Environmental Impact Assessment

Project Number: 47052
July 2014

People's Republic of China: Low Carbon District Heating Project in Hohhot in Inner Mongolia Autonomous Region

Prepared by Hohhot City Development Investment and Operation Company and Hohhot Chengfa Heating Company for Asian Development Bank

CURRENCY EQUIVALENTS
(as of 25 June 2014)

Currency unit	–	Yuan (CNY)
CNY1.00	=	$ 0.1603
$1.00	=	CNY 6.2402

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Person
ASL	Above Sea Level
CEMS	Continuous Emissions Monitoring System
CHP	Combined Heat and Power
CNY	Chinese Yuan
CSEMP	Construction Site Environmental Management Plan
EA	Executing Agency
EHS	Environment, Health and Safety
EHSS	Environment, Health and Safety Specialist
EHSU	Environment, Health and Safety Unit
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EMS	Environmental Monitoring Station
EPB	Environmental Protection Bureau
FGD	Flue-Gas Desulfurization
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Green House Gas
GIMAR	Government of Inner Mongolia Autonomous Region
GIP	Good International Practice
GRM	Grievance Redress Mechanism
HCDIO	Hohhot City Development Investment and Operation Company
HDPE	High Density Polyethylene
HES	Heat Exchange Station
HH	Household
HSP	Heat Supply Plant
IA	Implementing Agency
IEE	Initial Environmental Examination
IMAR	Inner Mongolia Autonomous Region
IT	Interim Target
LIC	Loan Implementation Consultant
MEP	Ministry of Environmental Protection

MSDS	Material Safety Data Sheet
NG	Natural Gas
OM	Operations Manual, ADB
PCR	Physical Cultural Resources
PPCU	Project Public Complaint Unit
PPE	Personnel Protective Equipment
PPTA	Project Preparatory Technical Assistance
PRC	People's Republic of China
PUR	Polyurethane
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SPS	Safeguard Policy Statement, ADB
TA	Technical Assistance
UPS	Uninterrupted Power Supply
WB	World Bank
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

WEIGHTS AND MEASURES

BOD_5	Biochemical Oxygen Demand, five days
$CaCO_3$	Calcium Carbonate
cm	Centimeter
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dB(A)	A-weighted sound pressure level in decibels
DO	Dissolved Oxygen
GJ	Gigajoules
GWh	Gigawatt Hour
ha	Hectare
kg	Kilogram
km	Kilometer
kV	Kilovolt
kWh	Kilowatt Hour
Leq	Equivalent Continuous Noise Level
m	Meter
m/s	Meters per Second
m^3	Cubic Meters
mg/l	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
MW	Megawatt
NO_2	Nitrogen Dioxide

NO_x	Nitrogen Oxides
^oC	Degrees Celsius
pH	A measure of the acidity or alkalinity of a solution
PM_{10}	Particulate Matter smaller than 10 micrometers
$PM_{2.5}$	Particulate Matter smaller than 2.5 micrometers
SO_2	Sulfur Dioxide
t/h	Tons per Hour
TSP	Total Suspended Particulates

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Environmental Impact Assessment (EIA) report for the proposed Low Carbon District Heating Project (the Project) in Inner Mongolia Autonomous Region (IMAR) of the People's Republic of China (PRC). The Project consists of the Haoqingying, Xinjiaying and Jinqiao district heating zones located in eastern Hohhot City. The Project was initially designed incorporating coal-fired heat supply plants (HSPs) and pilot testing of a 25 MW wind powered electrode boiler. To address concerns about the environmental impacts of coal as a heating source, the design was subsequently revised to utilize low nitrogen oxides (NO_x) natural gas-fired HSPs, and the wind powered electrode boiler capacity was increased to 50 MW.

B. Policy, Legal and Administrative Framework for Environmental Impact Assessment

2. Environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Domestic EIA studies are required to be undertaken by relevant PRC environmental laws and regulations. National and local legal and institutional frameworks for EIA review and approval have been established to ensure that proposed projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards. The domestic EIA reports for the Project were prepared by a qualified EIA consultant and were approved on 28 March 2014 by the Hohhot Environmental Protection Bureau (EPB).

3. ADB's Safeguard Policy Statement (SPS, 2009) has also been carefully considered. The Project has been classified by ADB as environment category A, requiring the preparation of an EIA (this report). All applicable requirements of the SPS have been addressed in the EIA.

C. Project Scope

4. The Project scope includes: (i) 21 boilers with a heating capacity of 1,610 MW, comprising 19 low NO_x natural gas-fired boilers and two 25 MW wind powered demonstration 10 kV electrode boilers; (ii) 73.76 km of primary heating network; (iii) 180 Heat Exchange Stations (HESs), 11 of which will be building-level HESs; and (iv) SCADA systems installed in all three heating zones. In addition, once the Project is operational, 50 inefficient and polluting small coal-fired boilers in the Jinqiao heating zone will be decommissioned by the Hohhot municipal government.

D. Implementation Arrangements

5. The Government of IMAR (GIMAR) will be the executing agency (EA) and the Hohhot City Development Investment and Operation Company (HCDIO) will be the implementing agency (IA). HCDIO has appointed three Branches which will have direct responsibility for each heating zone.

E. Budget and Time Schedule

6. The Project cost is estimated at 2.389 billion CNY ($391.86 million). The ADB loan will finance 38.3% (914.54 million CNY or $150 million) from ordinary capital resources, the

IA will finance 20.3% (484.600 million CNY or $79.482 million), and the China Everbright Bank will finance 41.4% (990.700 million CNY or $162.377 million). The total construction period for the Project will be approximately 5 years.

F. Description of the Environment

Location and Topography

7. The Project consists of three heating zones located in the eastern part of Hohhot City:

- The Haoqingying heating zone is located in Xincheng District in northeastern Hohhot. This is a relatively undeveloped district, which was previously farmland, and is the main area for Hohhot's future urban development.

- The Xinjiaying heating zone is located in Saihan District in central eastern Hohhot, adjacent to the site of the existing HSP owned by HCDIO. This area was also previously farmland, and is also designated for future urban expansion.

- The Jinqiao heating zone is located in the Jinqiao in Saihan District in southeastern Hohhot. The site consists of an abandoned brick and tile factory and unused land, and is considered waste land.

8. Hohhot is on the northern edge of the Hetao Plateau (upper reaches of the Yellow River) and the southern edge of the Gobi Desert. It has an elevation of 1,065 masl. The urban topography is flat, though the Daqing Shan Mountains are immediately to the north and the Man Han range is to the southeast. All three heating zones have flat topography.

Meteorology and Climate

9. Hohhot has a temperate continental monsoon climate with long cold dry winters, short hot summers, and dry windy springs. The annual average temperature is 8.7 ^{0}C, the maximum temperature in July is 38.5 ^{0}C, and the minimum temperature in December is -27.6 ^{0}C. Annual average precipitation is 393.2 mm, with April to October accounting for about 94% of the total rainfall throughout the year. The area receives an annual average of 2,662.7 hours sunlight. All three HSPs have been sited to take into account the predominant NW wind direction during the heating season, with sparsely populated areas to the SE.

Water Resources

10. Rivers in the Hohhot area belong to the Yellow, Daheihe and Hunhe river systems. However, there are no rivers, creeks or streams on any of three HSPs. There are a series of fish ponds to the northwest of the Jinqiao HSP site, and care will need to be taken during construction to avoid pond contamination.

Ecological and Sensitive Resources

11. Hohhot is located in a mid-temperate semi-arid climatic zone. The surrounding area includes forest (limited), shrubs, grasslands and steppe meadows. However, the three heating zones are all located within urban or semi-rural environments within the city limits, and are either ex-farmland in areas slated for urban development, or disturbed and unused "waste" land. Existing vegetation cover is typically grass or shrubs, or disturbed soil with little or no vegetation cover. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special ecological significance within or adjacent to any of the sites. The project sites are considered as modified habitat under ADB's SPS (2009) definition.

Socioeconomic Conditions

12. Hohhot has a total area of 17,224 km^2. The land area of the rural portion of Hohhot is 15,170 km^2 (88.1% of the total land area), while the urban area is 2,054.0 km^2 (11.9% of the total land area). The urban area includes a built-up (city) area of 79.2 km^2. Hohhot has a population of 2.9488 million (2012), including the urban area with a population of 1.9233 million and the rural area with a population of 1.0255 million.

13. The beneficiaries of the Project include both current and potential future heat users. It is estimated that by 2020 the Project will benefit a population of 883,500.

Physical Cultural Resources

14. The heating zones are located within urban landscapes. They are not on or near any tourism sites, and there are no know Physical Cultural Resources (PCRs) within or adjacent to the sites. However, there is a tomb approximately 100 m south of the Jinqiao heating zone boundary near the existing access road, and care will need to be taken during construction to protect the tomb.

G. Environmental Baseline

15. Air quality data provided by the Hohhot EPB for the 2000 to 2012 period shows that air quality in Hohhot was generally in compliance with relevant standards for SO_2 although there was a peak in 2007, and that NO_2 levels have been well below the applicable standards. Both pollutants are showing a downward trend in annual average concentrations from peak levels in 2007.

16. Site specific baseline environmental monitoring was conducted by a certified environmental monitoring station during the 2013/14 heating season. The results indicate that air quality at the heating zones is good, and all results for TSP, $PM_{10,}$ $SO_{2,}$ and NO_2 were in compliance with the relevant standard, Class II of *GB3095—2012 Ambient Air Quality Standards*. However $PM_{2.5}$ levels exceeded the 24-hour standards at all three heating zones. The most likely causes are vehicle exhaust and coal-fired flue emissions.

17. Annual average groundwater quality data (2010) was sourced from the Hohhot Groundwater Quality Monitoring Station. Monitoring data indicates that groundwater quality in Hohhot is relatively good and is in compliance with the relevant standard, Class III of *GB/T14848-93 Quality Standards for Ground Water*.

18. Noise monitoring indicates that daytime and nighttime noise levels at the at the site boundaries of all three heating zones meet the applicable Class II standards (60 dB(A) daytime, 50 dB(A) nighttime) of *GB12348-2008 Noise Standards for Industrial Enterprises at Site Boundary*. The results also indicate that daytime and nighttime noise levels at the adjacent sensitive locations for all three heating zones meet the applicable Class II standards (60 dB(A) daytime, 50 dB(A) nighttime) in *GB3096-2008 Environmental Quality Standards for Noise*.

H. Anticipated Impacts and Mitigation Measures

19. Anticipated positive and negative environmental impacts of the proposed Project were assessed during the EIA preparation based on the findings of the domestic heating zone EIAs and feasibility study reports, supported by site visits, stakeholder consultations, additional surveys undertaken by national and international environmental consultants, and additional atmospheric modeling undertaken in 2014.

20. Pre-construction, construction phase and operation phases were each considered separately. The results of the assessment analysis indicates that during the pre-construction phase issues are very limited, and are mostly associated with siting and ensuring appropriate incorporation of mitigation measures into the project design. Potential negative construction phase environmental impacts are short-term and localized, and are associated with soil erosion, construction noise and fugitive dust, disruption of traffic and community services, and risks to worker health and safety. Potential negative operation phase impacts are associated with boiler emissions, waste and wastewater, noise, and health and safety risks to workers. Air dispersion modelling modeling results indicate that even the worst case cumulative operation phase pollutant ground level concentrations (GLCs), which occur only a few times per year at a few specific locations, are fully in compliance with PRC ambient air quality standards. Overall, negative impacts can be minimized with the application of appropriate mitigation measures.

21. Potential positive operation phase impacts are significant and long-term, and are associated with emissions reductions compared to equivalent heat production from coal-fired boilers.

I. Alternative Analysis

22. The district heating area in Hohhot increased from 14.74 million m^2 in 2004 to 86.81 million m^2 in 2012, an annual growth rate of 24.81%. With rapid urban expansion heat demand increases dramatically, leading to an urgent need to construct new heating infrastructure. If the Project is not implemented heat from traditional coal-fired HSPs will be required to meet the increasing demand for district heating in Hohhot, and existing polluting small coal-fired boilers may continue to be used. Based on an overall analysis of alternatives, the Project has selected the most appropriate heat source, fuel type, low NOx burner, electric boiler, heat system connection, pipeline type and installation method, and HES type.

J. Information Disclosure and Public Consultations

23. HCDIO has undertaken extensive public consultation and information disclosure. The two phase process began when the Project design still incorporated coal-fired HSPs, and continued when the design was revised to natural gas-fired HSPs. The process has included information disclosure in newspaper articles, two beneficiary surveys with over 190 surveys completed and returned, web-posting of the heating zone EIAs, and a recent public meeting where participants expressed unanimous support for the Project.

K. Grievance Redress Mechanism

24. A project-level grievance redress mechanism (GRM) has been established to receive and facilitate resolution of complaints about the Project's environmental performance during construction and operation phase. The GRM includes procedures for receiving grievances, recording/ documenting key information, and evaluating and responding to the complainants in a reasonable period of time. Any concerns raised through the GRM will need to be addressed quickly and transparently, and without retribution to the affected person.

L. Environmental Management Plan

25. A comprehensive EMP was developed to ensure (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting against the performance indicators; and (iii) Project compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS. The EMP includes an environment monitoring plan (EMoP) to monitor the environmental impacts of the Project

and assess the effectiveness of mitigation measures, and a capacity building and training program focused on health, safety and environment. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting. The EMP is presented in Appendix I.

M. Conclusion

26. The Project environmental assessment process has (i) selected an appropriate technology to reduce the emission of pollutants; (ii) identified negative environment impacts and appropriately established mitigation measures; (iii) received public support from the majority of Project beneficiaries and affected people; (iv) established effective Project GRM procedures; (v) assessed the capacity of the EA and the IA; and (vi) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

27. Based on the analysis conducted it is concluded that overall the Project will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Air quality dispersion modelling results indicate that even the worst case cumulative operation phase pollutant ground level concentrations (GLCs), which occur only a few times per year at a few specific locations, are fully in compliance with relevant standards. When compared to the equivalent production of heat through traditional coal-fired sources, once operational the Project will: (i) result in the closure of 50 small urban low-efficiency and polluting coal-fired boilers; (ii) eliminate the use and transport through urban areas of 1.27 million tons of raw coal; (iii) result in energy savings equivalent to 848,500 ton of standard coal, thereby providing a global public good by avoiding the annual emission of 1,299,400 tons CO_2; and (iv) improve local air quality through the estimated annual reduction of emissions of SO_2 by 11,800 tons, NO_x by 9,000 tons, PM by 26,000 tons, and fly and bottom ash by 191,000 tons. By 2020 the Project will provide low-emission high efficiency district heating to an estimated 294,500 households with a population of 883,500.

28. Overall, any minimal adverse environmental impacts associated with the Project can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that: (i) the Project's categorization as ADB environment category A is confirmed; (ii) this EIA is considered sufficient to meet ADB's environmental safeguard requirements for the Project, and no additional studies are required; and (iii) the Project be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the EA and IA to ensure these commitments are effectively and expediently implemented.

I. INTRODUCTION

A. The Project

1. The proposed Low Carbon District Heating Project in Hohhot, Inner Mongolia Autonomous Region, (the Project), will upgrade and expand district heating in three heating zones in Hohhot city. The Project will provide 1,560 megawatts (MW) of clean-burning natural gas-fired heating capacity and 50 MW of demonstration wind powered electrode heating capacity, which in combination will heat approximately 30 million m^2 of public and residential building space.

2. The Project consists of the Haoqingying, Xinjiaying and Jinqiao district heating zones located in eastern Hohhot city, in central Inner Mongolia Autonomous Region (IMAR) (**Figure 1** and **Figure 2**). The Project was initially designed incorporating coal-fired heat supply plants (HSPs) and pilot testing of a 25 MW wind powered electrode boiler. To address concerns about the environmental impacts of coal as a heating source, the design was subsequently revised to utilize low NO_X natural gas-fired HSPs, and the wind powered electrode boiler capacity was increased to 50 MW.

3. The Government of IMAR (GIMAR) is the executing agency (EA) and the Hohhot Chengfa Heating Company (HCHC) is the implementing agency (IA), which is responsible for day to day project management, including contractor management, operation and maintenance, and social and environment safeguard monitoring and assurance. The HCDIO[1] is engaged to provide management oversight to the HCHC; to liaise with the GIMAR, and Hohhot municipal government; to provide support and supervision in the project procurement; and to provide timely managerial and technical support to the IA to ensure the timely project implementation as well as good governance of the project. The HCDIO and HCHC will jointly establish a project management office (PMO).

4. The Project cost is estimated at $403 million. The Asian Development Bank (ADB) is considering providing a loan of $150 million from ADB's ordinary capital resources to help finance the Project.

5. When compared to the equivalent production of heat through traditional coal-fired sources, once operational the Project will: (i) result in the closure of 50 small urban low-efficiency and polluting coal-fired boilers; (ii) eliminate the use and transport through urban areas of 1.27 million tons of raw coal; (iii) result in energy savings equivalent to 848,500 ton of standard coal, thereby providing a global public good by avoiding the annual emission of 1,299,400 tons CO_2; and (iv) improve local air quality through the estimated annual reduction of emissions of SO_2 by 11,800 tons, NO_x by 9,000 tons, PM by 26,000 tons, and fly and bottom ash by 191,000 tons.

B. Report Purpose

6. ADB's environmental safeguard requirements are specified in the Safeguard Policy Statement (SPS 2009). The Project has been screened and classified by ADB as Environment Category A, requiring the preparation of an Environmental Impact Assessment (EIA) including an environmental management plan (EMP). This EIA for the Project has

[1] The HCDIO will sign onlending agreements with the GIMAR, through Hohhot municipal government, and will onlend to the HCHC. The HCDIO is directly responsible for making equity contributions amounting to 23% of the total project cost.

been prepared in compliance with the ADB's SPS requirements.

C. Approach to EIA Preparation

7. This EIA report has been prepared based on domestic Feasibility Study Reports (FSRs) for three heating zones, domestic Environmental Impact Assessment (EIA) reports for three heating zones, technical due diligence reviews of the FSRs undertaken by district heating specialists, and additional surveys, modelling and consultations undertaken by national and international environmental consultants. Key data sources are presented below:

