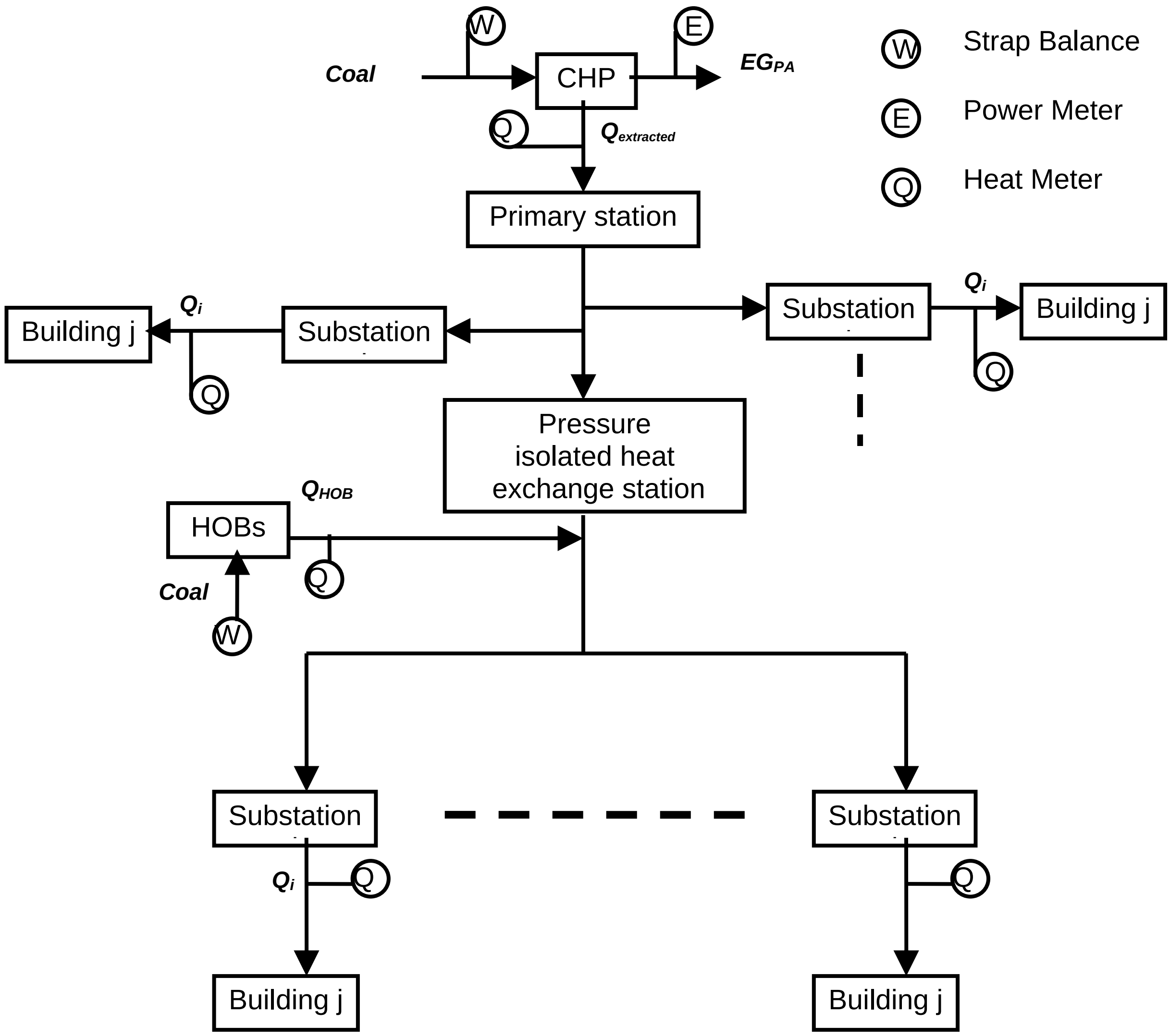

Figure B-4: The layout of the installation of the monitoring instruments

3. Monitoring instruments

i) The monitoring instruments are installed at the points of the measurement as shown in Figure B-4, the layout of the installation of the monitoring instruments (heat meters, electricity meter and strap balance). A backup electricity meter with the same specification as the main meter is installed at the same place;
ii) Technical standard of the monitoring instrument: as seen in Table 1 Annex 4 in detail;
iii) Calibration of the monitoring instruments will be carried out regularly by the authorized third party entity in line with standard calibration procedure: as seen in Table 1 Annex 4 in details.

4. Monitoring procedures

The data exchange regarding the heat source control and space heating network between Urumqi Heating Supply Co., Ltd. and Xinjiang Huadian Hongyanchi Power Plant Co., Ltd. is realized on the platform established in the network server in the management and control center. In this way, Urumqi Heating Supply Co., Ltd. receives information on quantity of heat extracted, $Q_{extracted,}$ from Xinjiang Huadian Hongyanchi Power Plant Co., Ltd. and at the same time sends out the information on primary heating network parameters to Xinjiang Huadian Hongyanchi Power Plant Co., Ltd. In addition, the measured quantity of electricity supply and coal consumption will be confirmed by both sides.

The monitoring data on the primary, secondary and third heating network will be collected, shared and recorded on-time through SCADA system so as to secure the accuracy, simultaneity and consistency

Normal monitoring procedure is that all data on electricity, heat and coal consumption will be measured recorded, reported and registered. This procedure will be contacted by the monitoring team in the data measurement and record sector, the data auditor and the management and control center respectively responsible for the same.

5. Data processing and reporting

An Excel based monitoring database is set up by the CDM project management group, on which all monitoring data and basic parameters will be processed to calculate baseline emission, project emissions and emission reductions (CERs). And the monitoring report will be generated under the monitoring parameters regularly.

The monitored data required for verification and certification are archived for at least two years after the end of the crediting period or the last issue of CERs for this project activity, whichever occurs later.

6. QA / QC procedures and emergency response

1) ***Quality assurance and quality control***

The original monitoring data and results of data processing are subject to internal auditing by the stuffs in the responsible data audit sector. During the QA/QC process those monitoring data will be crosschecked with the energy invoices to ensure that the monitored records are accurate and reliable.

Vice group leader of the CDM project management group takes overall responsibility for monitoring, recording, archiving, calculation and report of the CO_2 emission reductions.

2) ***Malfunction treatment and emergency response***

The management and control centre responsible for monitoring the operation of southern district heating network is located in the main control center (MCC), where two set of data server are installed, one is main server and another is submissive server. When the main server is out of work, the submissive one is switched to replace the main server.

For the electricity monitoring, when the main electricity meter is found to be in malfunction, the backup electricity meter will take place of it.

For the heat supply monitoring, when the heat relevant parameters exceeds the safety limitation, the monitoring system will alarm with sound and light signals. And the emergency response procedure will start immediately and automatically.

All data collected as part of monitoring should be archived and be kept at least for 2 years after the end of the last crediting period.

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

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Date of completion of the application of the baseline study and monitoring methodology is 30/12/2007.

Global Climate Change Institute, INET, Tsinghua University
Address: Energy and Science Building, Tsinghua University, Peking
Person in charge: LIU Deshun, GU Alun
Tel: 86-10-62772752
Fax: 86-10-62771150
E-mail: liuds@tsinghua.edu.cn
E-mail: gal@tsinghua.edu.cn

Beijing Huaxia Zhengtian International Info. Cons. Co., Ltd.
Adress: R.21C, Building C, Guangxin Jiayuan, Guang'anmennei 319, Xuanwu Dist., Beijing 100053, P.R.China
Person in charge: HE Cuiying , ZHANG Yukun
Tel: 010-83131005
Fax: 010-83131136
E-mail: hcycc1018@yahoo.com.cn
E-mail:yukun_hxzt@126.com

Responsible person(s)/entity(ies) are not project participants.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

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14/01/2005
According to CDM Glossary of terms version 05, the starting date of the project activity is defined as "the earliest date at which either the implementation or construction or real action of a project activity begin". Therefore, 14th, Jan, 2005 is the start date of the project which is earliest among those dates mentioned in the timeline in section B.5. .

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

>>
22 years 0 months

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

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

>>
Not applicable

C.2.1.2. Length of the first crediting period:

>>
Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
15/10/2011

C.2.2.2. Length:

>>
10 years 0 months

SECTION D. Environmental impacts

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

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The Environmental Impact Assessment (EIA) Report for the proposed project was prepared by Urumqi Environmental Protection Institute in May 2004 and was approved by the Environmental Protection Bureau of Xinjiang Uygur Autonomous Region in June 2004(Approved document No. Xinhuankonghan [2004] 271). In the EIA report, the potential environmental impacts of the proposed project on the water

and air quality as well as habitants' life etc are assessed. The main conclusion of the EIA report is summarized as following.

AIR QUALITY

In civil construction period, the operation of construction equipment and transport vehicles will bring dust emission. Thus, the effects on surrounding environment will be greatly mitigated as enhancing environmental management work and frequently carrying out watering. Dust emission can be eliminated when the construction activities end.

During the operation period, the heat only boilers serving as supplementary heat source will produce 2000mg/Nm^3 dust. Accordingly, an electrostatic precipitator will be configured for each boiler with collection efficiency 99%. The concentration of dust released to the atmosphere will not exceed 20mg/Nm^3, which is far less than the allowable value 200mg/Nm^3 in the Emission Standard of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boiler (GWPB3-1999). Meanwhile, the concentration of SO_2 emission will be 347 mg/Nm^3, much lower than the allowable value 900mg/Nm^3. .

WATER QUALITY

The proposed project will not cause negative impact on water quality in the surrounding environment. The wastewater discharged during civil construction is inorganic, most of which will vaporize naturally and will not be discharged off-site. The sewage water during construction and operation period will be treated in the municipal wastewater treatment system.

NOISE

The noise during civil construction will originate from transportation, loading and unloading and the subsequent building works. To reduce the impacts of noise on the residents, the construction time and interval will be controlled strictly. Some sound insulation measures will also be adopted on site, such as noise barrier and earplug.

The noises mainly originate from the fans, pumps, motors and electromagnetism during the operation period. However, the proposed project will use low-noise facilities and components, and the noisy equipments will be installed in the sound insulation houses far away from the hostel, laboratories and any other noise sensitive areas.

SOLID WASTE

During the civil construction period, the soil waste and residues will be transported to designated sites for storage and the slag will be cleared out of the boiler houses for brick making and other building materials.

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

>>
The project activity reducing the coal-dust air pollution of Urumqi City due to heating supply in winter is expected to protect the environment and is expected to have an overall positive impact on the local and global environment. The EIA has been approved by the Xinjiang Uygur Autonomous Region Environmental Protection Bureau.

SECTION E. Stakeholders' comments

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

>>
Public comments were invited to evaluate the proposed project adopting the method of sending "Public Opinion Questionnaires". The project developer has sent out investigation questionnaires to the stakeholders in the surrounding area of the proposed project in Urumqi City for the comments of the proposed project construction in November 2007. And the notice of this investigation also was published in a local newspaper with large regular reader volume in Urumqi City. During the investigation, 50 copies of questionnaire were distributed, and 50 pieces of reply were received. The response from 100% stakeholders shows a quite positive attitude towards the proposed project. In the 50 interviewees, there are 27 local residents, 15 government officials, 3 dispersive boiler staffs and 5 other persons and there are 40 Hans, 2 Uigurs and 8 in other nationalities. All of the questions in "Public Opinion Questionnaires" are listed as follows:

1. Do you know the project "Southern District Heating Network in Urumqi City"?
2. What kind of heating technology is used in your family in winter?
3. What kind of impact do you think the implementation of the project will have on the local environment
4. Do you think the implementation of the project will promote the local sustainable development?
5. Do you think the implementation of the project will increase the local job opportunity
6. Do you think this kind of "new primary district heating network" constructed now in Southern District should also be applied in other districts in Urumqi City?
7. Do you have other comments or recommendations on this project? If yes, please detail your opinions.

E.2. Summary of the comments received:

>>
The summary of the investigation is listed in Table E-1.