Figure 1: Project Location, Inner Mongolia Autonomous Region

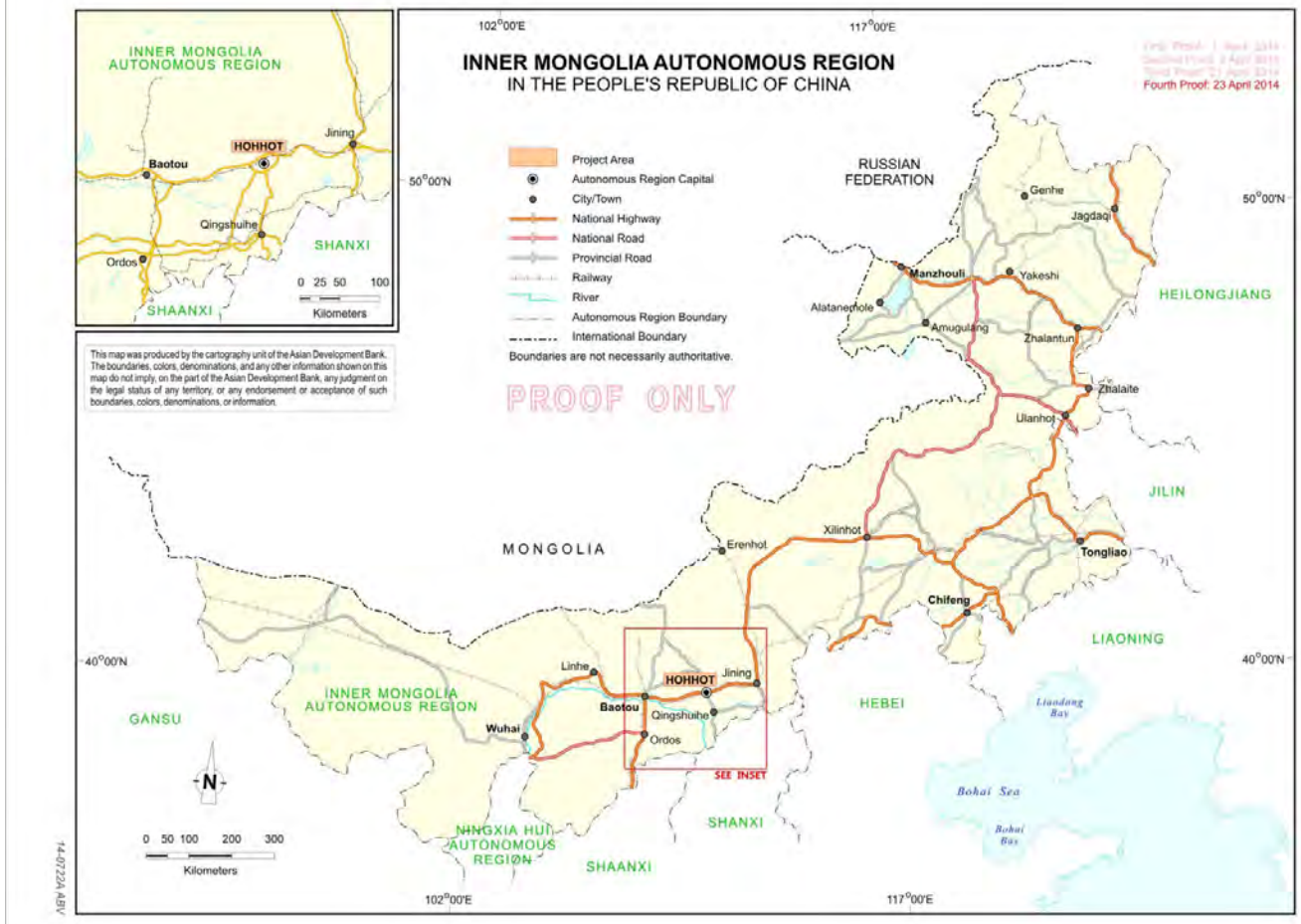
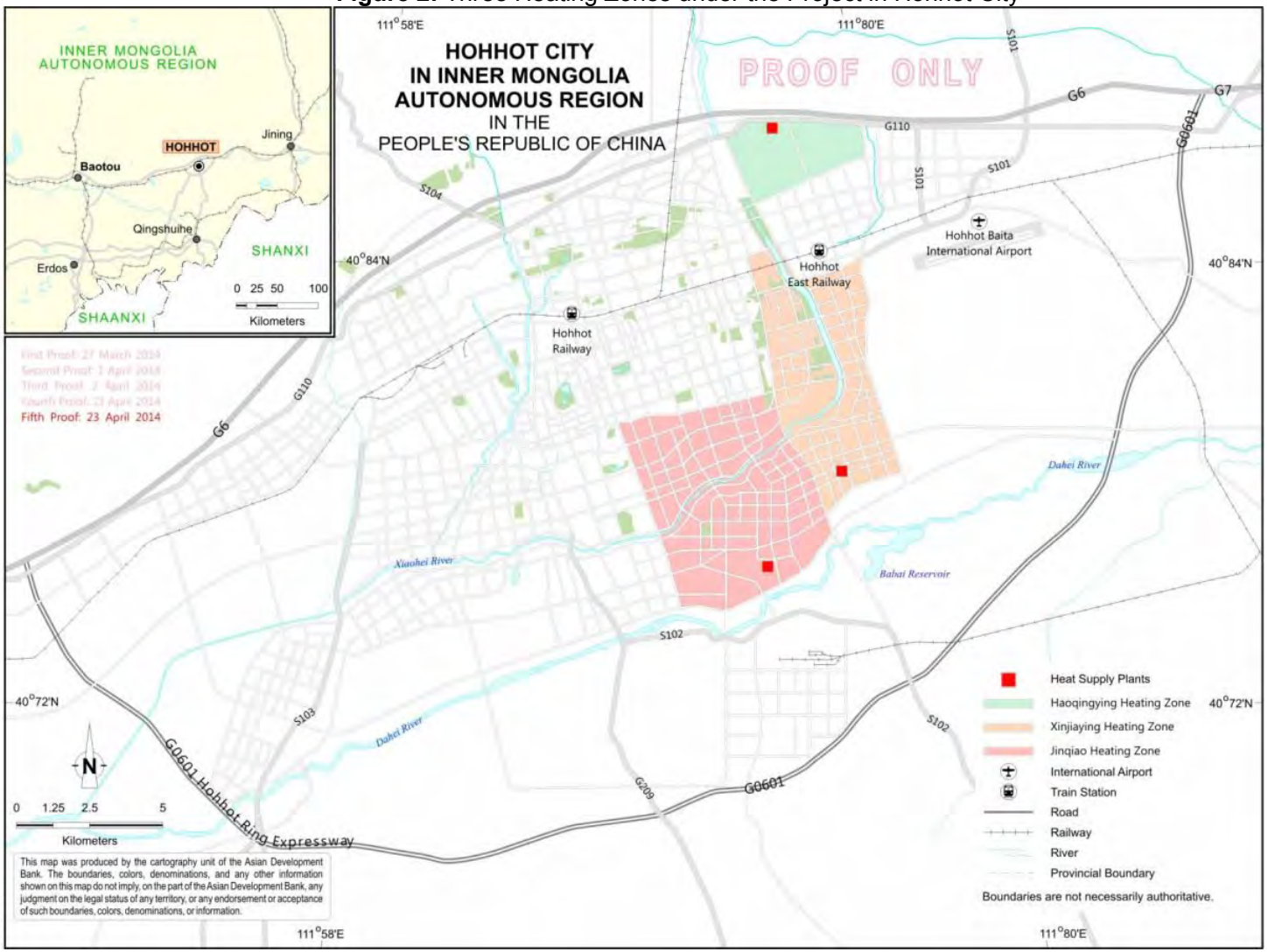


Figure 2: Three Heating Zones under the Project in Hohhot City



Project Description - Data sources include: (i) FSRs prepared by qualified consultants from a certified domestic feasibility study institute, the North China Municipal Engineering Design Research Institute;[2] (ii) domestic EIA reports for three heating zones prepared in compliance with the PRC's environmental assessment requirements and regulatory framework at the national and local levels by a certified EIA institute, Zhong Ye Dong Fang Ltd. in Baotou (see Chapter II for additional information on the domestic EIA process);[3] and (iii) Project due diligence work (site visits, surveys, consultations) undertaken by ADB national and international technical assistance (TA) consultants, including district heating, environment, social and financial technical specialists.[4]

Climate - Data sources for local climate include the IMAR Atmospheric Sounding Technical Support Center and the China Metrological Administration.

Topography, Geology, Soil - Data sources include: (i) field surveys conducted by the domestic EIA consultants in 2012 and 2013; and (ii) site visits conducted by ADB environmental consultants in February and April 2014.

Terrestrial Ecological Resources - Data sources include: (i) ecological field surveys conducted by the domestic EIA consultants in 2012 to 2013; and (ii) site visits conducted by ADB environmental consultants in February and April 2014.

Air Quality Baseline - Data sources include: (i) publicly available ambient air monitoring data; (ii) site specific air quality monitoring for particulate matter less than 2.5 micrometer in diameter ($PM_{2.5}$), particulate matter less than ten micrometer in diameter (PM_{10}), total suspended particulates (TSP), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) undertaken in January 2014 by a certified organization on behalf of the EIA institute, Lv Se Jing Cheng (Beijing) Physical and Chemical Inspection Technology Ltd., and additional air quality monitoring undertaken in April 2014 by the EIA institute; and (iii) data collected by the domestic EIA consultants from available existing databases.

Background Noise - Data for background noise levels came from noise monitoring at heating zone boundaries and adjacent sensitive points, undertaken by a certified organization on behalf of the EIA institute, Lv Se Jing Cheng (Beijing) Physical and Chemical Inspection Technology Ltd., in January 2014.

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[2] The three FSRs are:
- Feasibility Study Report for Jinqiao peak shaving heat source plant heating supply area in district heating project by HCDIO low carbon heat supply project in Hohhot, Inner Mongolia, 2014. Prepared by the North China Municipal Engineering Design Research Institute.
- Feasibility Study Report for Haoqingying heat source plant heating supply area in district heating project by HCDIO, low carbon heat supply project in Hohhot, Inner Mongolia, 2014. Prepared by the North China Municipal Engineering Design Research Institute.
- Feasibility Study Report for Xinjiaying heat source plant heating supply area in district heating project by HCDIO, low carbon heat supply project in Hohhot, Inner Mongolia, 2014. Prepared by the North China Municipal Engineering Design Research Institute.

[3] The three EIAs are:
- EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, January 25 2014. Prepared by Zhong Ye Dong Fang Ltd.
- EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.
- EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Peak Adjustment Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.

[4] Consultant services provided through ADB PPTA-8403 PRC: Low-Carbon District Heating Project in Hohhot in Inner Mongolia Autonomous Region.

Water Resources – Baseline underground water quality data came from annual groundwater monitoring data of Hohhot in 2010.

Socioeconomic Status - Socioeconomic surveys and data were collected by the domestic EIA consultants and the social TA consultant.

Public Consultation and Information Disclosure - Project information was disclosed by HCDIO with assistance from the domestic EIA consultants in 2011 and 2012, when the Project design still incorporated coal-fired HSPs. Public consultations were undertaken by the EIA consultants through field based questionnaire surveys in October 2011. When the design was revised to natural gas-fired HSPs, project information was disclosed by HCDIO with the assistance from the domestic EIA consultants in February 2014 and March and April, 2014. A public information meeting was also held on 10 April, 2014.

Energy Efficiency and Emissions Reduction - Coal saving data was calculated based on the domestic FSR and EIA reports and information from ADB's district heating technical consultants. Analyses on air pollutant emission reductions were undertaken the PPTA environmental consultants.

D. Report Structure

8. This EIA report consists of an executive summary, nine chapters and appendixes. The report is structured as follows:

Executive Summary
Summarizes critical facts, significant findings, and recommended actions.

I Introduction
Introduces the proposed Project, report purpose, approach to EIA preparation and EIA structure.

II Policy, Legal, and Administrative Framework
Discusses PRC's and ADB's environmental assessment legal and institutional frameworks, status of approval of the domestic EIA reports, and applicable environmental guidelines and standards.

III Description of the Project
Describes the Project rationale, scope, components, location, key features, implementation arrangements, budget and time schedule.

IV Description of the Environment
Describes relevant physical, biological, and socioeconomic conditions within the Project area, and presents results of baseline environmental monitoring.

V Anticipated Environmental Impacts and Mitigation Measures
Describes impacts predicted to occur as a result of the Project, and identifies the mitigation measures which will be implemented. .

VI Analysis of Alternatives
Presents an analysis of Project alternatives undertaken to determine the best way of achieving the Project objectives while minimizing environmental and social impacts.

VII Information Disclosure, Consultation, and Participation
Describes the process undertaken for engaging stakeholders and carrying out EIA disclosure and public consultation.

VIII Grievance Redress Mechanism
Describes the Project grievance redress mechanism (GRM) for resolving complaints.

IX Conclusion and Recommendation
Presents conclusions drawn from the assessment and recommendations.

Appendixes
Appendix I presents the environmental management plan (EMP), including required construction and operation phase environmental mitigation measures, an environmental monitoring plan (EMoP), reporting requirements, and capacity building. Other appendices present supporting documentation and approvals, data on small coal-fired boilers to be decommissioned, and coal and emission reduction factors, assumptions and calculations.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

9. This EIA and the domestic EIAs upon which it is based have been prepared in accordance with PRC's national and local environmental legal and institutional framework and environmental assessment requirements. This EIA has also been prepared in accordance with applicable ADB policies, regulations, requirements, and procedures.

A. PRC Environmental Legal Framework

10. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative and technical institutions. At the top level the People's Congress of the PRC has the authority to pass and revise national environmental laws; the Ministry of Environmental Protection (MEP) under the State Council promulgates national environmental regulations; and the MEP either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards. The provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

11. Key PRC environmental laws are listed in **Table 1**. The implementation of environmental laws is supported by a series of associated management and technical guidelines issued by the MEP summarized in **Table 2**.

Table 1: Applicable PRC environmental laws.

No.	Title of the Law	Year Issued/Updated
1	Environmental Protection Law	1989
2	National Environmental Impact Assessment Law	2003
3	Water Law	2002
4	Water Pollution Prevention and Control Law	2008
5	Air Pollution Prevention and Control Law	2000
6	Noise Pollution Control Law	1999
7	Solid Waste Pollution Prevention and Control Law	2005
8	Water and Soil Conservation Law	2011
9	Forest Law	1998
10	Wild Fauna Protection Law	2004
11	Energy Conservation Law	2008
12	Cleaner Production Promotion Law	2012
13	Urban and Rural Planning Law	2008
14	Land Administration Law	1999

Source: TA Consultants.

Table 2: Applicable PRC environmental management and assessment guidelines.

No.	Guideline	Code and/or Year Issued/Updated
1	Guideline for Technical Review of EIA on Construction Projects	HJ 616-2011
2	Management Guideline on EIA Categories of Construction Projects	2008
3	Further Enhance the Management of EIA and Preventing Environmental Risks	2012
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Guideline on EIA Categories of Construction Projects	2008
6	Interim Guideline on Public Consultation for EIA	2006
7	Technical Guidelines for EIA – General Program	HJ 2.1-2011
8	Technical Guideline for EIA – Atmospheric Environment	HJ 2.2-2008
9	Technical Guideline for EIA – Surface Water	HJ/T 2.3-1993
10	Technical Guideline for EIA – Acoustic Environment	HJ 2.4-2009
11	Technical Guideline for EIA – Groundwater Environment	HJ 610-2011
12	Technical Guideline for EIA – Ecological Impact	HJ 19-2011
13	Technical Guidelines for Environmental Risk Assessment for Construction Projects	HJ/T 169-2004

Source: TA Consultants.

12. In addition to environmental laws and regulations, there are occupational health and safety laws and regulations the IA must comply with, including the *PRC Safety Production Law (2002), State Administrative Regulations of Safety Production (2004),* and *PRC Prevention and Control of Occupational Diseases Law (2011).*

B. PRC Environmental Impact Assessment Framework

13. EIA procedures have been established in the PRC for over 20 years. Article 16 of the PRC *Law on Environmental Impact Assessment* (2003) stipulates that an EIA document is required for any capital construction project producing significant environmental impacts. Projects are classified into three categories[5]:

(i) **Category A:** Projects with significant adverse environmental impacts, for which a full EIA report is required;

(ii) **Category B:** Projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a simplified tabular EIA report is required; and

(iii) **Category C:** Projects unlikely to have adverse environmental impacts, for which an EIA registration form is required.

14. A full EIA report and a simplified tabular EIA report for category A and B are similar to ADB's EIA and IEE reports, respectively. The registration form of an EIA is similar to an ADB Category C project (see section II.G for more information on ADB's EIA requirements).

[5] *National Environmental Impact Assessment Law*, published on Oct 28 2002 and implemented in Sep 1, 2003.

15. In 2008 the MEP issued "Management Guideline on EIA Categories of Construction Projects". The MEP guidelines provide detailed EIA requirements for 23 sectors and 198 subsectors based on the project's size, type (e.g., water resources development, agriculture, energy, waste management, etc.), and site environmental sensitivity (e.g., protected nature reserves and cultural heritage sites).

16. The MEP's "Guidelines on Jurisdictional Division of Review and Approval of EIAs for Construction Projects" (2009) defines which construction project EIAs require MEP review and approval, and which EIAs are delegated to the provincial EPBs.

C. Project Domestic EIA Report Approval Status and Conditions

17. The Project was initially conceived as a coal-based district heating system, which was categorized as A under the PRC law on EIA. Category A EIAs were prepared by Zhong Ye Dong Fang Ltd., a qualified and licensed EIA institute, and were approved by the Hohhot Environment Protection Bureau in June, 2012.

18. Due to concerns raised by the PRC Government and the ADB with respect to SO_2, NO_x and PM emissions, the Project was subsequently redesigned to switch fuel from coal to natural gas-fired boilers and to expand wind power capacity from 25 to 50 MW using two high voltage electrode boilers. Given the significantly reduced emission from natural gas and electrode boilers, the revised Project was classified as Category B under the PRC EIA law, and tabular EIAs were prepared by Zhong Ye Dong Fang Ltd.[6] On January 25th 2014 the tabular EIA for each heating zone were submitted to the Hohhot EPB, which had been delegated to undertake the EIA review and approval. The EPB's Construction Project EIA Technical Review Committee reviewed the report. Based on the evaluation's recommendation, the Hohhot EPB approved the EIAs on 28 March 2014 (Appendix II).

19. The Project will source electricity for the electrode boilers from the Datang (Hohhot) Renewable Power Company wind farm. An EIA was prepared for the wind farm and was approved by the IMAR EPB in 2011. In addition, the Jinqiao heat source plant (HSP) will be operated in coordination with the Jinqiao combined heat and power (CHP). An EIA was prepared for the Jinqiao CHP, and was approved by the former State Environmental Protection Agency on December 21, 2004. The CHP is equipped with low NO_X combustion technology, limestone wet scrubbing flue-gas desulfurization (FGD), bag-type dust collectors, and a continuous emissions monitoring system (CEMS).

D. Relevant International Agreements

20. The PRC has signed a number of international agreements regarding environmental and biological protection. Those which have potential application to the Project are listed in **Table 3.**

[6] The three EIAs are:
- EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, January 25 2014. Prepared by Zhong Ye Dong Fang Ltd.
- EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.
- EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Peak Adjustment Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 3: Applicable international agreements.

No.	Agreement	Year	Purpose
1	United Nations Framework Convention on Climate Change	1994	Stabilization of greenhouse gas concentrations in the atmosphere
2	Kyoto Protocol to the United Nations Framework Convention on Climate Change	2005	Further reduction of greenhouse gas emissions
3	Montreal Protocol on Substances That Deplete the Ozone Layer	1989	Protection of the ozone layer

Source: the ADB PPTA Consultants.

E. Other Relevant Guidelines

21. During the design, construction, and operation of a project the ADB requires the borrower to follow environmental standards consistent with good international practice (GIP), as reflected in internationally recognized standards such as the World Bank Group's *Environment, Health and Safety Guidelines* (hereafter referred to as the *EHS Guidelines*).[7] The *EHS Guidelines* contain discharge effluent, air emissions, and other numerical guidelines and performance indicators as well as prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technology. When host country regulations differ from these levels and measures, the borrower/client is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client is required to provide justification for any proposed alternatives.

22. The *EHS Guidelines* include *General EHS Guidelines* (covering environment; occupational health and safety; and community health and safety) and *Industry Sector Guidelines*. Relevant guidelines referenced in this report include the *General EHS Guidelines* and the *EHS Guidelines for Thermal Power Plants.*

F. Applicable Standards

23. The environmental quality standard system that supports the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by function: ambient environmental standards and pollutant emission/discharge standards. The main standards applicable to the Project are presented in **Table 4**.

1. Ambient Air Quality

24. Ambient air quality limits are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average, and/or annual average. The PRC's *Ambient Air Quality Standards GB3095—2012* has two classes of limit values; Class 1 standards apply to special areas such as natural reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial areas. The PRC standards for Class 2 areas are applicable for the Project.

[7] *World Bank Group, Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

Table 4: Applicable PRC environmental standards.

No.	Standard	Code
1	Ambient Air Quality Standards	GB 3095-2012
2	Groundwater Quality Standard	GB/T 14848-93
3	Surface Water Quality Standards	GB 3838-2002
4	Environmental Quality Standards for Noise	GB 3096-2008
5	Noise Standards for Construction Site Boundary	GB 12523-2011
6	Noise Standards for Industrial Enterprises at Site Boundary	GB 12348-2008
7	Integrated Emission Standard of Air Pollutants	GB 16297-1996
8	Integrated Wastewater Discharge Standard	GB 8978-1996
9	Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers	GB 13271-2001
10	Limits and measurement methods for crankcase pollutants From heavy-duty vehicles equipped with P.I. engines	GB 11340-2005
11	Emission Limits and Measurement Methods for Exhaust Pollutants from Vehicle Compression-Ignition and Gas Fuelled Ignition Engines	GB 17691-2005
12	Limits and measurement methods for exhaust pollutants from vehicles equipped ignition engine under two-speed idle conditions and simple driving mode conditions	GB 18285 -2005
13	Limits and Measurement Methods for Emissions from Light Duty Vehicles	GB 18352-2005

Source: ADB PPTA Consultants.

25. The World Health Organization (WHO) Air Quality Guidelines are recognized as international standards and are adopted in the *EHS Guidelines*. In addition to guideline values, interim targets (IT) are given for each pollutant by the WHO as incremental targets in a progressive reduction of air pollution. The WHO guidelines and corresponding PRC standards are presented in **Table 5**.

- For TSP, there are PRC standards but no corresponding WHO guidelines.
- For PM_{10} PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for either PRC or WHO).
- For $PM_{2.5}$ PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO).
- For SO_2 WHO only has a 24-hour average guideline (.125 mg/m^3), which is slightly lower than the PRC standard (.150 mg/m^3). However, SO_2 levels are low in the Project area, and the Project will only contribute extremely low levels of SO_2, so the very minor difference is inconsequential.
- For NO_2 the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO guideline.

26. Overall the PRC standards show a high degree of equivalency to the WHO guidelines or IT-1 values, and are adopted for use in the EIA report.

Table 5: PRC ambient air quality standards (*GB3095—2012)* and WHO ambient air quality guidelines, mg/m^3.

Standard	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2
WHO Ambient Air Quality Guidelines					
Annual mean		.020	.010	--	.040
Annual mean IT-1		.070	.035	--	--
24-hr mean		.050	.025	.020	--
24-hr mean IT-1		.150	.075	.125	--
1-hr mean		--	--	--	.200
1-hr mean IT-1		--	--	--	--
PRC Ambient Air Quality Standard					
Annual mean (class 2)	.200	.070	.035	.060	.040
24-hr mean (class 2)	.300	.150	.075	.150	.080
1-hr mean (class 2)	--	--	--	.500	.200

Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB 3095-2012.