Table E-1: The summary of the investigation

Question	Answer	No. of Person	%
1. Do you know about the project "Southern District Heating Network in Urumqi City"?	a Yes	40	80
	b No	10	20
	c Not hearing of	0	0
2. What kind of heating technology is used in your family in Winter ?	a. Individual coal fired heating boiler	15[28]	30
	b. Individual small stoves	2	4
	c. Small isolated heating system	33	66
3. What kind of impact do you think the implementa-	a. Significantly reduce	50	100

[28] There were a few individual coal fired heating boilers and individual small stoves in winter for heating, however, such area is unlikely to meet the requirements of district heating, such as distribution of pipe network and were not included in existing buildings connected to existing boiler houses. If these building are demolished and new buildings are constructed in such area, the new small isolated heating system will be established to connect these new buildings.

tion of the project will have on the local environment ?	the coal based pollution		
	b. Negative impact	0	0
	c. Not sure	0	0
4. Do you think the implementation of the project will promote the local sustainable development ?	a. Yes	50	100
	b. No	0	0
	c. Not sure	0	0
5. Do you think the implementation of the project will increase the local job opportunity ?	a. Yes	44	88
	b. No	2	4
	c. Not sure	3	6
6. Do you think this kind of "new primary district heating network" constructed now in Southern District should also be applied in other districts in Urumqi City ?	a. Yes	50	100
	b. No	0	0
	c. Not sure	0	0

The answers by all stakeholders show that implementation of the proposed project activity will promote the energy conservation and pollutant emission reduction and improve environmental quality and investment circumstances and therefore facilitate the local economic development. All stakeholder families will be beneficial by shifting from decentralized space heating to CHP district heating. Some of the stakeholders expressed their concerns about the heating quality issue after the completion of the project. The project owner will due take into account their concerns in the next Section E.3.

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

>>

Since the comments received from the stakeholders actively present their positive altitude to the construction and implementation of the project, in general there is no significant issue that needs to be further considered. Meanwhile, some of the stakeholders are concerned about the heating supply quality, wishing the indoor temperature would not be reduced due to the change of the heating supply mode. Consequently, the project owner Urumqi Heating Supply Co., Ltd. will work out detailed heating plan in response to the various possible conditions with a view to secure the space heating temperature and the living standard of residents.

Annex 1
CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No official funding from Annex I Party Country is involved in this proposed project.

Annex 3

Table 1 Baseline information of boilers

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
1	2×2.80	2.4	42.22%
2	2×2.80 1×4.20	0.37	48.81%
3	3×2.80	5	52.77%
4	1×1.40	0.8	52.77%
5	1×2.80 1×4.20	1.2	48.71%
6	1×1.40	0.12	45.23%
7	1×1.40 1×2.80	2.2	48.37%
8	1×1.40	0.7	43.97%
9	2×4.20	3.7	44.37%
10	1×4.20 1×2.80	5	62.82%
11	1×4.20 2×2.80	5	47.12%
12	3×4.20 3×2.80 1×1.40	9.2	48.55%
13	1×7.00 1×14.00	18	47.49%
14	2×7.00 2×4.20	13	43.97%
15	2×4.20 2×2.80	8	43.97%
16	1×0.70	0.3	43.97%
17	2×2.80	2.23	58.84%
18	2×2.80	2	52.77%
19	2×2.80	3	60.89%
20	1×1.40	0.9	45.67%
21	3×4.20 1×2.80	13	45.13%
22	2×2.80	4	45.89%

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
23	1×7.00 1×4.20 1×1.40	6	43.97%
24	1×4.20 2×2.80	7	45.05%
25	1×4.20 1×1.40	3	46.56%
26	2×1.40	1.1	48.37%
27	1×1.40	1	52.77%
28	1×10.5 2×14.00	10.25	45.84%
29	4×4.20 1×14.00	30	52.77%
30	1×7.00 2×2.80	7.2	61.28%
31	1×1.40	2.5	59.97%
32	1×7.00 1×10.5 1×4.20	18.9	63.12%
33	2×1.40 1×0.70	0.25	54.97%
34	2×1.40	1.85	48.81%
35	2×14.00 1×4.20	33	64.02%
36	1×7.00 1×4.20 1×1.40	7	46.17%
37	2×7.00 1×2.80	8	52.77%
38	2×2.80	3.1	58.42%
39	3×7.00	24	45.23%
40	2×2.80 2×0.70	8	60.31%
41	1×2.80	1.5	52.77%
42	1×2.80	2	52.77%
43	1×1.40	0.9	59.37%

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
44	1×2.80 1×0.70	2	52.77%
45	1×1.40	1	52.77%
46	3×2.80 1×1.40	8	63.96%
47	1×2.80 1×4.20	3.5	61.56%
48	1×1.40	1	52.77%
49	1×2.80 1×4.20	2.2	58.05%
50	3×2.80 3×4.20	12	62.08%
51	3×2.80	2	52.77%
52	2×10.5 1×2.80	10	58.63%
53	1×2.80	1.5	56.54%
54	1×2.80	1	52.77%
55	1×2.80	0.88	58.05%
56	2×2.80	3	49.47%
57	2×2.80	3	43.97%
58	2×2.80	3	49.47%
59	2×2.80	4.5	62.49%
60	1×2.80 1×4.20	6.2	54.53%
61	1×1.40	0.8	46.91%
62	2×2.80	6.5	63.52%
63	1×2.80 1×1.40	3	52.77%
64	1×2.80 1×4.20	1	43.97%
65	3×7.00 2×2.80	25	47.12%
66	2×2.80	1	43.97%
67	2×4.20 2×2.80	4	42.22%
68	1×2.80	3.8	50.13%

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
	2×4.20		
69	1×1.40	2.9	58.86%
	1×2.80		
70	1×2.80	4	58.63%
	1×4.20		
71	2×1.40	1.6	46.91%
72	2×2.80	7	61.56%
	1×1.40		
73	2×2.80	3	52.77%
74	2×7.00	18	64.18%
	1×4.20		
75	1×2.80	1	43.97%
76	2×7.00	25	65.96%
	1×14.00		
77	2×4.20	5	43.97%
	1×2.80		
78	1×4.20	3	56.54%
79	1×4.20	0.4	52.77%
	1×2.80		
	1×1.40		
80	1×2.80	8.3	47.61%
	1×7.00		
	1×4.20		
81	1×2.80	2	47.97%
	2×1.40		
82	1×1.40	3	49.47%
	1×4.20		
83	1×1.40	4	60.31%
	1×4.20		
84	1×4.20	3.5	48.60%
	1×2.80		
85	4×1.40	2	52.77%
86	2×4.20	3.5	57.72%
	1×2.80		
87	1×4.20	2	47.97%

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
88	1×2.80 1×1.40	2.1	55.41%
89	1×0.70	0.6	43.97%
90	1×2.80	2.2	58.05%
91	2×2.80	5	62.82%
92	1×1.40	1.2	52.77%
93	1×4.20 1×4.20 1×1.40	8	58.63%
94	1×0.70	0.2	43.97%
95	2×4.20 2×28.00	46	60.69%
96	2×4.20 2×2.80	6.5	57.17%
97	1×2.80 1×4.20	2.4	48.71%
98	3×7.00	18	52.77%
99	1×2.80 6×0.70	2.1	50.37%
100	2×7.00 3×2.80	12	57.57%
101	2×2.80 1×4.20	7	61.56%
102	1×0.70	0.6	52.77%
103	1×2.80	2	47.97%
104	2×4.20	9	49.47%
105	1×1.40	0.5	43.97%
106	1×2.80	1.1	58.05%
107	2×2.80	3.6	47.49%
108	4×2.80	3.7	48.81%
109	1×1.40	1.5	56.54%
110	1×2.80	3	60.89%
111	1×2.80 1×4.20	4	58.63%
112	2×2.80	3	56.54%
113	1×4.20	3	46.56%
114	1×4.20	3	52.77%
115	2×4.20	0.9	47.49%

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
116	2×2.80 2×4.20	14	58.63%
117	1×2.80	2.5	43.97%
118	1×2.80	2	43.97%
119	3×1.40	3.3	43.54%
120	1×14.00 2×10.5 1×7.00	46	60.69%
121	2×2.80	5	65.96%
122	2×2.80	2	52.77%
123	2×1.40	2.1	55.41%
124	1×7.00 2×4.20 2×2.80	11	42.68%
125	1×4.20 1×2.80	7	54.53%
126	1×7.00 2×4.20	18	65.06%
127	1×7.00 1×4.20 1×2.80	8	52.77%
128	1×7.00 1×14.00	10	47.12%
129	1×7.00 1×4.20	9.7	51.19%
130	2×2.80	2.1	55.41%
131	1×1.40	1.1	58.05%
132	2×2.80	3	57.36%
133	1×2.80	1.4	47.36%
134	3×4.20	6.1	47.34%
135	2×4.20 1×2.80	10	53.85%
136	2×2.80	0.7	52.77%
137	2×2.80	4	58.63%
138	1×2.80 1×1.40	3	49.47%
139	1×2.80	3	52.77%
140	2×29.00 1×14.00	75.45	72.13%

Series of boiler No.	Installed capacity (MW)	$A_{j,i}$	ε_{boiler}
141	1×14.00	30	52.77%
	1×10.5		
	1×2.80		
142	1×7.00	6	46.56%
143	2×4.20	7	54.32%
144	6×29	227.9	66.63%
145	1×29	253.6	71.84%
	5×46		

Table 2 List of existing coal fired boilers and remaining lifetime

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
		C=2009-A	D=B*C	
1	1991	43,905	19	834,195
2	1991	5,854	19	111,226
3	1990	73,175	20	1,463,500
4	1991	11,708	19	222,452
5	2000	19,026	10	190,255
6	1991	2,049	19	38,929
7	1990	35,124	20	702,480
8	1992	12,293	18	221,281
9	2000	64,394	10	643,940
10	2002	61,467	8	491,736
11	2000	81,956	10	819,560
12	2002	146,350	8	1,170,800
13	2000	292,700	10	2,927,000
14	1996	228,306	14	3,196,284
15	2003	140,496	7	983,472
16	2002	5,269	8	42,149
17	2000	29,270	10	292,700
18	1993	29,270	17	497,590
19	1992	38,051	18	684,918
20	1990	15,220	20	304,408
21	1999	222,452	11	

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
				2,446,972
22	2001	67,321	9	605,889
23	1999	105,372	11	1,159,092
24	1999	120,007	11	1,320,077
25	2000	49,759	10	497,590
26	2000	17,562	10	175,620
27	2000	14,635	10	146,350
28	2001	172,693	9	1,554,237
29	1999	439,050	11	4,829,550
30	2001	90,737	9	816,633
31	1999	32,197	11	354,167
32	2002	231,233	8	1,849,864
33	2001	3,512	9	31,612
34	2002	29,270	8	234,160
35	2000	398,072	10	3,980,720
36	1999	117,080	11	1,287,880
37	2000	117,080	10	1,170,800
38	2000	40,978	10	409,780
39	1999	409,780	11	4,507,580
40	2002	102,445	8	819,560
41	1999	21,953	11	241,478
42	2000	29,270	10	292,700
43	2001	11,708	9	105,372

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
44	1999	29,270	11	321,970
45	1999	14,635	11	160,985
46	2000	96,591	10	965,910
47	2000	43,905	10	439,050
48	2000	14,635	10	146,350
49	2001	29,270	9	263,430
50	1999	149,277	11	1,642,047
51	1999	29,270	11	321,970
52	2000	131,715	10	1,317,150
53	2000	20,489	10	204,890
54	2000	14,635	10	146,350
55	1999	11,708	11	128,788
56	2001	46,832	9	421,488
57	2000	52,686	10	526,860
58	2000	46,832	10	468,320
59	2001	55,613	9	500,517
60	1999	87,810	11	965,910
61	2000	13,172	10	131,715
62	2001	79,029	9	711,261
63	1999	43,905	11	482,955
64	1999	17,562	11	193,182
65	1999	409,780	11	4,507,580
66	2001	17,562	9	

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
				158,058
67	2000	73,175	10	731,750
68	1999	58,540	11	643,940
69	2000	38,051	10	380,510
70	2001	52,686	9	474,174
71	2000	26,343	10	263,430
72	1999	87,810	11	965,910
73	2000	43,905	10	439,050
74	2001	216,598	9	1,949,382
75	2000	17,562	10	175,620
76	1999	292,700	11	3,219,700
77	1999	87,810	11	965,910
78	2000	40,978	10	409,780
79	2000	5,854	10	58,540
80	2001	134,642	9	1,211,778
81	1999	32,197	11	354,167
82	2001	46,832	9	421,488
83	2002	51,223	8	409,780
84	2000	55,613	10	556,130
85	2000	29,270	10	292,700
86	2001	46,832	9	421,488
87	2000	32,197	10	321,970
88	1999	29,270	11	321,970