2. Groundwater

27. The *EHS Guidelines* do not provide ambient ground water standards but state that wastewater discharges should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality. Therefore the PRC groundwater water quality standards are utilized in this report. The main use of groundwater water at the monitoring wells is domestic drinking water, and therefore the applicable standard is Class III of *GB/T14848-93 Quality Standard for Ground Water* (**Table 6**).

3. Noise

28. **Table 7** presents the relevant PRC Urban Noise Standards compared with relevant international guidelines from the WHO (as presented in the *EHS Guidelines*). The classes within the standards are not directly comparable as their classifications to divide residential, commercial, and industrial zones are different, but PRC Class II standards exceed WHO Class II standards and are within 5 dB(A) of WHO Class I standards. PRC noise standards are utilized in this report as the project areas are mixed residential, commercial, and industrial areas.

4. Boiler Plant Emissions

29. **Table 8** presents the relevant PRC *Emission Standard of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers* compared with relevant international standards (*EHS Guidelines*) for gas-fired boilers. The NOx emission standard of 400 mg/Nm^3 is the applicable PRC standard. However, HCDIO has voluntarily agreed to reduce emissions to less than 100 mg/Nm^3, which exceeds both the PRC sensitive area standard (200 mg/Nm^3) and the EHS Guideline (240 mg/Nm^3).

Table 6: Applicable groundwater standard (Class III, *GB/T14848-93 Quality Standard for Ground Water*).

No	Item	Unit	Limit
1	pH	-	6.5-8.5
2	Sulfate	mg/L	≤250
3	Volatile Phenols	mg/L	≤0.002
4	Total hardness ($CaCO_3$)	mg/L	≤450
5	Ammonia nitrogen	mg/L	≤0.2
6	Molybdenum	mg/L	≤0.1
7	Cyanide	mg/L	≤0.05
8	Chloride	mg/L	≤250
9	Cadmium	mg/L	≤0.01
10	Cr VI	mg/L	≤0.05
11	Arsenic	mg/L	≤0.05
12	Zinc	mg/L	≤1.0
13	Fluoride	mg/L	≤1.0
14	Lead	mg/L	0.05
15	Permanganate index	mg/L	3.0
16	Iron	mg/L	0.3
17	Manganese	mg/L	≤0.1
18	Copper	mg/L	≤1.0
19	selenium	mg/L	≤0.01
20	Total coliforms	/L	≤3.0

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 7: PRC *Environmental Quality Standards for Noise* (GB3096-2008) and relevant international guidelines.

PRC Standards Leq dB(A)			International Standards One Hour Leq dB(A)		Comparison
Class	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: special health zone	50	40	WHO Class I: residential, institutional, educational: 55	WHO Class I: Residential, institutional, educational: 45	Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards. PRC standards are utilized in this report.
I: mixed residential; and education areas	55	45			
II: mixed residence, commercial and industrial areas	60	50			
III: industrial areas	65	55	WHO Class II: industrial, commercial: 70	WHO Class II: Industrial, Commercial: 70	
IV: a	70	55			
B	70	60			

Source: Unofficial translation of Chinese original by the ADB PPTA consultant.

Table 8: Relevant PRC *Emission Standards of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers* (GB 13217-2001) and relevant international guidelines.

Parameter	PRC Standard for Gas Burning Boilers for Heating (operational after 1 January 2001)	EHS Guidelines for Boilers	Comparison
Stack Height	Stack height is determined according to the requirements in the approved EIA, and must be > 8 m.	Design stack height according to Good International Practice (GIP) to avoid excessive ground level concentrations and minimize impacts.	PRC standard meets GIP
Smoke and Dust	50 mg/Nm^3	NA	No EHS guideline.
SO_2	100 mg/Nm^3	NA	No EHS guideline.
NO_x	400 mg/Nm^3 (200 mg/Nm^3 in sensitive areas)	240 mg/Nm^3	PRC standard for sensitive areas is more stringent than the EHS guidelines .

Source: Unofficial translation of Chinese original by the ADB PPTA consultant.

5. Industrial Noise Emissions

30. **Table 9** presents the relevant PRC and international standards (US EPA, there no such WHO or EHS Guideline standards) for on-site construction noise. The PRC standards are more stringent than international guidelines, and are utilized in this report.

Table 9: PRC *Noise Standard for Construction Site Boundary* (GB12523-2011) and relevant international guidelines.

Day Leq dB(A)	Night Leq dB(A)	International Standards Leq dB(A)	Comparison
70	55	US EPA: 85 (day, 8 hour exposure)	PRC standards meet or exceed international standards

Source: Unofficial translation of Chinese original by the ADB PPTA consultant.

31. **Table 10** presents the relevant PRC and international standards for noise at the boundary of an industrial facility during operation. The classes within the standards are not directly comparable, but PRC Class II standards exceed WHO Class II standards and are within 5 dB(A) of WHO Class I standards. Taking into consideration the mixed residential, commercial and industrial characteristics of three heating zones, the PRC noise standards are utilized in this report.

Table 10: *PRC Noise Standards for Industrial Enterprises at Site Boundary* (GB12348-2008) and relevant international guidelines.

PRC Standards Leq dB(A)			International Standards Leq dB(A)		Comparison
Class	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: recuperation areas	50	40	WHO Class I: residential, institutional, educational: 55 WHO Class II: industrial, commercial: 70	WHO Class I: Residential, institutional, educational: 45 WHO Class II: Industrial, commercial: 70	Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards and are very close (within 5 dB (A) to WHO Class I standards). PRC standards are utilized in this report
I: mixed residential; and education areas	55	45			
II: mixed with residence, commercial and industrial areas	60	50			
III: industrial areas	65	55			
IV: areas within 10 m on both sides of traffic roadways	70	55			

Source: Unofficial translation of Chinese original by the ADB PPTA consultant.

6. Wastewater Emissions

32. **Table 11** presents the relevant PRC wastewater emission standards. The *EHS Guidelines* indicate that wastewater discharged to public or private wastewater treatment systems should: meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges; not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations; and be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. The Projects wastewater discharges will be required to meet Class III *Integrated wastewater discharge standard* (GB8978-1996).[8]

Table 11: PRC *Integrated wastewater discharge standard* (Class III, GB8978-1996).

No	Pollutant	Maximum acceptable concentration mg/L (except pH)
1	pH	6-9
2	SS	400
3	BOD_5	300
4	COD	500
5	Ammonia nitrogen	—

Source: Unofficial translation of Chinese original by the ADB PPTA consultant.

[8] Wastewater discharged into city and town sewage systems which have a secondary wastewater treatment plant must meet Class 3 standards. Wastewater discharged into city and town sewage systems which do not have a secondary wastewater treatment plant, will be subject to provisions according to the functional requirements of the water area which receives effluent from the sewage system.

G. Applicable ADB Policies, Regulations and Requirements

33. The major applicable ADB policies, regulations, requirements and procedures for EIA are the *Environmental Safeguards – A Good Practice Sourcebook* (2012), and the *Safeguard Policy Statement* (SPS 2009), which provides the basis for this EIA. The SPS promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2010).

34. All projects funded by ADB must comply with the SPS, which establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

35. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to:

i) reflect the significance of the project's potential environmental impacts;

ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and,

iii) determine consultation and disclosure requirements.

36. ADB assigns a proposed project to one of the following categories:

i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale environmental impact assessment (EIA) including an environmental management plan (EMP), is required.

ii) **Category B**. Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An initial environmental examination (IEE), including an EMP, is required.

iii) **Category C**. Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.

iv) **Category FI**. Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

37. The Project has been classified by ADB as environment category A, requiring the preparation of an EIA (this report).

38. The SPS 2009 requires a number of additional considerations, including: (i) project

risk and respective mitigation measures and project assurances; (ii) project-level grievance redress mechanism; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIAs, have been considered, and all applicable environmental requirements in the SPS 2009 are covered in this EIA.

III. PROJECT DESCRIPTION

A. The Project

39. The proposed Low Carbon District Heating Project in Hohhot, IMAR, will upgrade and expand district heating in three heating zones: Haoqingying, Xinjiaying and Jinqiao. The Project will provide 1,560 MW of clean-burning natural gas fired heating capacity, and 50 MW of demonstration wind powered electrode heating capacity. In total the Project will provide heat to 29.72 million m^2 of public and residential building space. Once the Project is operational, 50 existing inefficient and polluting small coal-fired boiler plants in the Jinqiao heating zone will be decommissioned by the Hohhot municipal government's Public Utilities Bureau.

B. Project Rational

40. The building area of Hohhot has increased rapidly in recent years, from 38.29 million m^2 in 2004 to 91.31 million m^2 in 2012, an annual growth rate of 11.48%. As of 2012, the total built urban area in Hohhot City was 91.31 million m^2 and the total heating area was 86.81 million m^2, of which 81.24 million m^2 was centrally heated (89%). According to the Hohhot Urban Heating Plan (2005 to 2020), by 2015 the total urban heating area will increase to 151.3 million m^2, and by 2020 it will reach 243.1 million m^2. With urban expansion heat demand increases dramatically, leading to an urgent need to construct additional heating infrastructure.

41. Current heat sources in Hohhot include a combination of coal-fired CHPs, HSPs, small neighborhood boiler houses, and household stoves. There are currently three large CHPs providing heat to four district heating systems, including the Jinqiao CHP owned by Huaneng Group in the Jinqiao heating zone (the other CHPs are jointly owned by the Futai and Kelin Heating Company, and the Shengtai Heating Company). These three CHPs provide heat to 20.7 million m^2, approximately 23.8% of the total Hohhot heating area (**Table 12** and **Figure 3**). These CHPs produce hot water and sell it to heating companies; the heating companies are responsible for operating and managing the heating systems and providing heat to the end-users. The Hohhot Urban Heating Plan indicates that two additional CHPs should be constructed by 2020, though work has not yet begun on either.

Table 12: Existing CHPs plants in Hohhot.

Name	Heating Company	Heating Area Covered by CHP Million m^2	Power Generation Capacity MW
Huhot CHP	Kelin Heating Company	6.60	4X350
	Futai Heating Company	4.60	2X200
Jinshan CHP	Shengtai Heating Company	2.95	2X300
Jinqiao CHP	CHP is owned by the Huaneng Group, but HCDIO is the heating company	6.55	2X300
Total		20.70	3000

Source: HCDIO, 2014.

There are currently 5 large HSPs in Hohhot heating a total of 24.4 million m^2, 28.1% of the total heating area. Their total heating capacity is 2,153 MW, which is only 22% of the target planned in the Hohhot Urban Heating Plan (

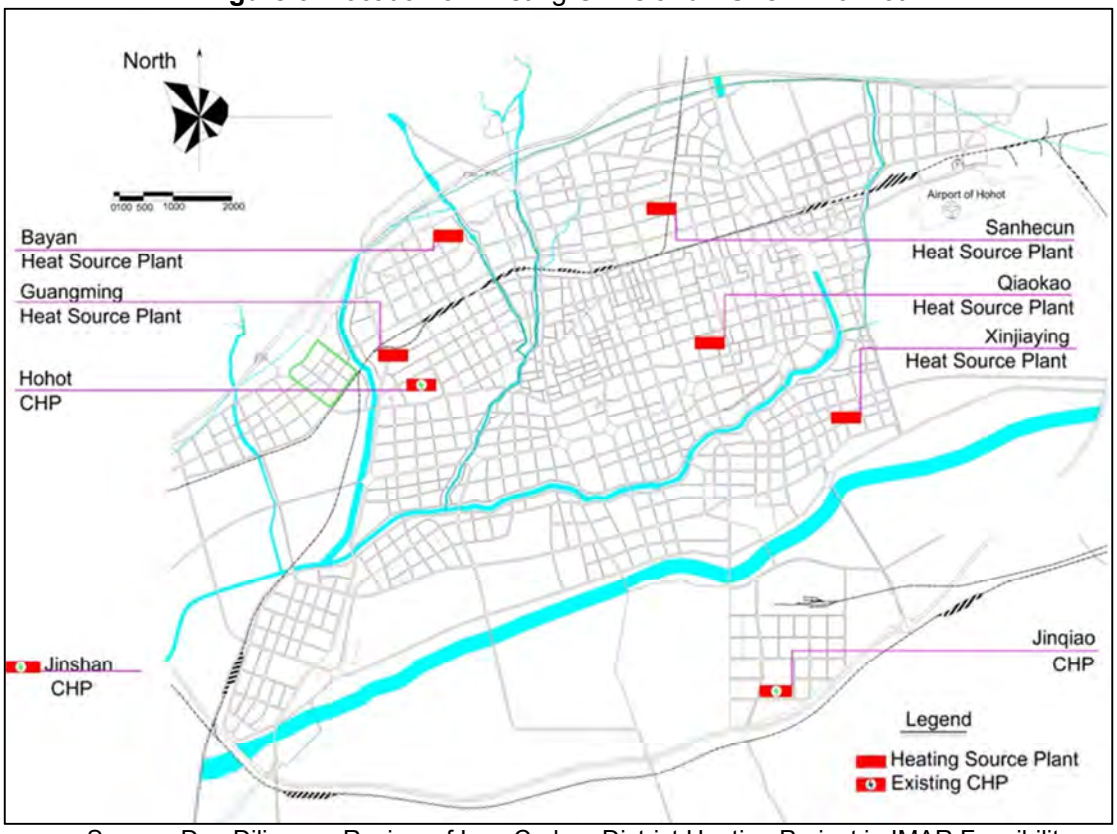
42. **Table 13** and **Figure 3**). Under the Hohhot Urban Heating Plan, an additional 5 HSPs are required to meet the expected demand.

Table 13: Existing Large HSPs in Hohhot.

Name	Owned by	No. Boilers	Heating Capacity MW	Heating Area million m^2
Xinjiaying HSP	HCDIO	6	(4*70)+(2*84) = 448	4.73
Qiaokao HSP	HCDIO	12	(10*58)+(2*70) = 720	9.37
Sanhecun HSP	HCDIO	9	(5*29)+(4*70) = 425	6.70
Guangming HSP	Futai Heating Company	4	(4*70) = 280	2.30
Bayan HSP	Futai Heating Company	4	(4*70) = 280	1.30
Total		35	2,153	24.4

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Figure 3: Location of Existing CHPs and HSPs in Hohhot.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility

Study Report, 2014.

43. Currently, there are many small neighborhood coal-fired boiler houses, heating 25.82 million m^2, which is 29.7% of the total heating area in Hohhot. These boiler houses are dispersed throughout existing urban areas. To mitigate air pollution caused by these small inefficient boilers, the Hohhot government promotes replacing these boilers with natural gas boilers in cental urban areas. In 2013, 64 small coal-fired boilers were replaced by natural gas boilers, which cover 4.6 million m^2 of heating area. In 2014, it is planned to replace 136 small boilers with natural gas boilers, which accounts for 10.7 million m^2 coverage.

44. Areas that are not covered by ether district heating or neighborhood boiler houses are still relying on coal-fired house stoves to sustain heating, which cause serious indoor and outdoor air pollution in winter.

45. To meet the anticipated heating demand from an urban heating area of 243.1 million m^2, the Hohhot Urban Heating Plan calls for the development of 2 CHPs and 5 HSPs by 2020. The Hohhot Urban Heating Plan was based on the 2010-2020 Hohhot Urban Development Plan, which was approved in 2011. Based on the 2010-2020 Hohhot Urban Development Plan, the Hohhot municipal government requested to the HCDIO to provide district heating services in three heating zones in Hohhot's eastern growth area by providing clean-burning natural gas fired heating to a total area of 29.72 million m^2.

C. Project Scope

46. The Project scope includes: (i) 21 boilers with a heating capacity of 1,610 MW, comprising 19 low NOx natural gas-fired boilers and two 25 MW wind powered 10 kV electrode boilers; (ii) 73.76 km of primary heating network; (iii) 180 Heat Exchange Stations (HESs), 11 of which will be building-level HESs; (iv) and SCADA systems installed in all three heating zones. The Project will provide heat to a total built area of 29.72 million m^2. In addition, once the Project is operational, 50 inefficient and polluting small coal-fired boilers in the Jinqiao heating zone will be decommissioned by the Hohhot municipal government's Public Utilities Bureau.

47. According to PRC building code space heating starts when the daily mean temperature is below 5°C and ends when the daily mean temperature meets or exceeds 5°C. Hohhot experiences long and cold winters, and based on this criteria the official winter heating season lasts for 183 days. According to the requirements of the thermal design code and local regulations, the design heat load is 45 W/m^2 for residential building and 55 W/m^2 for public buildings.

48. **Table 14** provides a summary of the Project scope, while **Table 15** provides the key Project indicators.

Table 14: Summary of Project scope.

No.	Item	Unit	Jinqiao Heating zone	Xinjiaying Heating zone	Haoqingying Heating zone		Total
			NG	NG	NG	Wind Power	
1	Project Heating Area	Million m^2	9.53	8.83	10.36	1.00	29.72
2	Total Heat Load	MW	454.6	444.0	556.4		1,455.0
3	Heat Source Capacity	MW	490	490	580	50	1,610
4	Boiler Quantity and Capacity	# * MW	7*70	7*70	5*116	2*25	21
5	Length of Primary Network	km	17.06	26.02	30.68		73.76
6	District HES	#	45	48	76		180
	Building-level HES	#	0	0	11		
7	SCADA	#	1	1	1		3
8	Coal Boiler Closure	#	50				50

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

D. Project Location

49. The Project is located in eastern Hohhot city. Hohhot is prefecture level city, which consists of four urban districts (Huimin; Xincheng; Yuquan; and Saihan districts), and five rural counties (Toghoh county; Wuchuan county; Horinger county; Qingshuihe county; and Tumed Left banner.) Total area of Hohhot is 17,224 km^2, containing 2,054 km^2 (11.9%) of urban and 15,170 km^2 (88.1%) of rural areas.

50. The Project consists of three mixed residential, commercial and industrial heating zones located in Xincheng and Saihan urban districts of Hohhot city:

- The Haoqingying heating zone is located in Xincheng District in northeastern Hohhot.
- The Xinjiaying heating zone is located in Saihan District in central eastern Hohhot. The Xinjiaying HSP will be adjacent to the site of an existing HSP owned by HCDIO.
- The Jinqiao heating zone is located in Saihan District in southeastern Hohhot. The Jinqiao HSP will be located 5.5 km north of the existing Jinqiao CHP.

Table 15: Key Project indicators.

No.	Item	Unit	Jinqiao Heating Zone	Xinjiaying Heating Zone	Haoqingying Heating Zone		Total
			NG	NG	NG	Wind Power	
1	**Project Heating Area**	Million m^2	9.53	8.83	10.36	1	29.72
1.1	Existing built area to be served by small coal-fired neighborhood boilers	Million m^2	6.71	0	0		6.71
1.2	Area currently served by small coal-fired stoves	Million m^2	2.82	8.83	11.36		23.01
2	**Maximal Heat Load**	MW	454.58	444.15	556.64		1455.37
2.1	Public Building Area	Million m^2	2.57	4.68	4.54		11.80
2.2	Specific Heat Load of Public Building	W/ m^2	55	55	55		
2.3	Residential Building Area	Million m^2	6.96	4.15	6.82		17.92
2.4	Specific Heat Load of Residential Building	W/ m^2	45	45	45		
3	**Heating Capacity**	MW	490	490	580	50	1610
3.1	Boiler Quantity and Capacity	MW	7*70	7*70	5*116	2*25	21
3.2	High Flue Stacks	# x H(m)	7*30	7*30	5*30		19
3.3	Supply and Return Water Temperature	^{0}C	120/60	120/60	120/60		
3.4	Flow Rate of Primary System	t/h	6400	6400	8000		20800
3.5	Length of Primary Heating Network	km	17.06	26.02	30.68		73.76
3.6	HES		45	48	87		180
4	**Total Heat Energy Supply**	GJ/a	4683067	4567080	5670606		14920753
4.1	Heat value of NG	MJ/Nm^3	32.65	32.65	32.65		
4.2	Efficiency of Heat Source	%	93	93	93	98.5	
4.3	Standard Coal Consumption Per GJ	kg/GJ	36.69	36.69	36.69	34.64	
4.4	Heating Energy Sourced from CHP	GJ/a	2488781				2488781
4.5	Heat Energy Supply of HSPs	GJ/a	2194286	4567080	5275326	395280	12431972
4.6	Energy Supply Per m^2 Heating Area	GJ/($a.m^2$)	0.49	0.52	0.51	0.40	0.50
5	**Annual NG Consumption**	×$10^6$$Nm^3$/a	76.57	155.71	186.00		418.28
5.1	NG Consumption Per m2 Heating Area	Nm^3/($a.m^2$)	8.03	17.63	16.37		13.3
6	**Annual Water Consumption**	×10^3t/a	246.50	514.00	580.30		1340.80
6.1	Specific Water Consumption	t/m^2	0.03	0.06	0.06		0.05
7	**Annual Electricity Consumption**	Million kWh/a	11.67	16.41	19.59	109.80	157.46
7.1	Normal Electricity Consumption	Million kWh/a	11.67	16.41	19.59		47.66
7.2	Wind Electricity Consumption	Million kWh/a				109.80	109.80
7.3	Specific Electricity Consumption	kWh/($a.m^2$)	1.22	1.86	1.89	109.80	1.60

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

E. Key Project Features

1. Energy Efficiency and Environmental Improvement

51. The Project will build 19 large and efficient (93% efficiency) low-NO_x gas-fired boilers, and two high voltage high efficiency (99.9%) zero emission electrode boilers using curtailed renewable wind power. Once the Project is operational, 50 small existing coal-fired boilers located in 29 existing small decentralized boiler houses will be closed (**Figure 4**). These small coal-fired boilers have a total of 158 MW heating capacity and currently service 6.71

million m^2 of existing heating area. The boilers have low thermal efficiency in the range of 55% to 65%, and lack adequate pollution control devices. Detailed information on boiler houses to be closed is presented in Appendix III.