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
89	2000	10,537	10	105,372
90	1999	29,270	11	321,970
91	2000	61,467	10	614,670
92	2000	17,562	10	175,620
93	1999	105,372	11	1,159,092
94	2000	3,512	10	35,124
95	1998	585,400	12	7,024,800
96	1994	87,810	16	1,404,960
97	1999	38,051	11	418,561
98	2000	263,430	10	2,634,300
99	2001	32,197	9	289,773
100	2003	160,985	7	1,126,895
101	2001	87,810	9	790,290
102	1999	8,781	11	96,591
103	2000	32,197	10	321,970
104	2001	140,496	9	1,264,464
105	2000	8,781	10	87,810
106	2001	14,635	9	131,715
107	2000	58,540	10	585,400
108	2002	58,540	8	468,320
109	2000	20,489	10	204,890
110	1999	38,051	11	418,561
111	2001	52,686	9	

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
				474,174
112	2000	40,978	10	409,780
113	2003	49,759	7	348,313
114	2003	43,905	7	307,335
115	2003	14,635	7	102,445
116	2000	184,401	10	1,844,010
117	1999	43,905	11	482,955
118	2000	35,124	10	351,240
119	2003	58,540	7	409,780
120	1999	585,400	11	6,439,400
121	1998	58,540	12	702,480
122	1991	29,270	19	556,130
123	2002	29,270	8	234,160
124	1990	199,036	20	3,980,720
125	1998	87,810	12	1,053,720
126	1998	213,671	12	2,564,052
127	1998	117,080	12	1,404,960
128	2000	163,912	10	1,639,120
129	1999	146,350	11	1,609,850
130	1999	29,270	11	321,970
131	2001	14,635	9	131,715
132	1999	40,393	11	444,319
133	2000	22,831	10	228,306

Series number of boiler houses (i)	Commission date (A)	Heat generation (GJ) (B)	Age of boilers (Year) (C)	D
134	2000	99,518	10	995,180
135	2000	143,423	10	1,434,230
136	2000	10,245	10	102,445
137	2001	52,686	9	474,174
138	2000	46,832	10	468,320
139	1999	43,905	11	482,955
140	2000	807,852	10	8,078,520
141	2001	439,050	9	3,951,450
142	2000	99,518	10	995,180
143	2000	99,518	10	995,180
144	2000	1,523,056	10	15,230,560
145	2002	3,036,552	8	24,292,420
Total		17,663,787		178015156
Average age	$\frac{\sum_i D}{\sum_i B}$	10.08	Average remaining lifetime	14.92

Table 3 The detailed information of sub-station *i*

Category a Substation in the project (connected to buildings supplied by only one boiler house in baseline scenario)

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$CAP_{j,i}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{HG,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I312	98	180,000	0	0	180,000	137,635	-	21.0	328,406	137,635	0.1889	26,004
I316	76	250,000	0	0	250,000	191,160	-	28.0	437,875	191,160	0.1511	28,893
I323	78	30,000	70,000	0	100,000	22,939	48,659	4.2	65,681	65,681	0.1763	11,582
I329	128	100,000	30,000	0	130,000	76,464	20,854	21.0	328,406	97,318	0.2116	20,593
I330	129	97,000	20,000	0	117,000	74,170	13,903	11.2	175,150	88,073	0.1948	17,155
I332	29	300,000	0	0	300,000	229,392	-	30.8	481,663	229,392	0.1889	43,340
I333	30	72,000	0	0	72,000	55,054	-	12.6	197,044	55,054	0.1627	8,957
I334	28	102,500	30,000	0	132,500	78,376	20,854	38.5	602,078	99,229	0.2175	21,583
I336	65	250,000	0	0	250,000	191,160	-	26.6	415,981	191,160	0.2116	40,451
I350	121	50,000	60,000	0	110,000	38,232	41,708	5.6	87,575	79,940	0.1511	12,083
I355	47	35,000	50,000	0	85,000	26,762	34,756	7.0	109,469	61,519	0.1619	9,963
I361	100	120,000	40,000	0	160,000	91,757	27,805	22.4	350,300	119,562	0.1732	20,707
I364	40	80,000	0	0	80,000			7.0	109,469	61,171	0.1653	10,113

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$CAP_{j,i}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{HG,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
						61,171	-					
I366	21	130,000	0	0	130,000	99,403	-	15.4	240,831	99,403	0.2209	21,959
I369	22	40,000	0	0	40,000	30,586	-	5.6	87,575	30,586	0.2173	6,645
I370	52	100,000	30,000	0	130,000	76,464	20,854	23.8	372,194	97,318	0.1700	16,548
I376	12	92,000	0	0	92,000	70,347	-	22.4	350,300	70,347	0.2054	14,447
I377	13	180,000	0	0	180,000	137,635	-	21.0	328,406	137,635	0.2099	28,893
I378	14	130,000	0	0	130,000	99,403	-	22.4	350,300	99,403	0.2267	22,537
I380	37	80,000	0	0	80,000	61,171	-	16.8	262,725	61,171	0.1889	11,557
I381	15	80,000	0	0	80,000	61,171	-	14.0	218,938	61,171	0.2267	13,869
I382	38	31,000	0	0	31,000	23,704	-	5.6	87,575	23,704	0.1706	4,045
I383	39	240,000	0	0	240,000	183,513	-	21.0	328,406	183,513	0.2204	40,451
I384	1	24,000	0	0	24,000	18,351	-	5.6	87,575	18,351	0.2362	4,334
I385	34	18,500	0	0	18,500	14,146	-	2.8	43,788	14,146	0.2043	2,889

Category b Substation in the project (connected to buildings supplied by several boiler houses separately in baseline scenario)

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$Cap_{i,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m^2	m^2	m^2	m^2	GJ	GJ	MW	GJ	GJ	tCO_2/GJ	tCO_2
I379	2	3,700	0	0	65,700	50,237	-	9.8	153,256	50,237	0.18893	9,491
	3	50,000						8.4	131,363			
	5	12,000						7.0	109,469			
I374	4	8,000	0	0	67,000	51,231	-	1.4	21,894	51,231	0.18893	9,679
	7	22,000						4.2	65,681			
	9	37,000						8.4	131,363			
I375	6	1,200	0	0	58,200	44,502	-	1.4	21,894	44,502	0.15870	7,063
	8	7,000						1.4	21,894			
	10	50,000						7.0	109,469			
I373	11	50,000	150,000	0	203,000	40,526	104,269	9.8	153,256	144,795	0.21161	30,639
	16	3,000						0.7	10,947			
I367	17	22,300	0	0	121,300	92,751	-	5.6	87,575	92,751	0.16374	15,187
	18	20,000						5.6	87,575			
	19	30,000						5.6	87,575			
	20	9,000						1.4	21,894			
	25	30,000						5.6	87,575			
	27	10,000						1.4	21,894			
I368	23	60,000	0	0	141,000	107,814	-	12.6	197,044	107,814	0.20611	22,222
	24	70,000						22.4	350,300			
	26	11,000						2.8	43,788			