52. Overall, the Project is expected to improve the energy efficiency of the heating sector by approximately 33%. When compared to the equivalent production of heat through traditional coal-fired sources, once operational the Project will: (i) result in the closure of 50 small urban low-efficiency and polluting coal-fired boilers; (ii) eliminate the use and transport through urban areas of 1.270 million tons of raw coal; (iii) result in energy savings equivalent to 382,600 ton of standard coal, thereby providing a global public good by avoiding the annual emission of 1,299,400 tons CO_2, a greenhouse gas; and (iv) improve local air quality through the estimated annual reduction of emissions of SO_2 by 11,800 tons, NO_x by 9,000 tons, PM by 26,000 tons, and fly and bottom ash by 191,000 tons.

Figure 4: Existing low efficiency coal-fired boiler in Jinqiao heating zone. The boiler will be decommissioned and dismantled once the Project becomes operational.

Source: ADB PPTA consultant, 2014.

2. Low NOx Natural Gas Fired Boilers

53. The Project will expand the Xinjiaying HSP with seven 70 MW low NOx gas-fired boilers, and construct the Jinqiao HSP with seven 70 MW low NOx gas-fired boilers and the Haoqingying HSP with five 116 MW low NOx gas-fired boilers. Compared to traditional coal-fired heat sources, natural gas-based heat is cleaner burning with less emissions and higher efficiency (93%), and for these reasons natural gas is the boiler fuel source recommended in the IFC *EHS Guidelines*.

54. The PRC EIAs use a boiler NOx emission of 137.31 mg/m^3, based on a 2007 survey of industrial natural gas boilers in PRC. It's important to note that this emission level is in compliance with both the PRC natural gas boiler emission standard of 400 mg/m^3 and 200 mg/m^3 in sensitive areas (*PRC Emission Standards of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers* (GB 13217-2001)), and the 2007 *EHS Guidelines* of 240 mg/m^3 for boilers. However, to in order to maximize environmental benefits, the Project has committed to using low NOx natural gas boilers producing less than 100 mg/m^3 NOx emissions.

55. To meet the lass than 100 mg/m^3 commitment, low-NO_X combustion technologies will be used. Each boiler will be designed to optimize flame shape. Staged combustion technology will be used, resulting in a cooler flame which suppresses thermal NO_X formation. The swirl-stabilized primary area will be responsible for producing a very stable flame. Combustion chambers will be designed to match the low- NO_X burners. In addition, smart fuel-air compound control will generate the optimum conditions for the combustion air through a joint fan with a frequency converter. The combination of low- NO_X combustion, large combustion chambers, smart control systems and efficient combustion technology will benefit the environment as well as the operator, and will ensure that NO_X emissions are less than 100 mg/m^3. The flue gas will be used to heat incoming fresh air and cool return water through heat exchangers, and will then vent via 30 m tall chimneys.

56. The HSPs will produce 120°C supply water and the return water temperature will be 60°C. The total flow rate will be 6,400 t/h for the Jinqiao and Xinjiaying heating zones, and 8,000 t/h for Haoqingying heating zone, driven by circulating pumps. Make-up water for the boilers and associated equipment will be filtered, pre-treated, softened and the oxygen content will be reduced. In case of leakage and loss of circulating water, additional water will be added to the systems by variable speed pumps, ensuring a stable operation pressure for the district heating system and make up water.

57. The use of natural gas-fired boilers in the Project will contribute to energy efficiency improvement and emissions reduction in Hohhot. In addition, gas-fired boilers do not require large coal storage sheds or ash storage silos, and do not need water and electricity for coal, fly and bottom ash and slag treatment. Thus, the use of gas-fired HSPs instead of coal-fired HSPs will require less land and will consume less water and electricity. Furthermore, the transmission of natural gas by pipeline will eliminate the negative impacts of coal transportation through urban areas by truck or train.

3. Natural Gas Source, Regulation and Safety

58. Natural gas will be sourced from the Changqing natural gas reserve, located within the Ordos Basin in IMAR . Three major gas fields, the Wushen, Daniudi and Sulige, are operating with proven gas reserves totaling 717.7 billion m^3. The methane content of the natural gas is 96.08%. Its low heat value is 32.646 MJ/Nm^3, and its high heat value is 36.229 MJ/Nm^3. Detailed fuel quality analysis data is presented in **Table 16**.

Table 16: Natural gas fuel characteristics.

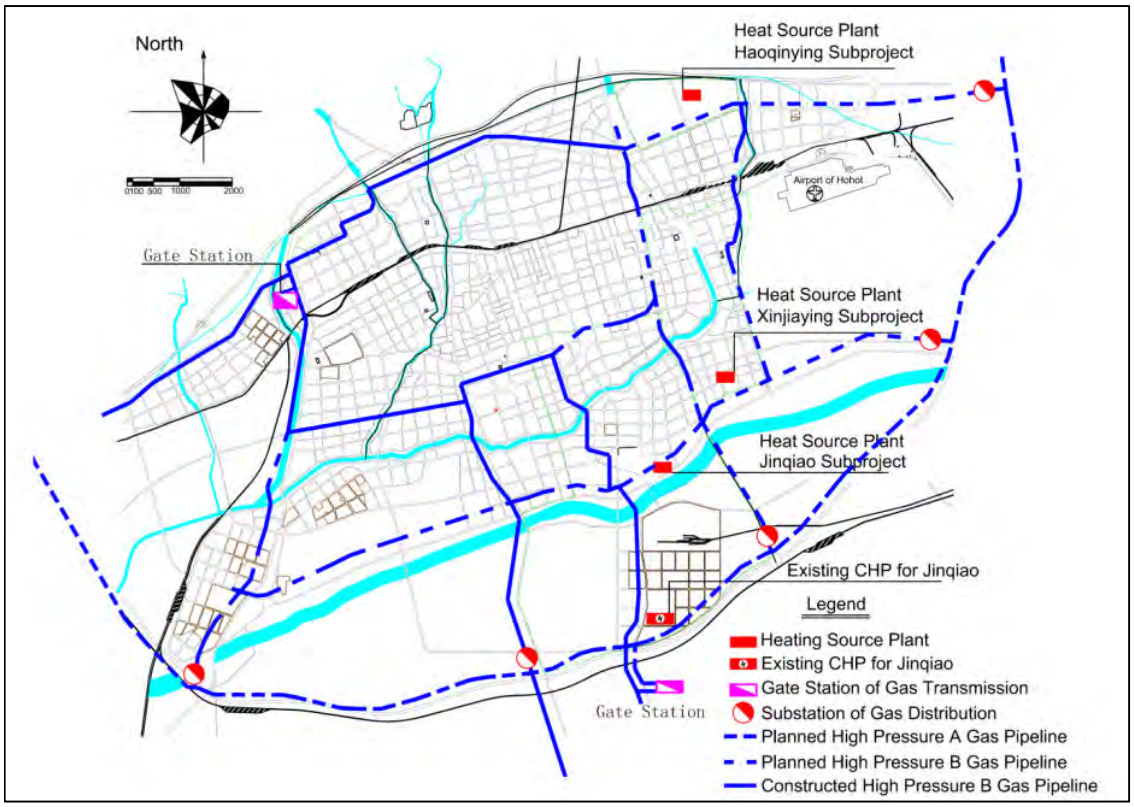
Component	**CH_4**	**C_2H_6**	**C_3H_8**	**iC_4H_{10}**	**nC_4H_{10}**	**iC_5H_{12}**
mol%	96.08	0.614	0.077	0.009	0.008	0.004
Component	**nC_5H_{12}**	**C^+_6**	**CO_2**	**He**	**N_2**	**H_2S**
mol%	0.002	0.125	2.89	0.023	0.162	0.35

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

59. The West Natural Gas Co. Ltd. is responsible for gas distribution in IMAR, and the China Gas Company of Hohhot is responsible for gas distribution in the urban areas of Hohhot. The China Gas Company has confirmed that there is sufficient capacity to meet the demands of the project and other users. Appendix IV presents the company's letter of commitment to provide gas for the Project's needs.

60. The natural gas will be transported by a 1.6 MPa natural gas network embedded under the east second ring road to gas regulation stations, utilizing DN400 transmission lines (**Figure 5**). Inside the pressure regulation stations the natural gas will be filtered, metered, and its pressure reduced to 0.3 to 0.4 MPa through three parallel filter, meter and regulation assemblies (**Figure 6**).

Figure 5: Existing natural gas network in Hohhot



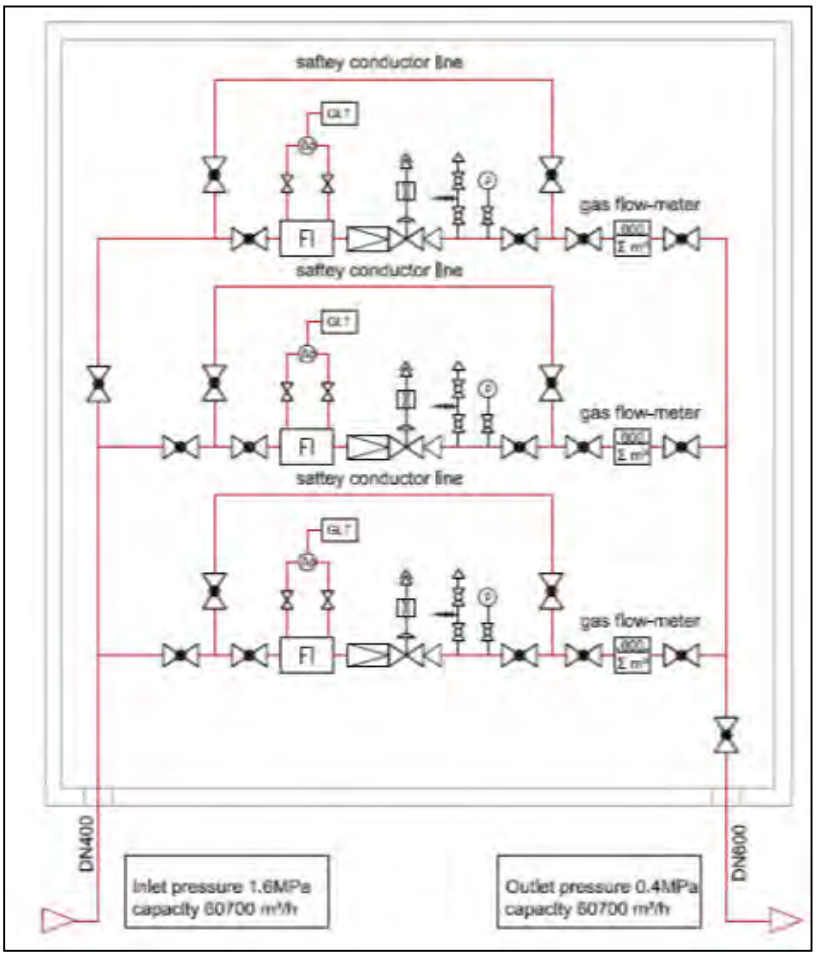
Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

61. Gas regulation stations and boilers pose a fire and explosion hazard due to the potential for gas leaks. All gas works will be in compliance with relevant PRC building code requirements, including *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92). Independent gas regulation station will be constructed 12 meters away from the main HSP buildings and 30 m from the site boundary, to minimize the risk of explosion

damaging other Project facilities or the public. The China Gas Company of Hohhot will construct and operate the gas regulation stations.

62. The gas regulation stations will be specially designed to withstand and contain explosions, and the stations and the connection to the boilers will be equipped with flammable gas detection and alarm systems. In case of a gas leak, automatic shutdown valves will shut down the gas supply, the system will generate audible and visual alarms, and the emergency ventilation system will exhaust gas from the stations so as to protect the building and operators. Normal air change for the stations will be six times per hour, but in emergencies the ventilation system will change the air 12 times per hour.

Figure 6: Schematic of natural gas pressure regulating station.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

63. The gas pipelines feeding into the pressure regulation stations will be embedded underground, and will be coated with three layers of PE corrosion protection sleeves. The gas lines exiting the gas pressure regulation stations will be suspended overhead, and will be treated with anti-corrosion paint. Pipelines will be grounded and equipped with anti-

lightning devices where applicable.

64. All other at risk areas will have flammable gas detection and alarm systems able generate audible and visual alarms, and automatic fire suppression systems. All gas related devices will be brightly colored and equipped with warning signs.

65. During detailed design construction and operation phase emergency risk and response plans for each heating zone will be established in accordance with the "*National Environmental Emergency Plan*" (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the World Bank EHS guidelines with respect to occupational and community health and safety. Construction and operation phase Environment, Health and Safety (EHS) plans will also be developed by occupational and gas boilers specialists to ensure worker and community safety.

4. Wind Powered Electrode Boilers

66. The Project will construct two 25 MW 10 kV wind powered electrode boilers in the Haoqingying heating zone. The use of such large scale high voltage electrode boilers is the first time in the PRC.

67. Wind power is clean renewable energy, and IMAR has the largest installed wind power capacity in the PRC with more than 18 gigawatt of wind power projects already in operation. However, due to rapid growth of wind farms, consequent over supply of wind generated electricity, and grid priority given to CHPs in winter night time, around 20% of the wind power has been curtailed in IMAR. During the winter time when heating demand rises, reliable coal-based CHP plants are prioritized in the grid operation, forcing many wind farms out of the grid. Wind to heat projects address this problem by utilizing wind power for heating when wind power generated electricity is available. This solution will increase wind power generation and reduce curtailment of wind power, reduce coal or gas consumption for district heating, improve energy conservation, reduce pollutant emissions, and minimize environmental impacts of winter time heating. **Figure 7** shows one of the wind farms from which electricity will be sourced. The Datang (Hohhot) Renewable Power Company wind farm is located on the Inner Mongolia plateau, 90 km northwest of Hohhot. The farm has 58 wind mills and a targeted production capacity of 50 MW

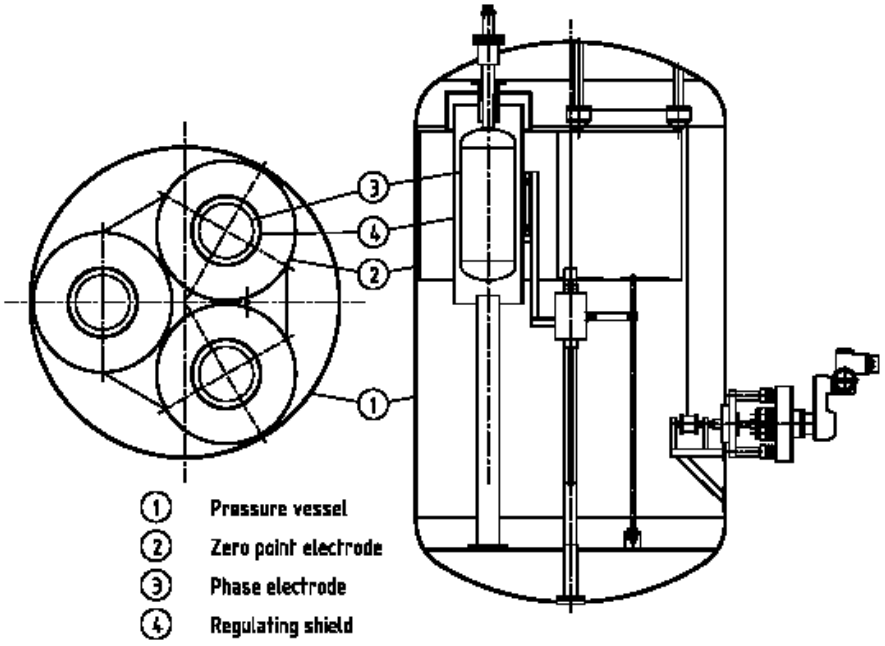
Figure 7: Datang (Hohhot) Renewable Power Company wind farm, northwest of Hohhot.

Source: ADB PPTA consultant, 2014.

68. Electrode boilers work by passing current through the water, between two electrodes,

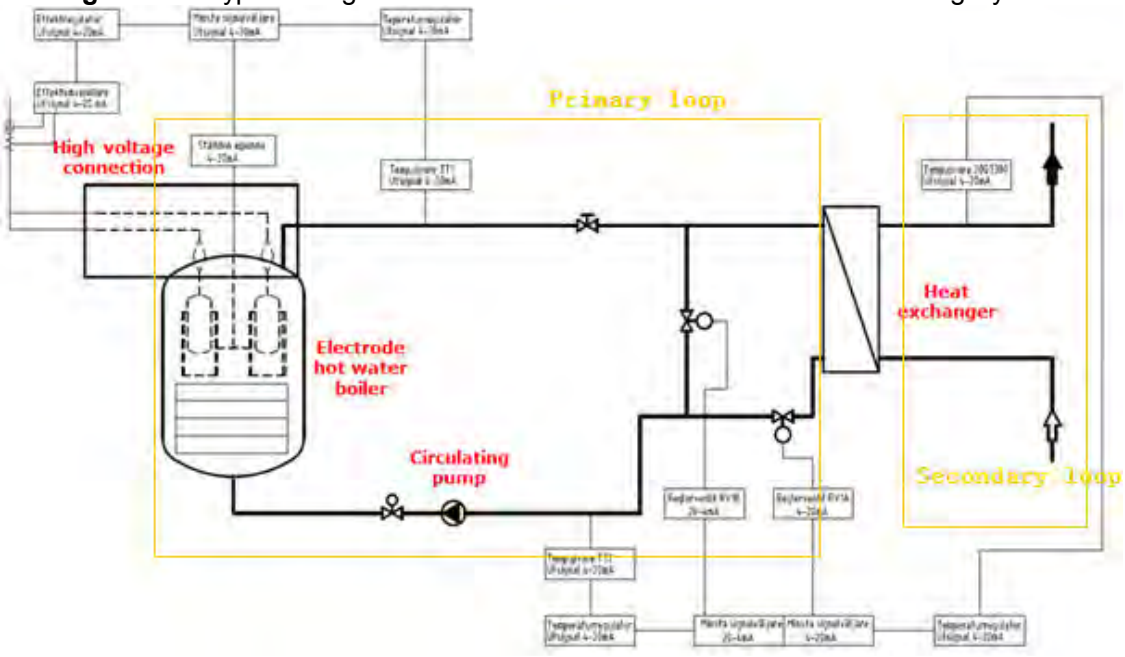
thereby creating heat. It uses conductivity and resistance feasture of water, transmits current and produces heat. The boiler has a 3-phase connection, each phase contains a phse electrode, a zero point electrode, and a regulating shield. The current is conducted directly in the water between the phase electrodes③ and the zero point electrodes②. The power depends on the area of the surface that can conduct the current between phase and zero, which is regulated by the regulating shield ④ that can expand or shrink. If the regulating shield expands, then, the surface area increases. This leads to more boiler power. A zero point electrode is mounted in a pressurized vessel①. A phase electrode is installed hanging in the ceiling of the pressure vessel. The structure of the electrode hot water boiler is shown in **Figure 8**.

Figure 8. A Typical Structure of an Electrode Hote Water boiler



69. An electrode boiler is usually built in a two-circuit system due to different water quality requirements: primary and secondary loops. A pump circulates the water between the boiler and the heat exchanger in a primary loop where the boiler water needs high purity. The district heating water at the secondary loop absorbs the thermal energy through the heat exchanger and then, is distributed to the district heating pipe networks. A typical system diagram of electrode boiler hot water heating system is shown in **Figure 9**.

Figure 9. A Typical Diagram for Electrode Boiler-based Hot Water Heating System



70. As there is no combustion, electrode boilers are emission free. They have several key advantages over fossil fuel fired boilers: they have extremely quick response times; they are flexible for cyclical or intermittent operations; they are clean firing and produce no combustion emissions and do not require stacks; they are greater than 99% efficient; and, they are smaller in volume and footprint than fossil fired boilers. **Table 17** presents the key design features for the Haoqingying electrode boilers.

Table 17: Key design features, Haoqingying electrode boilers.

No.	Item	Feature
1	Name	High voltage electrode hot water boiler
2	Power	25 MW
3	Diameter of boiler body	2700 mm
4	Voltage	10 kV
5	Area standing	15m^2（for the boiler body）
6	Weight	12 Ton

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

71. Each boiler will require 25 m^3 of boiler water at the outset. The boiler circulatory system is closed, and will only require 0.5 m^3 make-up water per heating season. Trisodium phosphate (Na_3PO_4) will be used as an electrolyte to increase the conductivity of the boiler water; approximately 0.3 kg will be required for each boiler per heating season.

5. Coordination with Existing Jinqiao CHP

72. It is estimated that the Jinqiao heating zone will use around 53% of total heat supply from the existing coal-fired CHP (**Figure 10**) and use around 47% of total heat from the Project constructed natural gas-fired HSP as heat sources. The existing CHP will cover the heating base load, and the natural gas-fired HSP will cover the peak load. Heat from the Jinqiao CHP will have a priority in order to reduce heat waste. Only when the CHP capacity

is insufficient to meet the heat demand, the natural gas-fired HSP will be used to provide heating. This strategy will optimize energy efficiency and improve environment protection.[9] It is estimated that the Jinqiao CHP with 582 MW can sufficiently supply heat to all heating area in Jinqiao heating zone when the outdoor temperature remins avobe -3^{0}C. However, if the temperature drops, the Jinqiao CHP cannot meet the increasing heat demand and the natural gas boiler under the Project will supply heat.

73. A brieft due diligence was conducted for the Jinqiao CHP. The domestic EIA for the Jinqiao CHP was prepared and approved by the former State Environmental Protection Agency on December 21, 2004. The CHP is fully equipped with emission control emasures, including low NOX combustion technology, limestone wet scrubbing flue-gas desulfurization (FGD), and bag-type dust collectors. In addition, a continuous emissions monitoring system (CEMS) is installed to measure emissions at all times. The Jinqiao CHP has been fully complied with the PRC environmental regulations. It is confirmed that there was no record of public complaints.

Figure 10: 582 MW Jinqiao CHP, operated by the state-owned China Huaneng Group.

Source: ADB PPTA consultant, 2014.

6. Primary Distribution Network and HESs

74. The Project will utilize an indirect connection system and will construct heat sources, primary heating networks, heat exchange stations (HESs), and control systems. The Project does not include secondary networks between the HESs and end-users.

75. The Project will construct a total of 180 HESs to transfer heat to the secondary networks. Each HES will service an area ranging from 20,000 to 200,000 m$^{2.}$ A typical HES will be equipped with plate heat exchangers, circulating pumps, and water supply devices.

[9] The primary function of the existing CHP is production of electricity. In a stand-alone power plant the heat produced during the electricity production would be waste energy and would have to be cooled in cooling towers, giving a typical plant efficiency of 30-35%. In a CHP this waste heat is captured and used for district heating, thereby increasing the total efficiency of the plant to 80-85% while adding no additional emissions as the coal otherwise would still have been burned to generate electricity. Therefore, use of the CHP will be maximised and the HSP will be used as a peaking plant.

The primary heating network working pressure will be 1.6 MPa, the water supply temperature will be 120°C, and the return water temperature will be 60°C. In the secondary heating network the supply temperature will be 85°C and the return temperature 60°C. A frequency modulating controller will be used for regulating the circulating pump. Measuring and automatic control devices or Remote Terminal Units (RTUs) will be linked to the central control room in the HSPs through the SCADA systems. **Figure 11** and **Error! Reference source not found.** show schematic diagrams of one and two units HESs, respectively. Primary distribution networks for each heating zone are presented in Section III.F.

76. The Project will adopt 11 building-level HESs (**Figure 11**). In a building-level HES, all equipment and auxiliary parts will be installed in small prefabricated packages close to the users, typically in the basements of the buildings to be served.[10] This result in cost saving by reducing the size of heating pipes, the reduction of transmission heat losses, the improvement of hydraulic balance and heat efficiency, and energy saving of HESs operation. It also conserves land and space compared to typical HESs.

Figure 11: Examples of Building Level HES.

(a)Building level HES unit (b)Building level HES unit-pump (c)Building level HES unit-Cabinet style

Source: Asian Development Bank, 2014.

Figure 12: Interior of two-unit automated district HES built in 2011.

Source: ADB PPTA consultant, 2014.

[10] Building level HESs will be approximately 2 m long, 1.5 m wide and 2 m high. The final dimensions will be dependent on the manufacturer.

7. Pipelines

77. The Project will install pre-insulated bonded heating pipes utilizing direct-bury installation. Steel pipes, polyurethane foam (PUR) and high density polyethylene (HDPE) are bonded into one piece in a sandwich-like structure. Non-ozone depleting blowing agents will be utilized for the PUR. Compared to on-site insulation of pipes buried in a tunnel, direct-bury pre-insulated bonded pipes have lower capital costs, reduced heat losses, improved energy efficiency, better anti-corrosive and insulation performance, longer service life, reduced land acquisition requirements, and shorter installation cycles, all of which protect the environment and simplify conditions for construction of municipal facilities.

8. Leak Detection Systems

78. Leak detection systems will be installed in the main pipeline networks to assist operators in detecting and localizing leaks. The systems will provide an alarm and display related data to the pipeline operators in case of leakage, which will help operators detect and accurately locate leakage point by using portable detection equipment. A total of 39.9 km of heating pipeline will be monitored for leakage.

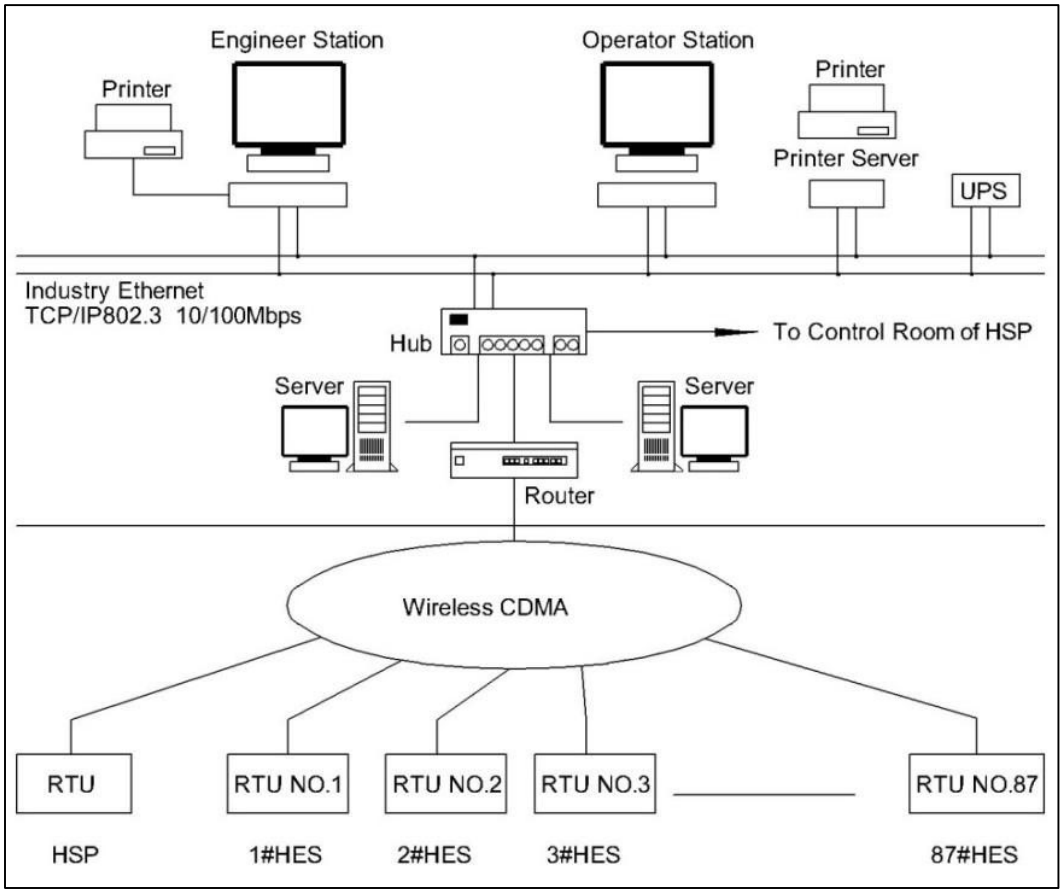
9. SCADA Systems

79. Each HSP will be equipped with a supervisory control and data acquisition (SCADA) system to monitor the main system parameters for the safe and optimal operation of the district heating systems. The SCADA systems will monitor and regulate process heat demand, heat consumption, water consumption and electricity consumption, and will maximize energy saving and ensure efficient and effective heating service.

80. Each SCADA will consist of a control center located at the regulation center building, regional control center, and local control and monitoring units. The control center will be responsible for the comprehensive data collection and processing, issuing control orders to the regional control center, coordinating the whole heating system, and communicating with external units. The regional control center will collect data from the local control units and submit to the central control center, and accept and execute orders from the central control center. The local control centers will be responsible for monitoring and control of the HESs.

81. Equipment in the control center such as host computer, communication controller, operator stations, engineer stations and printers will be connected with an industrial Ethernet. Communication between the central control center, regional control centers and local control units will be controlled by a communication controller and will pass through an interface connected to general packet radio service (GPRS) network or the Integrated Services for Digital Network (ISDN). A schematic diagram of a SCADA system for the Haoqingying heating zone, which is similar to other heating zones, is presented in **Figure 13**.

Figure 13: Schematic diagram of SCADA System (Haoqingying HSP).



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

10. Electrical Design

82. The HSP and HESs need a secure electricity supply to meet the demands of electric equipment such as boiler pumps, lighting, control panels, etc. In accordance with national regulations, the central control centers will be equipped with Uninterrupted Power Supplies (UPSs) to ensure the control systems can work continuously. Double 10 kV circuits and 800 KVA and 200 KVA transformers will be used in the boiler houses. In addition, high voltage and low voltage switch cabinets, direct current (DC) cabinet, and lighting systems have been designed for the HSPs. The HESs will have 380V/220V electric lines to power pumps, lighting, and control panels.

11. Water Supply, Wastewater

83. The Project will utilize an estimated 962,580 m³ of municipal water during the 183 day heating season for domestic and production water and fire protection systems (Xinjiaying and Jinqiao water consumption will be 1620 m³/d each, and Haoqingying water consumption will be 2020 m³/d). This is equivalent to 0.57% of Hohhot's annual water supply capacity of 168.9 million m³/year. Appendix V presents letters from the Hohhot Municipal Water Supply Company confirming the ability to supply the required water.

84. The Project will generate both domestic and production wastewater. Production wastewater includes wastewater from the HSP water treatment plants and boiler blowdown. Domestic wastewater will be produced from worker sanitation facilities. Domestic wastewater will be treated in digestion tanks, and then in combination with the production wastewater, will be discharged to the Hohhot municipal sewerage system for treatment at the Jinqiao wastewater treatment plant (WWTP), located west of Hangkai Road. All emission concentration of SS, COD, BOD_5 and ammonia nitrogen will be in compliance with Class III standard requirements of *Integrated Wastewater Discharge Standard* (GB8978-1996), which sets the emission standards for wastewater discharged to a municipal sewerage system.

85. The HSPs will require typical connections to the municipal water system and to the municipal sewerage system:

Haoqingying HSP

- Approximately 100m of water supply pipeline, connecting to the municipal water supply network under East Station road.
- Approximately 100m of wastewater discharge pipeline, connecting to the municipal wastewater drainage network under East Station road.

Jinqiao HSP

- Approximately 2000m of water supply pipeline, connecting to the municipal water supply network under Huyang road from the west wall of the HSP.
- Approximately 80m of wastewater discharge pipeline, connecting to the municipal wastewater drainage network under Fengzhou road from the west wall of the HSP.

Xinjiaying HSP

- Approximately 10m of water supply pipeline, connecting to the municipal water supply network through the plant gate.
- Approximately 10m wastewater discharge pipeline, connecting to the municipal wastewater drainage network through the plant gate.

12. Fire Protection

86. All natural gas works will be in compliance with relevant PRC building code requirements, including the *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92). Independent gas regulation stations will be constructed at least 14 meters away from other buildings and 30 m from the site boundary, to minimize the risk of explosion damaging other Project facilities or the public. The China Gas Company of Hohhot will construct and operate the gas regulation stations.

87. The gas regulation stations will be specially designed to withstand and contain explosions, and the connection to the boilers will be equipped with flammable gas detection, alarm and fire suppression systems. In case of a gas leak, automatic shutdown valves will shut down the gas supply, the system will generate audible and visual alarms, and the emergency ventilation system will exhaust gas from the stations so as to protect the building and operators. Normal air change for the stations will be six times per hour, but in emergencies the ventilation system will change the air 12 times per hour. Electrical devices within the explosion risk area will be safety equipped.

88. The gas pipelines feeding into the pressure regulation stations will be embedded underground, and will be coated with three layers of PE corrosion protection sleeves. The

gas lines exiting the gas pressure regulation stations will be suspended overhead, and will be treated 4 times with anti-corrosion paint. Pipelines will be grounded and equipped with anti-lightning devices where applicable.

89. All other at risk areas will have flammable gas detection and alarm systems able generate audible and visual alarms, and automatic fire suppression systems. All gas related devices will be brightly colored and equipped with warning signs. The risk of fire in HESs is low due to less flammable equipment and materials, so only manual dry fire extinguishers will be used for fire protection purposes.

90. An emergency risk and response plan for each heating zone will be established in accordance with the "*National Environmental Emergency Plan*" (24 January 2006) and other relevant PRC laws, regulations and standards. In addition construction and operation phase environment, health and safety (EHS) plans will be developed by specialists in occupational health and safety and gas-fired boilers to ensure protection of workers and the surrounding community.

13. Heating and Ventilation

91. Facilities will be equipped with cast-iron radiators for space heating. The design room temperature of the complexes, control rooms, and gatehouses is 18°C; pump rooms, heat exchanger rooms, and garages is 10°C; and chemical testing rooms and bathrooms is 16°C. The feed and return water temperatures at HES will be 80 and 65°C respectively.

92. The control room and electric rooms will be mechanically ventilated by fans. Other rooms will be naturally ventilated.

14. Landscaping

93. The HSP sites will be vegetated with appropriately selected native trees and shrubs.

15. Temporary Worker's Camps

94. During the project construction, a temporary workers' camp will be installed at each heat source plant within the premise of the heat source plants. No workers' camp is needed for pipeline construction as it is done in phases and a very limited number of workers will be needed for each phase of pipe installation.

F. Specific Design Details

1. Haoqingying Heating Zone

a) Location and Scope

95. The proposed HSP is located in the northern portion of the Haoqingying heating zone in northeastern Hohhot (**Error! Reference source not found.** and **Figure 14**). It will serve 11.36 million m^2 of heating area.

96. The scope includes construction of (i) one HSP with 630 MW heating capacity, including five 116 MW low NOx natural gas-fired boilers and two wind power 25MW 10 kV electrode boilers; (ii) 87 HESs, of which 11 will be building-level HESs; (iii) 30.68 km of primary network; and (iv) one SCADA system control center. Key parameters are presented in **Table 15**.

b) Main Works and Equipment

97. The main equipment includes five 116 MW low NOx natural gas-fired boilers and two 25 MW 10 kV electrode boilers, described below:

Natural Gas Boiler	
Type	Low NOx natural gas hot water boiler
Model	QXS116-1.6/120/60-Q
Rated heat supply	116 MW
Rated water supply pressure	1.6 MPa
Rated supply/ return water temperature	120/60 ^{0}C
Rated water circulation capacity	1600 t/h
Boiler efficiency	93%
NOx emissions:	< 100 mg/Nm^3
SO_2 emissions:	29.36 mg/Nm^3

Electrode Boiler	
Name	High pressure electrode hot water boiler
Type	DJR-35-1.6
Max power	25 MW
Operating Voltage	10 kV

98. **Table 18** presents the main project works.

c) Site Layout and Buildings

99. The general layout consists of five areas: the main plant area, gas pressure regulation station, water supply facility, electrical substation, and complex and office area. The total HSP building area is 10,257 m^2. The Project will construct the main plant and gas pressure regulation, and it will share other auxiliary facilities such as water supply, storage, electric substation, and office complex including mechanic workshop, dispatching center, etc., with the phase 2 HSP. All buildings will be designed for energy efficiency and noise mitigations will be incorporated into the pumping station. The detailed layout of the plant is shown in **Figure 14**, while **Table 19** provides data on HSP buildings.

Table 18: Main Works in Haoqingying Heating Zone

Project Works		Description
Main Works	1 Boiler Room	5×116 MW low NOx natural gas-fired boilers 2×25 MW 10 kV wind power electrode boilers
	2 Primary Heat Supply Network	30.68 km
	3 HESs	87 substations, including 11 building level HESs
Ancillary Works	1 Burning system	Each gas boiler is installed with one blower. Boiler flue gas is discharged to atmosphere via funnel and chimney.
	2 Water Treatment Facility	Circulating water pump, make-up pump, softwater preparation equipment, deaerator, etc.
	3 Thermal System	Return water of primary network is sent back to boiler room through deaerator and circulating water pump. Heat supply network is constant pressure by make-up pump. Make-up water is sent to circulating water pump inlet by softening process and deaerator and send back to boiler combined with return water of primary network.
	4 Gas Pressure Regulating Station	After the natural gas pressure is reduced to 0.3-0.4 MPa, the gas is sent to the burner in the boiler room by DN 600 pipeline.
	5 Wind Power Thermal system	Wind power thermal system will connect to primary pipe network directly. Supply temperature is 120^0C, return temperature is 60^0C.
Public Utilities	1 Water Supply	Production and domestic water source is municipal water.
	2 Wastewater	Production and domestic wastewater will be discharged to the municipal sewage pipeline network
	3 Power Supply	Power will be supplied by 110 kV Haoqingying transformer substation.
	4 Office	Comprehensive administration building, canteen and living quarters.
Environmental Protection	1 Boiler Emissions	Low NOx natural gas fired burners will be used (NOx content in flue gas will be < 100 mg/Nm^3)[11]. Flue gas will be vented via five 2.5 m diameter 30 m tall chimneys.
	2 Noise Control	Low-noise equipment with noise reduction measures like noise elimination, damping, sound insulation and enclosures will be used.

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 19: Haoqingying HSP Buildings

Name	Footprint (m^2)	Building Area (m^2)	Building Height (m)	Notes
Boiler House	9064	9064	22	5 Chimneys 30m High Φ＝2000mm
Gas Station	1093	------		
Total	10257	9064		

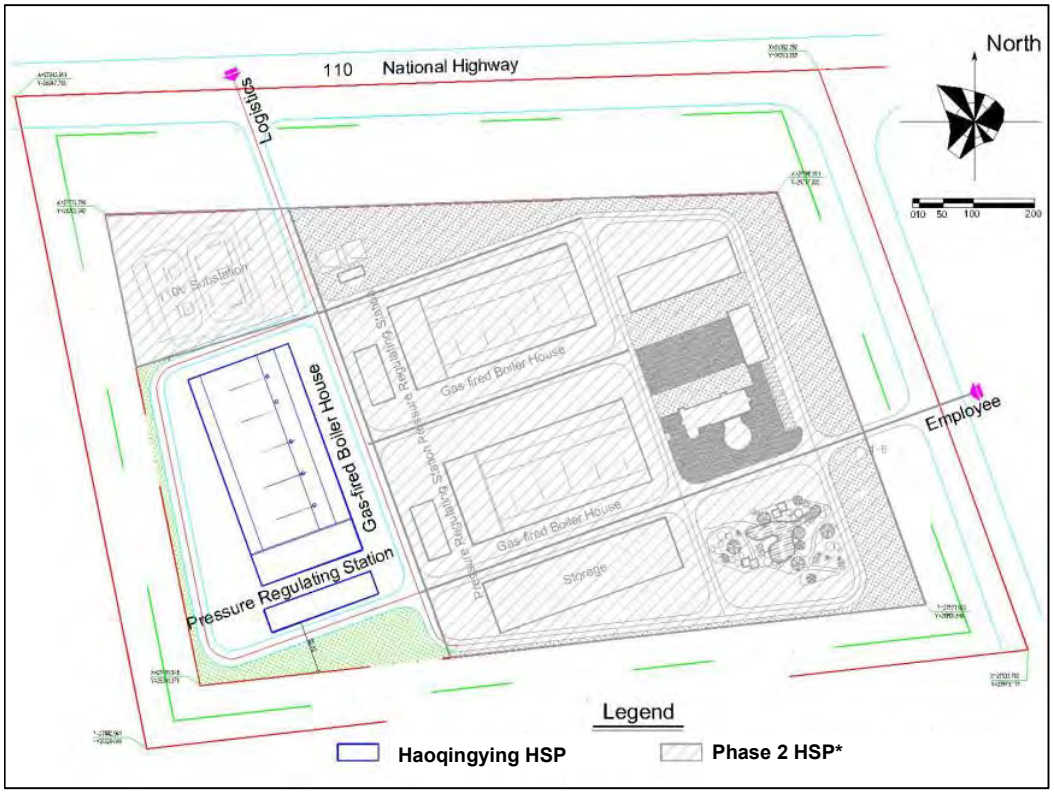
Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

[11] The PRC heating zone EIAs use a boiler NOx emission of 137.31 mg/m^3, based on a 2007 survey of industrial boilers in PRC. However, HCDIO has committed to using low NOx boilers producing less than 100 mg/m^3 NOx emissions.

d) Primary Transmission Network and HESs

100. The primary network will be 30.68 km of direct-bury pre-insulated bonded pipe with diameters ranging from DN 150 to DN 1200 mm. A total of 87 HESs will be constructed, including eleven 4 MW building level HESs (**Figure 15** and **Table 20**).