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$Cap_{i,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m^2	m^2	m^2	m^2	GJ	GJ	MW	GJ	GJ	tCO_2/GJ	tCO_2
I331	31	25,000	0	0	214,000	163,633	-	1.4	21,894	163,633	0.15794	25,845
	32	189,000						21.7	339,353			
I318	33	2,500	50,000	0	122,500	55,436	34,756	3.5	54,734	90,193	0.18138	16,359
	36	70,000						12.6	197,044			
I365	41	15,000	0	0	186,000	142,223	-	2.8	43,788	142,223	0.15587	22,168
	42	20,000						2.8	43,788			
	43	9,000						1.4	21,894			
	44	20,000						3.5	54,734			
	45	10,000						1.4	21,894			
	46	80,000						9.8	153,256			
	48	10,000						1.4	21,894			
	49	22,000						7.0	109,469			
I372	50	120,000	50,000	0	190,000	107,050	34,756	21.0	328,406	141,806	0.16059	22,773
	51	20,000						8.4	131,363			
I371	53	15,000	0	0	123,800	94,662	-	2.8	43,788	94,662	0.17176	16,259
	54	10,000						2.8	43,788			
	55	8,800						2.8	43,788			
	56	30,000						5.6	87,575			
	57	30,000						5.6	87,575			
	58	30,000						5.6	87,575			
I348	59	45,000	0	0	107,000			5.6	87,575	81,816	0.15954	13,053

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$Cap_{i,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m^2	m^2	m^2	m^2	GJ	GJ	MW	GJ	GJ	tCO_2/GJ	tCO_2
						81,816	-					
	60	62,000						7.0	109,469			
I356	61	8,000	0	0	113,000	86,404	-	1.4	21,894	86,404	0.15696	13,562
	62	65,000						5.6	87,575			
	63	30,000						4.2	65,681			
	64	10,000						7.0	109,469			
I337	66	10,000	50,000	0	138,000	67,288	34,756	5.6	87,575	102,045	0.19888	20,294
	67	40,000						14.0	218,938			
	68	38,000						11.2	175,150			
I340	69	29,000	0	0	85,000	64,994	-	4.2	65,681	64,994	0.16939	11,009
	70	40,000						7.0	109,469			
	71	16,000						2.8	43,788			
I322	72	70,000	40,000	0	152,000	85,640	27,805	7.0	109,469	113,445	0.16194	18,372
	73	30,000						5.6	87,575			
	92	12,000						1.4	21,894			
I317	74	180,000	0	0	190,000	145,282	-	18.2	284,619	145,282	0.15535	22,569
	75	10,000						2.8	43,788			
I313	77	50,000	0	0	187,000	142,988	-	11.2	175,150	142,988	0.18893	27,015
	79	4,000						8.4	131,363			
	80	83,000						14.0	218,938			

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$Cap_{i,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m^2	m^2	m^2	m^2	GJ	GJ	MW	GJ	GJ	tCO_2/GJ	tCO_2
	81	20,000						5.6	87,575			
	82	30,000						5.6	87,575			
I314	83	40,000	0	0	156,000	119,284	-	5.6	87,575	119,284	0.16532	19,720
	84	35,000						7.0	109,469			
	85	20,000						5.6	87,575			
	86	35,000						11.2	175,150			
	87	20,000						4.2	65,681			
	89	6,000						0.7	10,947			
I321	88	21,000	40,000	0	133,000	71,111	27,805	4.2	65,681	98,917	0.15870	15,698
	90	22,000						2.8	43,788			
	91	50,000						5.6	87,575			
I304	93	80,000	0	0	82,000	62,700	-	9.8	153,256	62,700	0.17004	10,662
	94	2,000						0.7	10,947			
I303	142	60,000	0	0	130,000	99,403	-	7.0	109,469	99,403	0.18354	18,244
	143	70,000						8.4	131,363			
I311	96	65,000	0	0	89,000	68,053	-	14.0	218,938	68,053	0.17440	11,868
	97	24,000						7.0	109,469			
I362	101	70,000	0	0	238,000	181,984	-	9.8	153,256	181,984	0.16194	29,471
	102	6,000						0.7	10,947			
	103	20,000						2.8	43,788			

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$Cap_{i,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m^2	m^2	m^2	m^2	GJ	GJ	MW	GJ	GJ	tCO_2/GJ	tCO_2
	104	90,000						8.4	131,363			
	105	5,000						1.4	21,894			
	106	11,000						2.8	43,788			
	107	36,000						5.6	87,575			
I363	108	37,000	0	0	152,000	116,225	-	11.2	175,150	116,225	0.16374	19,031
	109	15,000						1.4	21,894			
	110	30,000						2.8	43,788			
	111	40,000						7.0	109,469			
	112	30,000						5.6	87,575			
I359	113	30,000	0	0	234,000	178,926	-	4.2	65,681	178,926	0.17004	30,425
	114	30,000						4.2	65,681			
	115	9,000						8.4	131,363			
	116	140,000						14.0	218,938			
	117	25,000						2.8	43,788			
I353	118	20,000	0	0	53,000	40,526	-	2.8	43,788	40,526	0.22672	9,188
	119	33,000						4.2	65,681			
I346	123	21,000	0	0	131,000	100,168	-	2.8	43,788	100,168	0.17994	18,024
	124	110,000						21.0	328,406			
I360	130	21,000	30,000	0	167,000	104,756	20,854	5.6	87,575	125,609	0.17176	21,574
	131	11,000						1.4	21,894			
	132	30,000						5.6	87,575			

Substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$Cap_{i,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m^2	m^2	m^2	m^2	GJ	GJ	MW	GJ	GJ	tCO_2/GJ	tCO_2
	133	14,000						2.8	43,788			
	134	61,000						12.6	197,044			
I354	135	100,000	0	0	207,000	158,280	-	11.2	175,150	158,280	0.17004	26,914
	136	7,000						5.6	87,575			
	137	40,000						5.6	87,575			
	138	30,000						4.2	65,681			
	139	30,000						2.8	43,788			

Category c Substation in the project (connected to partial buildings supplied by one boiler house in baseline scenario)

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I305	95	180,000	0	0	180,000	137,635	-	64.4	1,007,113	393,442	0.16429	64,639
I306		180,000	0	0	180,000	137,635	-					
I307		100,000	60,000	0	160,000	76,464	41,708					
I401	140	159,300	0	0	159,300	121,807	-	72.0	1,125,965	576,921	0.13823	79,745
I410		83,800	0	0	83,800	64,077	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I411		81,800	0	0	81,800	62,548	-					
I402		51,900	0	0	51,900	39,685	-					
I403		62,000	0	0	62,000	47,408	-					
I404		74,600	0	0	74,600	57,042	-					
I405		77,600	0	0	77,600	59,336	-					
I406		43,700	0	0	43,700	33,415	-					
I407		35,500	0	0	35,500	27,145	-					
I408		61,900	0	0	61,900	47,331	-					
I409		22,400	0	0	22,400	17,128	-					
I301	141	150,000	0	0	150,000	114,696	-	27.3	426,928	229,392	0.18893	43,340
I302		150,000	0	0	150,000	114,696	-					
I101	144	81,000	0	0	81,000	61,936	-	174.0	2,721,082	1,743,378	0.14963	260,858
I110		75,000	0	0	75,000	57,348	-					
I111		27,000	0	0	27,000	20,645	-					
I112		43,000	0	0	43,000	32,880	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I113		117,000	0	0	117,000	89,463	-					
I114		81,000	0	0	81,000	61,936	-					
I115		74,000	0	0	74,000	56,583	-					
I116		90,000	0	0	90,000	68,818	-					
I117		26,000	0	0	26,000	19,881	-					
I118		12,000	0	0	12,000	9,176	-					
I119		2,000	0	0	2,000	1,529	-					
I102		26,000	0	0	26,000	19,881	-					
I120		19,000	0	0	19,000	14,528	-					
I121		6,000	0	0	6,000	4,588	-					
I122		26,000	0	0	26,000	19,881	-					
I123		11,000	0	0	11,000	8,411	-					
I124		55,000	0	0	55,000	42,055	-					
I125		41,000	0	0	41,000	31,350	-					
I126		3,000	0	0	3,000	2,294	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I127		62,000	0	0	62,000	47,408	-					
I128		75,000	0	0	75,000	57,348	-					
I129		65,000	0	0	65,000	49,702	-					
I103		59,000	0	0	59,000	45,114	-					
I130		5,000	0	0	5,000	3,823	-					
I131		72,000	0	0	72,000	55,054	-					
I132		95,000	0	0	95,000	72,641	-					
I133		18,000	0	0	18,000	13,764	-					
I134		20,000	0	0	20,000	15,293	-					
I135		120,000	0	0	120,000	91,757	-					
I136		93,000	0	0	93,000	71,111	-					
I137		50,000	0	0	50,000	38,232	-					
I138		11,000	0	0	11,000	8,411	-					
I139		9,000	0	0	9,000	6,882	-					
I104		72,000	0	0	72,000	55,054	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I140		44,000	0	0	44,000	33,644	-					
I141		67,000	0	0	67,000	51,231	-					
I142		24,000	0	0	24,000	18,351	-					
I143		125,000	0	0	125,000	95,580	-					
I105		63,000	0	0	63,000	48,172	-					
I106		97,000	0	0	97,000	74,170	-					
I107		115,000	0	0	115,000	87,934	-					
I108		66,000	0	0	66,000	50,466	-					
I109		38,000	0	0	38,000	29,056	-					
I201	145	19,000	0	0	19,000	14,528	-	259.0	4,050,346	1,939,126	0.13878	269,108
I210		77,000	0	0	77,000	58,877	-					
I211		80,000	0	0	80,000	61,171	-					
I212		36,000	0	0	36,000	27,527	-					
I213		55,000	0	0	55,000	42,055	-					
I214		17,000	0	0	17,000	12,999	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I215		25,000	0	0	25,000	19,116	-					
I216		38,000	0	0	38,000	29,056	-					
I217		43,000	0	0	43,000	32,880	-					
I218		34,000	0	0	34,000	25,998	-					
I219		56,000	0	0	56,000	42,820	-					
I202		9,000	0	0	9,000	6,882	-					
I220		68,000	0	0	68,000	51,995	-					
I221		32,000	0	0	32,000	24,468	-					
I222		10,000	0	0	10,000	7,646	-					
I223		9,000	0	0	9,000	6,882	-					
I224		26,000	0	0	26,000	19,881	-					
I225		27,000	0	0	27,000	20,645	-					
I226		11,000	0	0	11,000	8,411	-					
I227		47,000	0	0	47,000	35,938	-					
I228		110,000	0	0	110,000	84,110	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I229		63,000	0	0	63,000	48,172	-					
I203		65,000	0	0	65,000	49,702	-					
I230		105,000	0	0	105,000	80,287	-					
I231		37,000	0	0	37,000	28,292	-					
I232		82,000	0	0	82,000	62,700	-					
I233		36,000	0	0	36,000	27,527	-					
I234		72,000	0	0	72,000	55,054	-					
I235		22,000	0	0	22,000	16,822	-					
I236		7,000	0	0	7,000	5,352	-					
I237		20,000	0	0	20,000	15,293	-					
I238		5,000	0	0	5,000	3,823	-					
I239		34,000	0	0	34,000	25,998	-					
I204		124,000	0	0	124,000	94,815	-					
I240		61,000	0	0	61,000	46,643	-					
I241		4,000	0	0	4,000	3,059	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I242		7,000	0	0	7,000	5,352	-					
I243		74,000	0	0	74,000	56,583	-					
I244		33,000	0	0	33,000	25,233	-					
I245		28,000	0	0	28,000	21,410	-					
I246		18,000	0	0	18,000	13,764	-					
I247		51,000	0	0	51,000	38,997	-					
I248		33,000	0	0	33,000	25,233	-					
I249		93,000	0	0	93,000	71,111	-					
I205		102,000	0	0	102,000	77,993	-					
I250		52,000	0	0	52,000	39,761	-					
I251		81,000	0	0	81,000	61,936	-					
I252		24,000	0	0	24,000	18,351	-					
I253		5,000	0	0	5,000	3,823	-					
I254		11,000	0	0	11,000	8,411	-					
I255		48,000	0	0	48,000	36,703	-					