Figure 14: Haoqingying HSP Site Layout.



*Note: The HCDIO and the HCHC proposed the Haoqingying Phase 2 consisting of nine 70 MW gas-fired boilers, which will serve heating areas between the Haoqingying and Xinjiaying heating zones under the Project. It is expected that five 70 MW gas-fired boilers of Phase 2 project will be installed covering 6.30 million m^2 heating area by 2015, and the other four 70 MW gas-fired boilers will be installed by 2020 covering 2.70 million m^2 heating area.

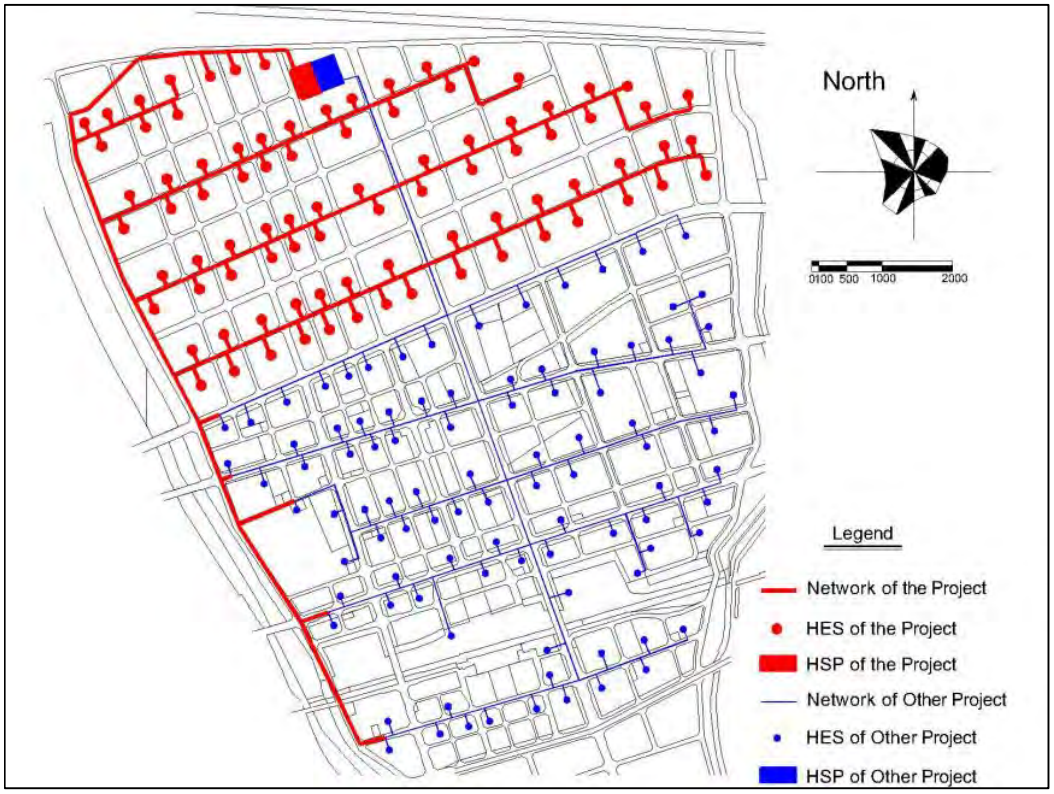
Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Table 20: HESs in Haoqingying heating zone.

Heat Load Capacity	**4MW**	**5MW**	**6MW**	**7MW**	**8MW**
Quantity	11	13	12	21	15
Heat Load Capacity	**2×5MW**	**2×6MW**			**Total**
Quantity	13	2			**87**

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Figure 15: Haoqingying primary network.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

2. Xinjiaying Heating Zone

a) Rationale

101. The Xinjiaying heating zone is mixed residential, commercial, and public buildings (IMAR and Hohhot municipal governments) area. It has an existing district heating system, heat of which is supplied by a HCHC-owned coal-fired 448 MW HSP (four 70 MW coal-fired boilers and two 84 MW coal-fired boilers), serving 4.73 million m^2 of heating area (**Figure 16**). Due to housing and other developments, the heating area of the district is expected to be 16.8 million m^2 by 2015 and 26.8 million m^2 by 2020, requiring additonal heating capacity. The Project will meet such increasing demand for district heating.

Figure 16: Existing Xinjiaying HSP, showing expansion which is expected to be completed by 2015.

Source: ADB PPTA consultant, 2014.

b) Location and Scope

102. The proposed HSP will be located adjacent to the west of the existing HSP site (**Error! Reference source not found.** and **Figure 17**). The scope includes construction of (i) one HSP with 490 MW heating capacity, including seven 70 MW gas-fired boilers; (ii) 48 HESs; (iii) 26.02 km of primary network; and (iv) one SCADA system control center. Key parameters are presented in **Table 15**.

c) Main Works and Equipment

103. **Table 21** presents the main project works. The main equipment includes seven 70 MW natural low NOx natural gas-fired boilers, described below:

Natural Gas Boiler	
Type	Low NOx natural gas hot water boiler
Model	QXS70-1.6/120/60-Q
Rated heat supply	70 MW
Rated water supply pressure	1.6 MPa
Rated supply/ return water temperature	120/60 ^{0}C
Rated water circulation capacity	1000 t/h
Boiler efficiency	93%
NOx emissions:	< 100 mg/Nm^3
SO_2 emissions:	29.36 mg/Nm^3

Table 21: Main works in Xinjiaying heating zone.

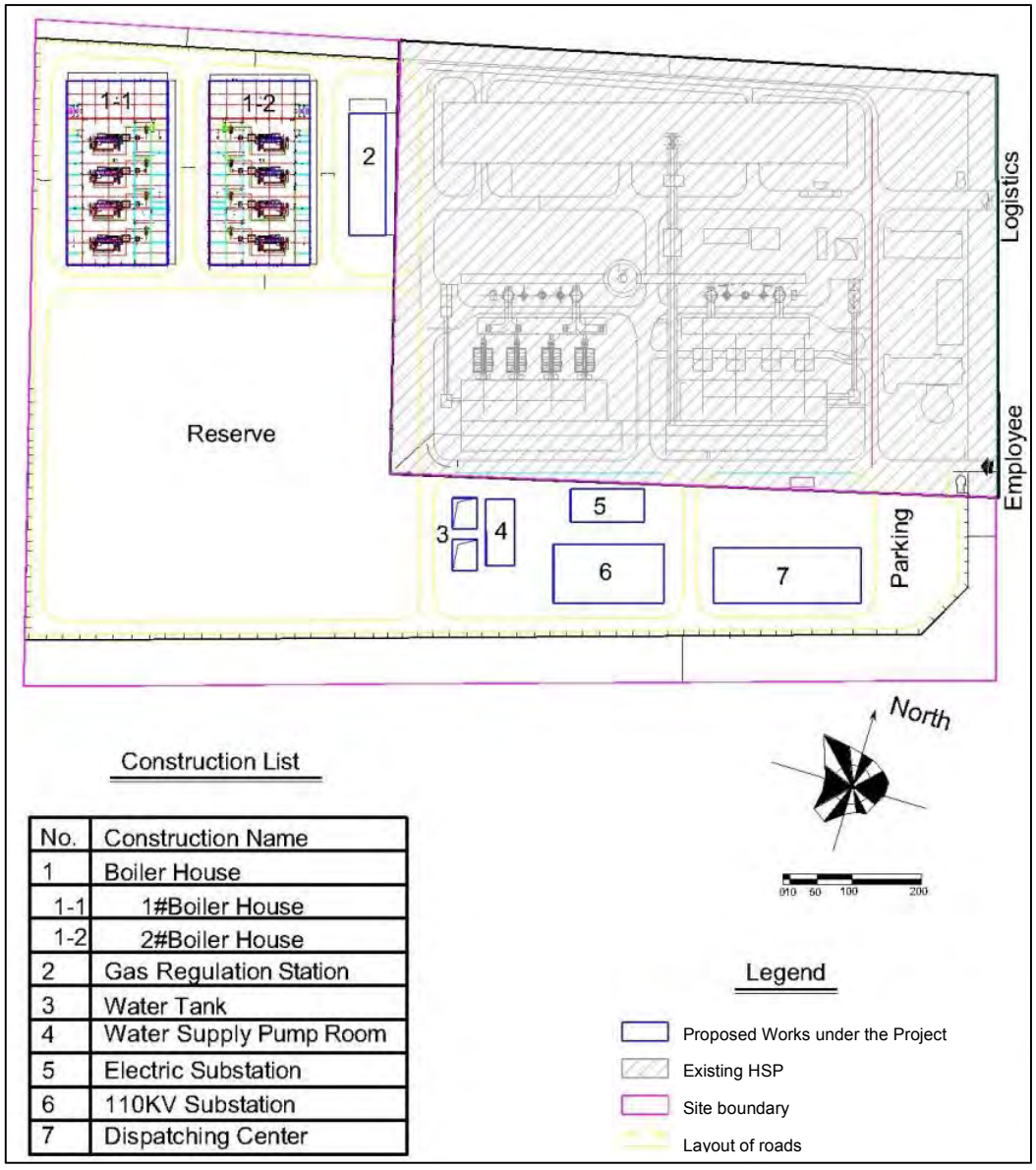
Project Works		Description
Main Works	1 Boiler Room	7x70 MW low NOx natural gas-fired boilers
	2 Primary Heat Supply Network	26.02 km
	3 HESs	48 substations
Ancillary Works	1 Burning system	Each gas boiler is installed with one blower. Boiler flue gas is discharged to atmosphere via funnel and chimney.
	2 Water Treatment Facility	Circulating water pump, make-up pump, softwater preparation equipment, deaerator, etc.,
	3 Thermal System	Return water of primary network is sent back to boiler room through deaerator and circulating water pump. Heat supply network is constant pressure by make-up pump. Make-up water is sent to circulating water pump inlet by softening process and deaerator and send back to boiler combined with return water of primary network.
	4 Gas Pressure Regulating Station	After the natural gas pressure is reduced to 0.3-0.4 MPa, the gas is sent to the burner in the boiler room by DN 600 pipeline.
Public Utilities	1 Water Supply	Production and domestic water source is municipal water.
	2 Wastewater	Production and domestic wastewater will be discharged to the municipal sewage pipeline network
	3 Power Supply	Power will be supplied by 110 kV Heihe transformer substation of Hohhot city. A 110 kV/10 kV transformer substation will be built to provide 10 kV electricity. Total operation capacity of gas boiler room is 5102 kW and electricity consumption is about 907.6×104 kWh during heating period.
	4 Office	Comprehensive administration building, canteen and living quarters.
Environmental Protection	1 Boiler Emissions	Low NOx natural gas fired burners will be used. Flue gas will be vented via seven 2.0 m diameter 30 m tall chimneys.
	2 Noise Control	Low-noise equipment with noise reduction measures like noise elimination, damping, sound insulation and enclosures will be used.

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

d) Site Layout and Buildings

104. The general site layout consists of five areas: the main plant area, gas pressure regulation station, water supply facility, electric substation, and complex and office area. In addition, there are three unoccupied areas reserved for future use. Within the main plant area, the units or facilities are installed successively from west to east: gas-fired boiler house → blowing fans → chimney. Auxiliary operations and services will be installed south of the main plant, including the office and dispatching center, water service facility, electrical substations, etc. The detailed layout of the HSP is shown in **Figure 17** while **Table 22** provides data on HSP buildings.

Figure 17: Xinjiaying HSP Site Layout.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Table 22: Xinjiaying HSP Buildings

No.	Name	Footprint (m^2)	Building Area (m^2)	Building Height (m)	Notes
1	No. 1 Boiler House	5462.73	5462.73	12	4 Chimneys 30m High Φ=2000mm
2	No. 2 Boiler House	5462.73	5462.73	12	3 Chimneys 30m High Φ=2000mm
3	Gas Regulation Station	1320	------		
4	Water Tank	459	------		
5	Water Supply Pump	561.5	561.5	4.5	
6	Electric Substation	720	720	5	
7	110kV Substation	1920	2200	8	
8	Dispatching Center	2400	7200	10	
	Total	**18305.96**	**21606.96**		

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

e) Primary Transmission Network and HESs

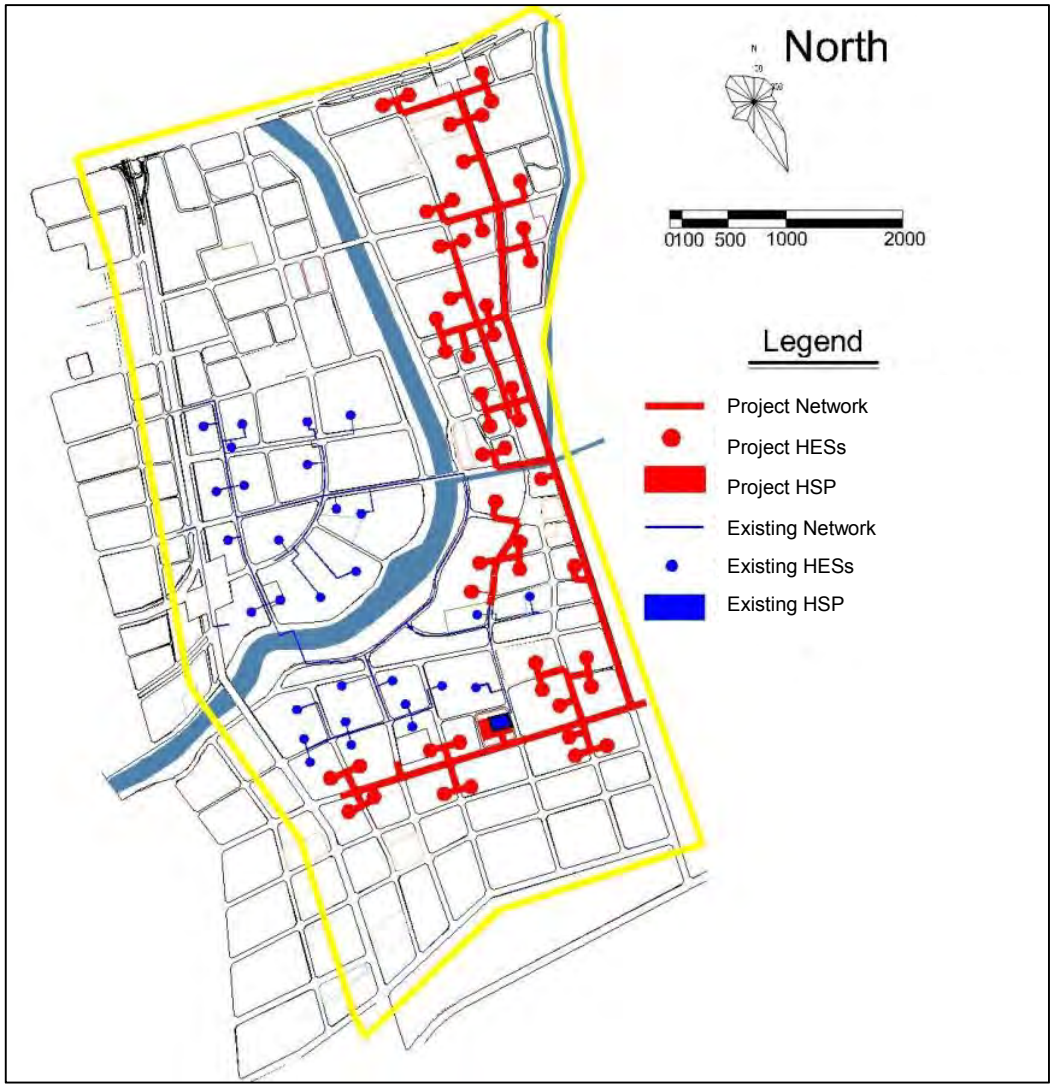
105. The primary network will be 26.026 km of direct-bury pre-insulated bonded pipe with diameters ranging from DN 150 to DN 1200 mm. A total of 48 HESs will be constructed, ranging in service area size from 20,000 to 180,000 m^2 (and **Figure 18**).

Table 23: HESs in Xinjiaying heating zone

Heat Load Capacity	**4MW**	**5MW**	**6MW**	**7MW**	**8MW**
Quantity	2	2	1	2	3
Heat Load Capacity	**2×5MW**	**2×6MW**	**3×4MW**	**2×4MW**	**Total**
Quantity	4	1	30	3	**48**

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Figure 18: Primary network in Xinjiaying heating zone.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

3. Jinqiao Heating zone

a) Rationale

106. The Jinqiao heating zone is located in southeastern Hohhot. The HCHC are responsible for urban district heating system operation and provides heat to 6.55 million m^2 from the existing coal-fired 582 MW Jinqiao CHP, operated by the state-owned China Huaneng Group (**Figure 10**). In addition there are 29 small decentralized boiler houses with a total of 50 small coal-fired boilers (**Figure 4**), which have a total of 158 MW heating capacity and serve 6.71 million m^2 of existing heating area. As they are old and inefficient, they will be removed once the Project is operational.

107. The Jinqiao CHP was designed to heat 9.70 million m^2 and still has unused capacity

to heat 3.15 million m^2. Under the Hohhot Urban Heating Plan, the heating area of the district is expected to be 21.0 million m^2 by 2015 and 33.4 million m^2 by 2020, while the district heating area served by the HCHC is expected to be 9.70 million m^2 by 2015 and 19.23 million m^2 by 2020. Hence, by 2015 the heating capacity of the Jinqiao CHP will be fully utilized. In order to meet the demand of 9.53 million m^2 of new heating area by 2020, a new HSP is required.[12]

b) Location and Scope

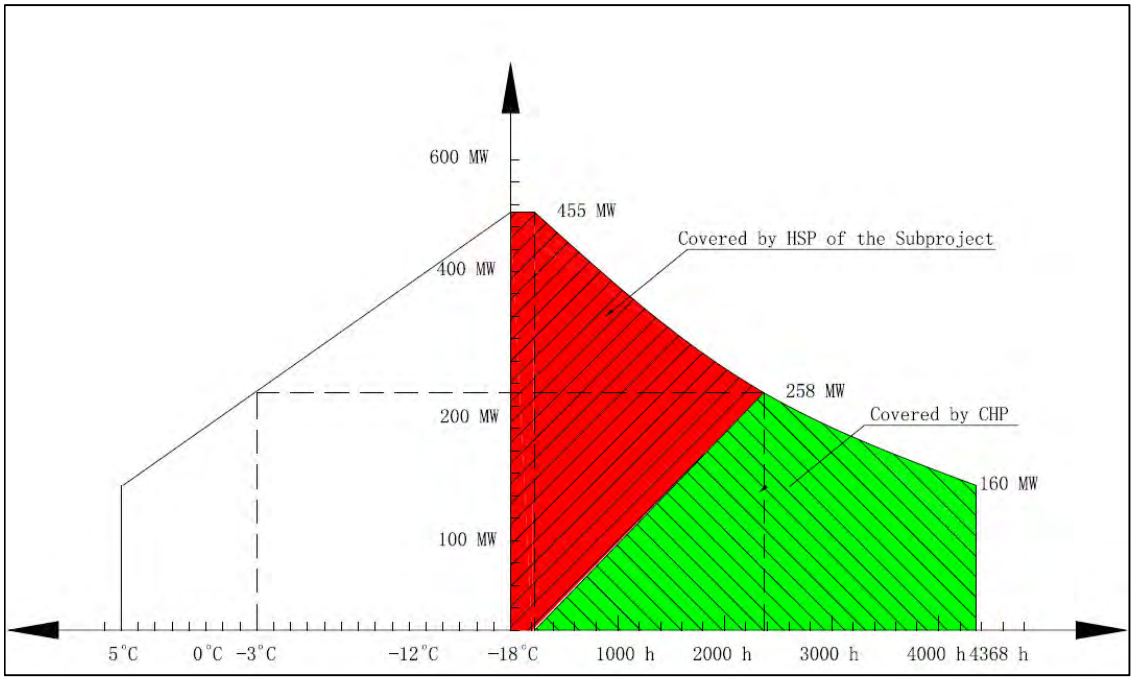
108. The proposed HSP is located at an abandoned brick and tile factory and unused land in southeastern Hohhot, 5.5 km northeast of the existing CHP (**Error! Reference source not found.** and **Figure 20**). The scope includes construction of (i) one HSP with 490 MW heating capacity, including seven 70 MW gas-fired boilers; (ii) 45 HESs; (iii) 17.06 km of primary network; and (iv) one central control center of SCADA system. It will provide heating service to both existing and newly-developed areas (73% residential and 27% public buildings), and will result in the decommissioning and dismantling of 50 existing small boilers (the boiler decommissioning is not included within the scope of the Project). Key parameters are presented in **Table 15**.

109. The existing CHP will cover the heating base load, and the natural gas-fired HSP will cover the peak load. Heat from the CHP will have the highest priority, and only when the CHP capacity is insufficient to meet the heating demand will the natural gas-fired HSP be used to provide heating. This strategy will optimize energy efficiency and improve environment protection.

110. More specifically, the Jinqiao CHP's 582 MW has sufficient capacity to provide heating to the existing area it is already serving and the new Jinqiao heating zone until the temperature reaches -3^0C. At that point priority for the CHP heat will be given to the area it currently serves, and the Jinqiao HSP will begin to provide heat to the new Jinqiao heating zone. At -18^0C the capacity of the CHP will be completely utilized providing heat to the existing heat area it serves, and the natural gas-fired HSP will be solely responsible for providing heat to the new Jinqiao heating zone (**Figure 19**).

[12] The 9.53 million m^2 includes the 1.29 million m^2 currently heated by the 50 small coal-fired boilers.

Figure 19: Coordination of Jinqiao CHP Base Load and Jinqiao HSP Peak Load Operation.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

c) Main Works and Equipment

111. **Table 24** presents the main project works. The main equipment includes seven 70 MW natural low NOx natural gas-fired boilers, described below:

Natural Gas Boiler	
Type	Low NOx natural gas hot water boiler
Model	QXS70-1.6/120/60-Q
Rated heat supply	70 MW
Rated water supply pressure	1.6 MPa
Rated supply/ return water temperature	120/60 ^{0}C
Rated water circulation capacity	1000 t/h
Boiler efficiency	93%
NOx emissions:	< 100 mg/Nm^3
SO_2 emissions:	29.36 mg/Nm^3

Table 24: Main works in Jinqiao heating zone.

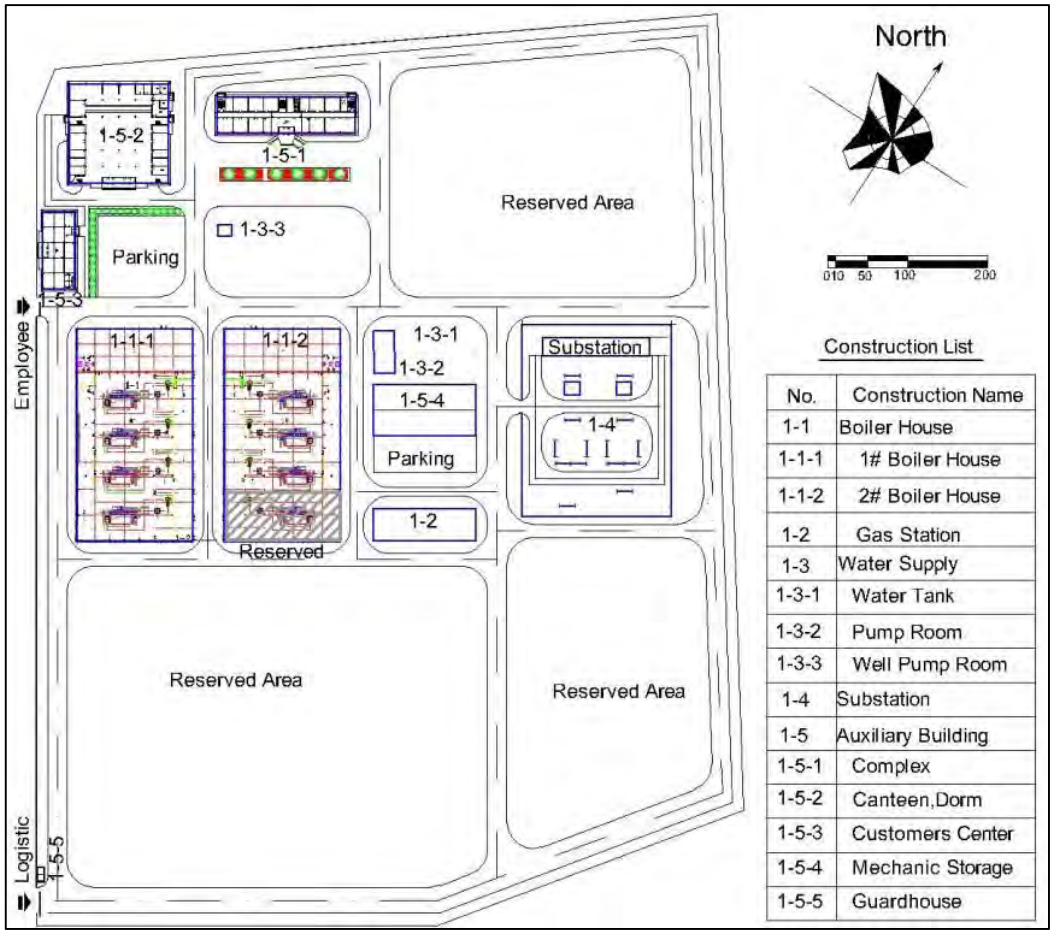
Project Works		Description
Main Works	1 Boiler Room	7x70 MW low NOx natural gas-fired boilers
	2 Primary Heat Supply Network	17.06 km
	3 HESs	45 substations
Ancillary Works	1 Burning system	Each gas boiler is installed with one blower. Boiler flue gas is discharged to atmosphere via funnel and chimney.
	2 Water Treatment Facility	Circulating water pump, make-up pump, softwater preparation equipment, deaerator, etc.,
	3 Thermal System	Return water of primary network is sent back to boiler room through deaerator and circulating water pump. Heat supply network is constant pressure by make-up pump. Make-up water is sent to circulating water pump inlet by softening process and deaerator and send back to boiler combined with return water of primary network.
	4 Gas Pressure Regulating Station	After the natural gas pressure is reduced to 0.3-0.4 MPa, the gas is sent to the burner in the boiler room by DN 600 pipeline.
Public Utilities	1 Water Supply	Production and domestic water source is municipal water.
	2 Wastewater	Production and domestic wastewater will be discharged to the municipal sewage pipeline network
	3 Power Supply	Two-circuit power will be supplied by Heihe transformer substation.
	4 Office	Comprehensive administration building, canteen and living quarters.
Environmental Protection	1 Boiler Emissions	Low NOx natural gas fired burners will be used. Flue gas will be vented via seven 2.0 m diameter 30 m tall chimneys.
	2 Noise Control	Low-noise equipment with noise reduction measures like noise elimination, damping, sound insulation and enclosures will be used.

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

d) Site Layout and Buildings

112. The general layout of the site includes five areas: the main plant area, gas pressure regulation station, water supply facility, electrical substation, and complex and office area. In addition, there are three unoccupied areas reserved for future use. Within the main plant area, the units or facilities are installed successively from west to east: gas-fired boiler house → blowing fans → chimney. Auxiliary operations and services will be installed around the main plant, including the office and administration center, water service facility, electrical substations, etc. The detailed layout of the plant is shown in **Figure 20**, while **Table 25** provides data on HSP buildings.

Figure 20: Jinqiao HSP site layout.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

e) Primary Transmission Network and HESs

113. The primary network will be 17.06 km of direct-bury pre-insulated bonded pipe with diameters ranging from DN 150 to DN 1200 mm. A total of 44 HESs will be constructed, ranging in service area size from 20,000 to 180,000 m^2 (**Figure 21** and **Table 26**).

Table 25: Jinqiao HSP buildings.

No.	Name	Footprint (m^2)	Building Area (m^2)	Building Height (m)	Notes
1	1# Boiler House	5462.73	5462.73	12	4 Chimneys 30m High Φ＝2000mm
2	2# Boiler House	5462.73	5462.73	12	3 Chimneys 30m High Φ＝2000mm
3	Gas Station	720	------		
4	Water Tank	260	------		
5	Pump Room	480	480	3.5	
6	Well Pump Room	35.64	35.64	3.5	
7	Substation	6300	420	5	
8	Complex	1136.4	5683.2	13.5	
9	Canteen and Dorm	2246.7	4383.2	8	
10	Customers Center	571	571	3.5	
11	Mechanic and Storage	1152	1152	6	
12	Guardhouse	21.8	21.8	3	
	Total	23849	23672.3		

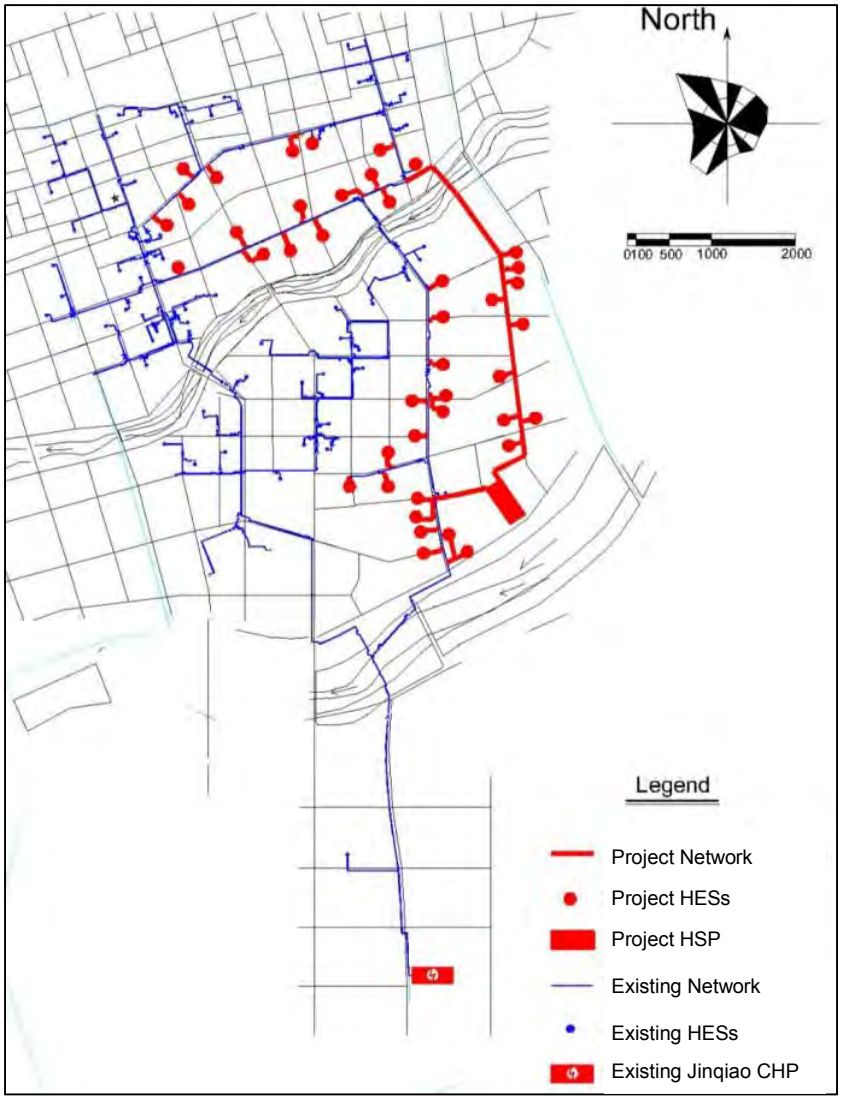
Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Table 26: HESs in Jinqiao heating zone.

Heat Load Capacity	**3MW**	**7MW**	**8MW**	**2×4MW**	**2×5MW**
Quantity	2	1	2	8	16
Heat Load Capacity	**2×7MW**	**2×8MW**	**3×5MW**	**3×6MW**	**Total**
Quantity	3	1	3	8	44

Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

Figure 21: Jinqiao primary network.



Source: Due Diligence Review of Low Carbon District Heating Project in IMAR Feasibility Study Report, 2014.

G. Implementation Arrangements

114. The Government of IMAR (GIMAR) is the executing agency (EA) and the Hohhot Chengfa Heating Company (HCHC) is the implementing agency (IA), which is responsible for day to day project management, including contractor management, operation and maintenance, and social and environment safeguard monitoring and assurance. The HCDIO[13] is engaged to provide management oversight to the HCHC; to liaise with the GIMAR, and Hohhot municipal government; to provide support and supervision in the project procurement; and to provide timely managerial and technical support to the IA to

[13] The HCDIO will sign onlending agreements with the GIMAR, through Hohhot municipal government, and will onlend to the HCHC. The HCDIO is directly responsible for making equity contributions amounting to 23% of the total project cost.

ensure the timely project implementation as well as good governance of the project. The HCDIO and HCHC will jointly establish a project management office (PMO). The HCHC has appointed three Branches which will have direct responsibility for each heating zone. The HCHC's Production Safety Office has primary responsibility for environmental, health and safety and has a staff of 22. Each Branch also has a corresponding Production Safety Office, typically with a staff of 10.

H. Budget and Time Schedule

115. The Project cost is estimated at 2.389 billion CNY ($391.86 million). The ADB loan will finance 38.3% (914.54 million CNY or $150 million) from ordinary capital resources, the IA will finance 20.3% (484.600 million CNY or $79.482 million), and the China Everbright Bank will finance 41.4% (990.7000 million CNY or $162.377 million).

116. The total construction period for the Project will be approximately 5 years. Construction will be undertaken in a phased approach, with detailed design, construction, equipment installation and trial operation expected to take about 50 months for each heating zone:

Feasibility research phase	8 months
Preliminary design phase	4 months
Detail design phase	6 months
Construction	16 months
Equipment and pipeline installation	12 months
Combined trial operation	4 months

117. The Project expected lifetime is 25 years.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Location

118. The Project is located in eastern Hohhot City, Inner Mongolia Autonomous Region (IMAR), in north-central PRC. IMAR borders Mongolia, and Russia to the north; Gansu and Ningxia provinces to the southwest; Ningxia, Shaanxi, Shanxi and Hebei provinces to the south; and Liaoning, Jilin and Heilongjiang provinces to the southeast and east (**Figure 1).** Hohhot is a prefecture level city, located on the northern edge of Hetao Plateau, south of Gobi desert. It consists of four urban districts, which are Huimin; Xincheng; Yuquan; and Saihan districts; and five rural counties, which are Toghoh county; Wuchuan county; Horinger county; Qingshuihe county; and Tumed Left banner. Total area of Hohhot is 17,224 km^2, containing 2,054 km^2 (11.9%) of urban and 15,170 km^2 (88.1%) of rural areas.

119. The Project consists of three heating zones, which are mixed residential, commercial and industrial areas, located in the northeastern, eastern and southeastern parts of Hohhot City. **Error! Reference source not found.** shows the location of the HSP sites and heating zones.

- The Haoqingying heating zone is located in Xincheng District in northeastern Hohhot (geographic coordinates 40°53'9.80"N 111°44'42.73"E). The 202,060 m^2 trapezoidal shaped HSP site is west of Shaliang village and south of national road 110. This relatively undeveloped area is a growth area for Hohhot's future urban and commercial development, and has recently seen housing and other developments.

- The Xinjiaying heating zone is located in Saihan District in central eastern Hohhot, adjacent to the site of the existing HSP owned by HCDIO (40°47'32.55"N, 111°46'8.35"E). The 105,087.86 m^2 HSP site is south of the Ruyi River, north of Guihua 7 Street and East of Guihua 3 Street. This area was previously farmland, and is designated for future urban expansion.

- The Jinqiao heating zone is also located in Saihan District in southeastern Hohhot, 5.5 km north of the existing Jinqiao CHP. The 131,701 m^2 HSP site is east of Fengzhou road, west of Labaying road, north of South Third Ring Road and south of Shijiedajie (40°45'21.54"N, 111°44'46.21"E). The site consists of an abandoned brick and tile factory and unused land, and is considered waste land.

B. Physical Resources

1. Geography

120. Hohhot is on the northern edge of the Hetao Plateau (upper reaches of the Yellow River) and the southern edge of the Gobi Desert. It has an elevation of 1,065 masl. It is located on an alluvial fan with mainly sandy or sandy clay soils. The urban topography is flat, though the Daqing Shan Mountains are immediately to the north (**Figure 22**) and the Man Han range is to the southeast. All three heating zone sites have flat topography.

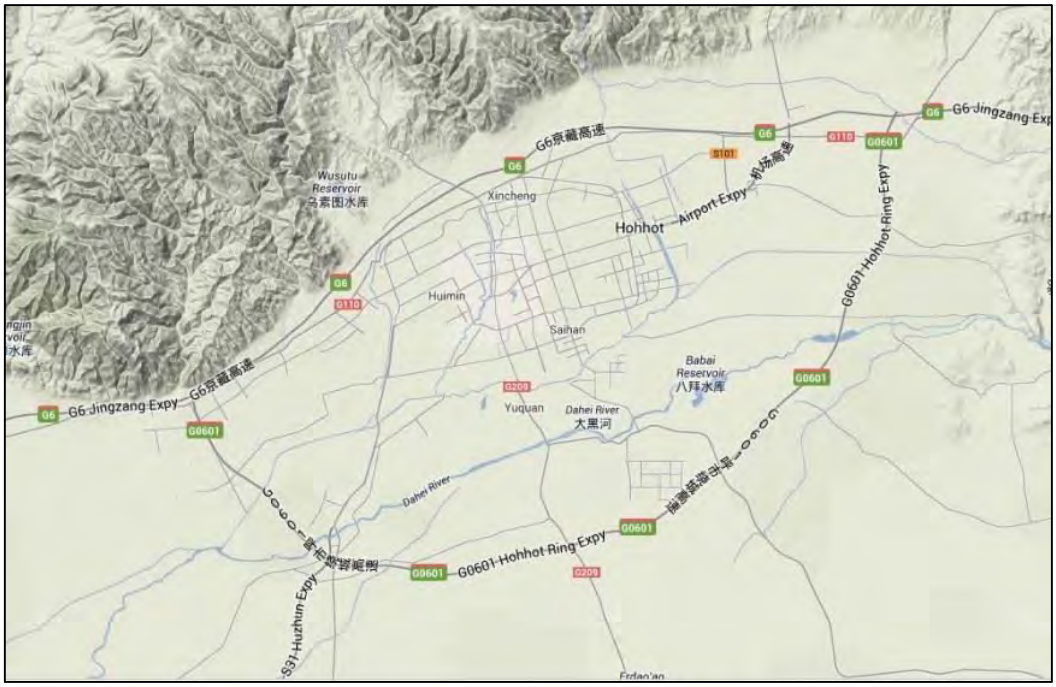
121. According to the PRC *Earthquake Parameter Map* (GB 18306-2001) Hohhot is in Earthquake Intensity Zone VIII, a zone where the peak ground acceleration is 0.20 g.[14] All buildings will be designed in accordance with Earthquake Intensity Zone VIII requirements

[14] g= acceleration due to gravity at the Earth's surface (9.8 m/s^2); 10 % probability of being exceeded within 50 years.

in *Code for Seismic Design of Buildings* (GB 50011-2010). However, the PRC EIA reports that all three heating zone sites are geologically stable and there is no risk of soil liquefaction. The Hohhot Land and Resources Bureau has confirmed that there are no geological risks at any of the sites.[15]

[15] Based on meeting with Mr. Xie Heping of the Hohhot Land and Resources Bureau Feb 12, 2014.

Figure 22: Hohhot topography.



Source: Google Maps, 2014.

2. Meteorology and Climate

122. Hohhot has a temperate continental monsoon climate, with long cold dry winters, short hot summers, and dry windy springs. The PRC EIAs indicate that region's annual average temperature is 8.7 ^{0}C, the maximum temperature in July is 38.5 ^{0}C, and the minimum temperature in December is -27.6 ^{0}C. Annual average atmospheric pressure is 896.2 hPa; annual average relative humidity is 52%; annual precipitation is 393.2 mm, with April to October accounting for about 94.0% of the total rainfall throughout the year. Annual evaporation is 1,361.5 mm, and the area receives an annual average of 2,662.7 hours sunlight. **Table 27** presents a summary of climatic data from 1971 to 2000, provided by the China Metrological Administration.

123. Hohhot is under the Mongolian high pressure zone in winter, and the atmospheric structure is stable and wind speeds are relatively low. Annual average wind speed is 1.8 m/s. Maximum wind speeds are in the spring in April and May at 2.65 m/s (April). Minimum wind speed are in January and December at 1.35 m/s (December). Wind speeds tend to be higher during the daytime than at night, and minimum wind speed occurs at around 8 am. Based on 30 years of weather data, the most frequent wind directions in each month are northwest (NW), east (E) and southwest (SW). The predominant wind direction from October to May is NW. This includes the winter heating season, and thus has a direct influence on pollution dispersion from heating plants. The predominant wind direction in summer and autumn (June, July and September) is E, while the most frequent wind direction in August is SW (**Figure 23**). All three HSPs have been sited to take into account the predominant NW wind direction during the heating season, with sparsely populated areas to the SE.

Table 27: Climate data for Hohhot, 1971-2000.