No. of substation i	No. of boiler house	$A_{i,1}$	$A_{i,2}$	$A_{i,3}$	A	$Q_{i,1,y}$	$Q_{i,2,y}$	$C_{api,j}$	$Q_{inst\_cap,j,i}$	Q_{min}	$EF_{BL,HG,j,i}$	$BE_{i,j,y}$
		m2	m2	m2	m2	GJ	GJ	MW	GJ	GJ	tCO2/GJ	tCO2
I206		77,000	0	0	77,000	58,877	-					
I207		62,000	0	0	62,000	47,408	-					
I208		81,000	0	0	81,000	61,936	-					
I209		90,000	0	0	90,000	68,818	-					

Category d Substation in the project (connected to partial buildings supplied by several boiler houses in the baseline scenario

No. of substation	No. of boiler house	Ai,1	Ai,2	Ai,3	A	Qi,1,y	Qi,2,y	Capi,j	Qinst_cap,j,i	Q_{min}	EFBL,HG,j,i	BEi,j,y
		m2	m2	m2	m2	GJ	GJ	MW	GJ		tCO2/GJ	tCO2
I315	99	101,000	0	0	101,000	77,229	-	7.0	109,469	296,194	0.15573	46,125
						-	-		-			
I325	35	100,000	40,000	0	140,000	76,464	27,805	32.2	503,556			
I326		150,000	0	0	150,000	114,696	-		-			
I344	120	240,000	0	0	240,000	183,513	-	42.0	656,813	367,027	0.16429	60,299
I345		240,000	0	0	240,000	183,513	-		-			
	122							5.6	87,575			

No. of substation	No. of boiler house	Ai,1	Ai,2	Ai,3	A	Qi,1,y	Qi,2,y	Capi,j	Qinst_cap,j,i	Q_{min}	EFBL,HG,j,i	BEi,j,y
		m2	m2	m2	m2	GJ	GJ	MW	GJ		tCO2/GJ	tCO2
						-	-					
I351	125	170,000	0	0	170,000	129,989	-	7.0	109,469	252,331	0.15325	38,669
	126					-	-	15.4	240,831			
I352		160,000	0	0	160,000	122,342	-		-			
	127					-	-	14.0	218,938			

Substation in the project (only connected to new buildings)

Substation i	No. of boiler house	Ai,1	Ai,2	Ai,3	A	Qi,3,y		Capi,j	Qinst_cap,j,i		EFBL,HG,j,i	BEi,j,y
		m2	m2	m2	m2	GJ		MW	GJ		tCO2/GJ	tCO2
I308	-	0	0	180000	180000	125,123			-		0.11729	14,676
I309	-	0	0	180000	180000	125,123			-		0.11729	14,676
I310	-	0	0	180000	180000	125,123			-		0.11729	14,676
I319	-	0	0	150000	150000	104,269			-		0.11729	12,230

Substation i	No. of boiler house	Ai,1	Ai,2	Ai,3	A	Qi,3,y		Capi,j	Qinst_cap,j,i		EFBL,HG,j,i	BEi,j,y
		m2	m2	m2	m2	GJ		MW	GJ		tCO2/GJ	tCO2
I320	-	0	0	40000	40000	27,805			-		0.11729	3,261
I324	-	0	0	130000	130000	90,366			-		0.11729	10,599
I327	-	0	0	175000	175000	121,647			-		0.11729	14,269
I328	-	0	0	175000	175000	121,647			-		0.11729	14,269
I335	-	0	0	100000	100000	69,513			-		0.11729	8,153
I338	-	0	0	225000	225000	156,404			-		0.11729	18,345
I339	-	0	0	225000	225000	156,404			-		0.11729	18,345
I341	-	0	0	100000	100000	69,513			-		0.11729	8,153
I342	-	0	0	150000	150000	104,269			-		0.11729	12,230
I343	-	0	0	150000	150000	104,269			-		0.11729	12,230
I349	-	0	0	60000	60000	41,708			-		0.11729	4,892
I357	-	0	0	150000	150000	104,269			-		0.11729	12,230
I358	-	0	0	150000	150000	104,269			-		0.11729	12,230

Annex 4

MONITORING INFORMATION

Table 1 Technical specification of monitoring instruments

Location	Instrument	Function	Accuracy	Calibration period	Monitoring frequency
Xinjiang Huadian Hongyanchi Power Plant Co., Ltd.	main electricity meter	amount of electricity supply	0.5	1 year	Continuous, annual registration
	backup electricity meter	amount of electricity supply	0.5	1 year	Continuous, annual registration
	electronic weighing balance	quantity of coal into the plant	III	1 year	continuous
	electronic strap balance	quantity of coal into the boilers	±0.5%	1 year	continuous
	heat meter	amount of heat supply	±0.5%	3 years	Hourly
Xingfu Road HOB boiler house	electronic weighing balance	quantity of coal into the plant	III	1 year	continuous
	electronic strap balance	quantity of coal into the boilers	±0.5%	1 year	continuous
	heat meter	amount of heat supply	±0.5%	3 years	Hourly
Guangming Road HOB boiler house	electronic weighing balance	quantity of coal into the plant	III	1 year	continuous
	electronic strap balance	quantity of coal into the boilers	±0.5%	1 year	continuous
	heat meter	amount of heat supply	±0.5%	3 years	Hourly
Xinsheng HOB boiler house	electronic weighing balance	quantity of coal into the plant	III	1 year	continuous
	electronic strap balance	quantity of coal into the boilers	±0.5%	1 year	continuous
	heat meter	amount of heat supply	±0.5%	3 years	Hourly
Weihuliang HOB boiler house	electronic weighing balance	quantity of coal into the plant	III	1 year	continuous
	electronic strap balance	quantity of coal into the boilers	±0.5%	1 year	continuous
	heat meter	amount of heat supply	±0.5%	3 years	Hourly
Substations	heat meter	amount of heat supply	±0.5%	3 years	Hourly