Climate data for Hohhot (1971−2000)													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Average high °C	−5	−0.4	7	16.3	23.2	27.3	28.5	26.4)	21.2)	14.1	4.4	−3.2	13.32
Average low °C	−16.8	−12.8	−5.5	1.6	8.2	13.3	16.4	14.8	8.3	1	−7	−14.2	0.61
Precipit-ation mm	2.6	5.2	10.2	13.5	27.6	47.2	106.5	109.1	47.4	20.7	6.2	1.8	398
Avg. precipit-ation days (≥ 0.1 mm)	2.5	2.8	3.4	3.7	6	8.9	12.9	12.7	8.3	4.5	2.4	1.8	69.9
% humidity	58	52	46	37	39	47	61	66	62	59	59	59	53.8
Mean monthly sunshine hours	180.7	198.3	245.5	268.6	294.5	291.3	264.9	255.2	252.1	244.8	195.3	171	2,862.20

Source: China Meteorological Administration, 2009.

3. Water Resources

a) Surface Water Resources

124. Rivers in the Hohhot area belong to the Yellow, Daheihe and Hunhe river systems (**Figure 24**).

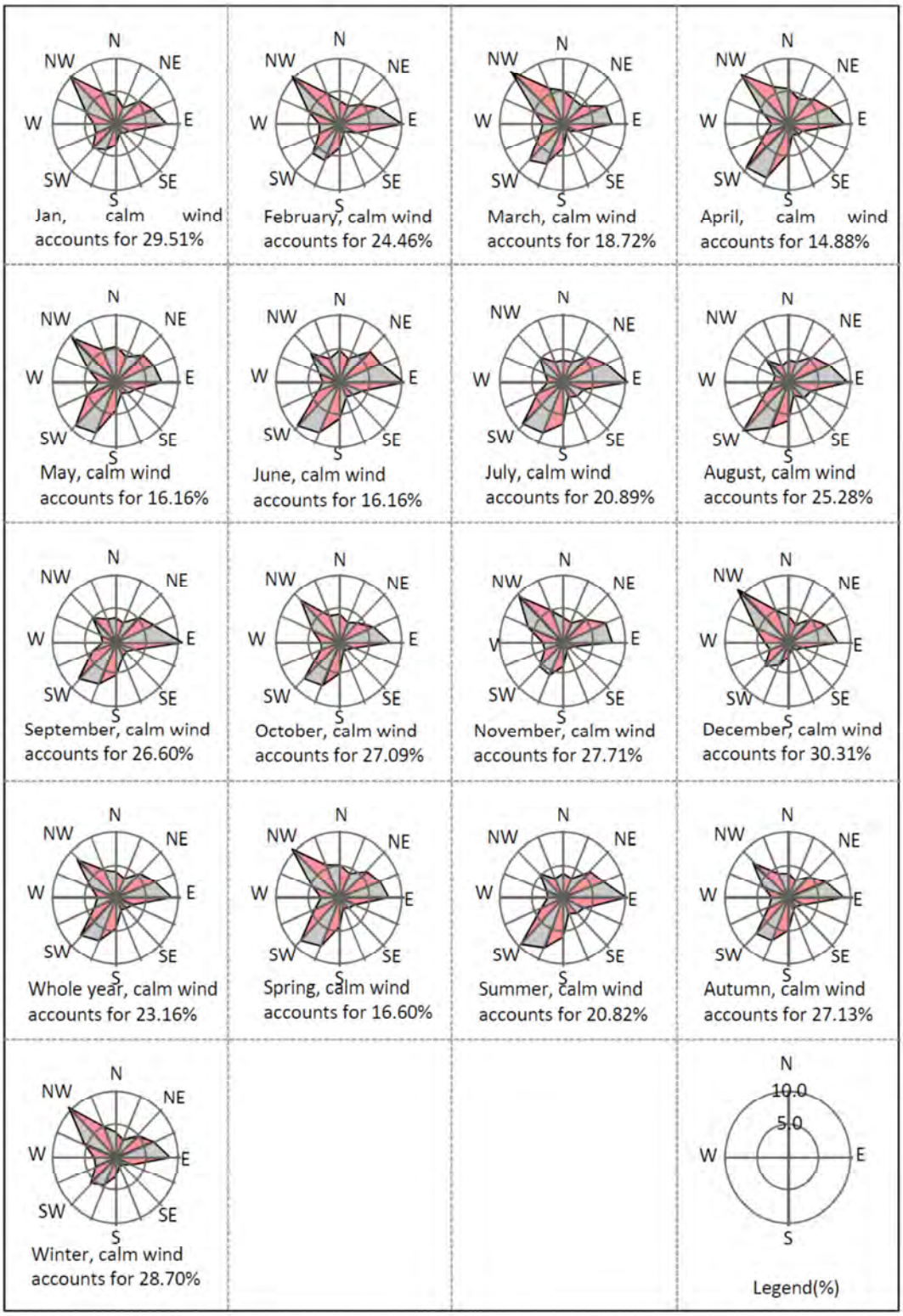
125. Hohhot is on the northern edge of the Hetao Plateau (upper reaches of the Yellow River). In the Hohhot region the Yellow River flows from Shisifenzi village southwest of Hohhot to Dantaizi Village in Qingshuihe County, and has a total length 109.5 km.

126. The Daheihe River is a level one tributary of the Yellow River, originating in mountains to the east of Hohhot and flowing from northeast to southwest, passing south of the urban center of Hohhot. It has a basin area of 17,673 k m^2 and a main stem length of 236 km. Its main tributaries include the Guaijiaofuhe River, Hasuhaitui canal, the Xiaoheihe River and the Shilawusuhe River. The Daheihe River is characterized by short duration peak flood flows during the wet season.

127. The Xiaoheihe River is a level one tributary of the Daheihe River, originating in Wuchuan County and flowing from the northeast to southwest, joining the Daheihe River at North Hunjin Bridge in Hohhot. The river has a basin area of 2,182 km^2 and a main stem length of 104.8 km. According to data from the Erdaohe hydrological station, the Xiaoheihe annual average runoff is 67.8 million m^3, and its average flow rate is 2.15 m^3/s. Maximum wet season flow in July and August is 87.5 m^3/ s, and minimum dry season flow is 0.92 m^3/s.

128. Huozhai Creek is a level one tributary of Xiaoheihe River, originating from Jingerliang, Youyouban village and flowing southeast into the Xiaoheihe.

Figure 23: Wind direction frequency and wind rose diagram by month (based on 30 years data).



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 24: Hohhot surface water resources.

Source: Google Maps, 2014.

129. There are no rivers, creeks or streams or other surface water resources on any of the HSPs in three heating zones. The Hohhot Water Affairs Bureau reviewed the HSP locations and confirmed that there are no sensitive surface water resources at or near the sites.[16] However, site visits by national and international environmental specialists noted that there are a series of fish ponds to the northwest of the Jinqiao HSP site, and care will need to be taken during construction to avoid pond contamination.

b) Ground Water Resources

130. Groundwater resources in Hohhot include both shallow and deep aquifers. The aquifers are young (Quaternary) sediments of fluvial and lacustrine origin. Groundwater from shallow aquifers is accessed using traditional open dug wells and more recent hand-pumped boreholes, usually less than 30 m deep. Boreholes deeper than 100 m tap into the deeper aquifera, which are often artesian. Within the city limits shallow groundwater recharge is 9.87 x 10^8 m^3, and annual developed reserves is 10 x 10^8 m^3.

131. The Hohhot Water Affairs Bureau reviewed all three HSP locations and confirmed that there are no sensitive groundwater resources at or near the sites.[17]

C. Ecological and Sensitive Resources

132. Hohhot is located in a mid-temperate semi-arid climatic zone. The surrounding area includes forest (limited), shrubs, grasslands and steppe meadows. However, the three HSP sites are all located within urban or semi-rural environments within the city limits with

[16] Based on meeting with Wu Li, Section Chief of Water Administration and Water Resources Department, Hohhot Water Affairs Bureau, Feb 12, 2014.
[17] Ibid.

surrounding landuse including mixed commercial, residential, agricultural and industrial. Original vegetation cover has been previously removed, and existing site vegetation is typically grass or shrubs, or disturbed dirt with little or no vegetation cover (**Figure 25**). Based on site visits by national and international environmental specialists, there are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to any of the sites. In addition, the Hohhot Forestry Bureau confirmed there are no rare or endangered flora or fauna at or near the HSP sites.[18] The project sites are considered as modified habitat under ADB's SPS (2009) definition.

Figure 25: Vegetation coverage at the proposed HSP sites in three heating zones.

(i) Jinqiao HSP site, looking to the north.

(ii)Xinjiaying HSP site, looking from the southern boundary to the north.

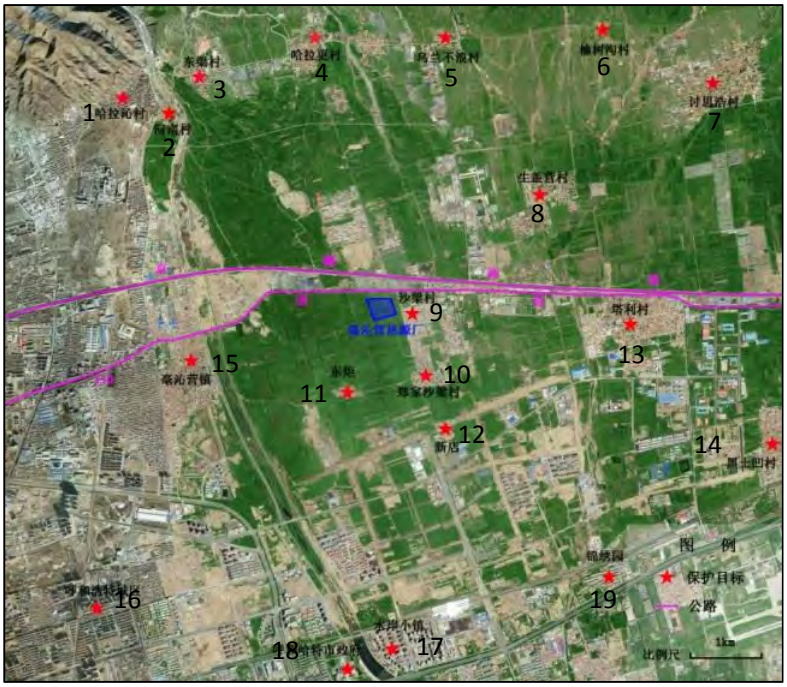
(iii)Haoqingying HSP site, looking from the northern boundary to the south.

Source: ADB PPTA consultants

133. Sensitive locations for air quality and noise impacts in the heating zone areas were determined in the domestic EIAs utilizing remote sensing and ground surveys. **Figure 26** show sensitive areas for air quality and noise impacts for Haoqingying HSP. There are no schools, hospital or temples within 3km of the HSP. **Figure 27** show sensitive areas for air quality and noise impacts for the Xinjiaying HSP. The closest school is in Xinjiaying Village, approximately 0.5 km northwest of the HSP. **Figure 28** show sensitive areas for air quality and noise impacts for the Jinqiao HSP. The closest school is approximately 1.4 km west of the HSP, while the closest hospital is 1.1 km to the west. **Table 28**, **Table 29** and **Table 30** present corresponding data on sensitive areas for air quality and noise impacts for the three HSPs.

[18] Based on meeting with Mr. Wang Hao, Chief Engineer, Hohhot Forestry Bureau, Feb 12, 2014.

Figure 26: Potentially sensitive sites, air quality and noise, Haoqingying Heating zone.



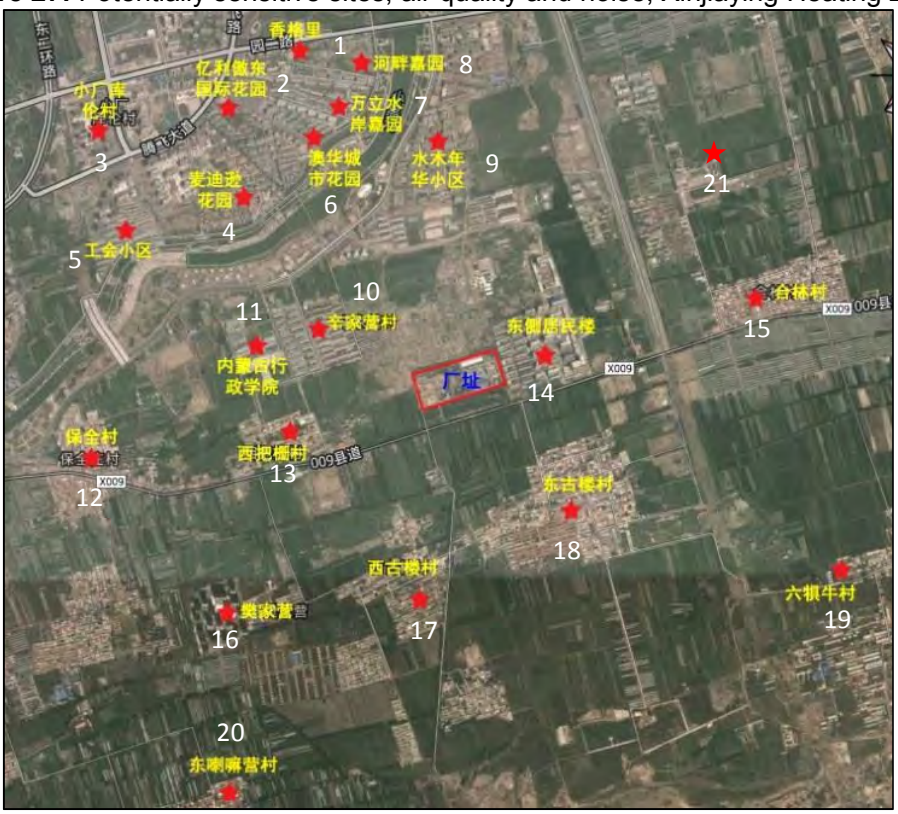
Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia, Haoqingying Heating Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 28: Sensitive areas (air quality, noise), Haoqingying Heating zone.

Sensitivity	No	Area	Direction	Distance	Function	Protection
Air quality	1	Halaqin	NW	4.2km	Residential Area	Class II
	2	Henan	NW	3.7km	Residential Area	Class II
	3	Dongliang	NW	3.8km	Residential Area	Class II
	4	Halageng	N	3.3km	Residential Area	Class II
	5	Wulanbulang	N	3.6km	Residential Area	Class II
	6	Yushugou	NNE	4.6km	Residential Area	Class II
	7	Taosihao	NE	4.9km	Residential Area	Class II
	8	Shenggaiying	NE	2.3km	Residential Area	Class II
	9	Shaliang village	SE	83m	Residential Area	Class II
	10	Zhengjiashaliang	SSE	0.8km	Residential Area	Class II
	11	Dongju village	SE	0.9km	Residential Area	Class II
	12	Xindian village	SSE	1.6km	Residential Area	Class II
	13	Tali village	ESE	2.5km	Residential Area	Class II
	14	Heituao village	SE	5.3km	Residential Area	Class II
	15	Haoqingying town	WSW	2.3km	Residential Area	Class II
	16	Hohhot urban area	SW	4.5km	Residential Area	Class II
	17	Waterbank town	S	4.2km	Residential Area	Class II
	18	Municipal government	SSW	4.8km	Office Area	Class II
	19	Jinxiuyuan	SE	4.5km	Residential Area	Class II
Noise	9	Shaliang (east of project site)	E	83m	Residential Area	Class II

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia, Haoqingying Heating Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 27: Potentially sensitive sites, air quality and noise, Xinjiaying Heating zone.



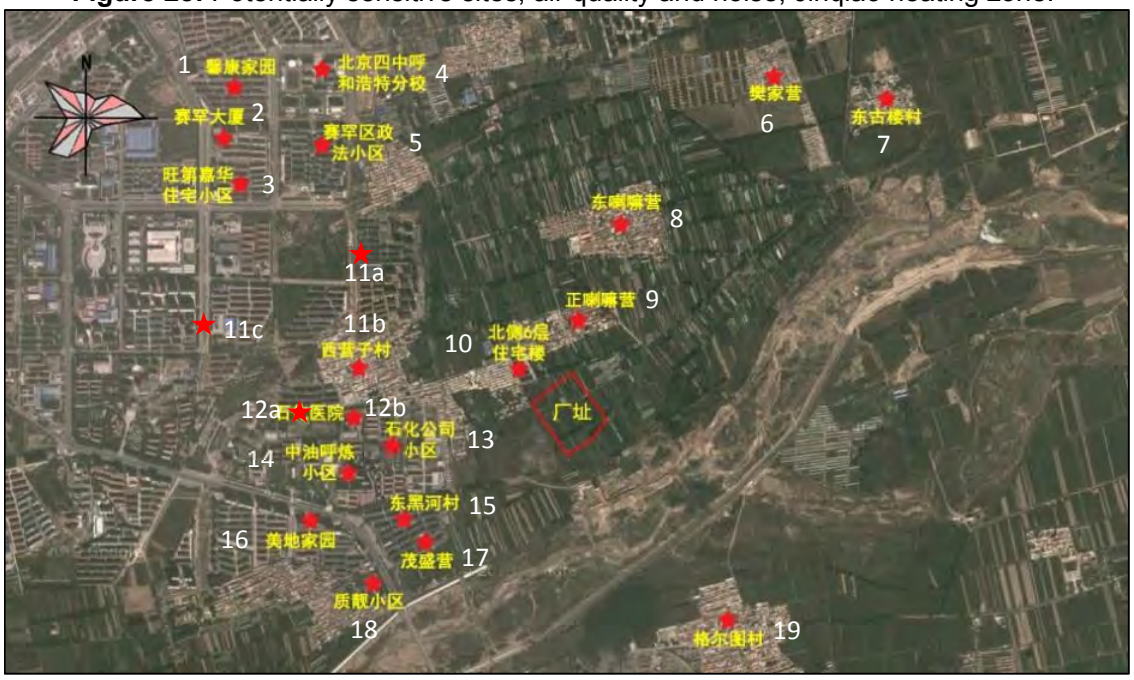
Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia, Xinjiaying Heating Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 29: Sensitive areas (air quality, noise), Xinjiaying heating zone.

Sensitivity	No	Area	Direction	Distance	Function	Protection
Air quality	1	Xianggeli	N	2.2km	Residential Area	Class II
	2	Yiliaodong Guoji Huayuan	NW	2.0km	Residential Area	Class II
	3	Xiaochang Kulun village	NW	2.5km	Residential Area	Class II
	4	Maidixun Huayuan	NW	1.5km	Residential Area	Class II
	5	Gonghui plot	NW	2.0km	Residential Area	Class II
	6	Aohua Chengshi Huayuan	N	1.69km	Residential Area	Class II
	7	Wanlishuian Jiayuan	N	1.7km	Residential Area	Class II
	8	Hepanjiayuan	N	1.9km	Residential Area	Class II
	9	Shuimunianhua plot	N	1.1km	Residential Area	Class II
	10	Xinjiaying village Party School of Inner Mongolia	NW NW	0.3km 0.5km	Residential Area School	Class II Class II
	11	Inner Mongolia Administrative College	W	0.9km	School	Class II
	12	Baoquan village	W	1.9km	Residential Area	Class II
	13	Xibazha village	W	0.7 km	Residential Area	Class II
	14	Residential buildings	E	40m	Residential Area	Class II
	15	Helin village	E	1.4 km	Residential Area	Class II
	16	Fanjiaying	SW	1.6 km	Residential Area	Class II
	17	West Gulou village	SW	0.6 km	Residential Area	Class II
	18	East Gulou village	S	0.5 km	Residential Area	Class II
	19	Liujuniu village	SE	2.3 km	Residential Area	Class II
	20	East Labaying village	SW	2.6 km	Residential Area	Class II
	21	Xibazha Center School	NE	21. km	School	Class II
Noise	14	Residential buildings	E	40m	Residential Area	Class II

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia, Xinjiaying Heating Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 28: Potentially sensitive sites, air quality and noise, Jinqiao heating zone.



Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia, Jinqiao Heating Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 30: Sensitive areas (air quality, noise), Jinqiao heating zone.

Sensitivity	No	Area	Direction	Distance	Function	Protection
Air quality	1	Xinkang Jiayuan	NW	2.5km	Residential Area	Class II
	2	Saihan Dasha	NW	2.4 km	Office	Class II
	3	Wandijiahua	NW	2.1km	Residential Area	Class II
	4	Branch school of Beijing Fourth School	NW	2.0km	School	Class II
	5	Zhengfa	NW	2.1km	Residential Area	Class II
	6	Fanjiaying	NE	2.3km	Residential Area	Class II
	7	East Gulou village	NE	0.7km	Residential Area	Class II
	8	East Labaying village	N	178m	Residential Area	Class II
	9	Zhenglabaying village	N	21m	Residential Area	Class II
	10	Residential buildings	N	168m	Residential Area	Class II
	11a	Saihan District Hospital	NW	1.5km	Hospital	Class II
	11b	Xiyingzi village	NW	0.8Km	Residential Area	Class II
	11c	Jinqiao Primary School	W	2.1km	School	Class II
	12a	No. 17 Middle School	W	1.4km	School	Class II
	12b	Petrochemical hospital	W	1.1km	Hospital	Class II
	13	Petrochemical company	W	0.9km	Residential Area	Class II
	14	PetroChina Hohhot refinery	W	1.2km	Residential Area	Class II
	15	East Heihe village	SW	1.0km	Residential Area	Class II
	16	Meidi Jiayuan	SW	1.5m	Residential Area	Class II
	17	Maoshengying	SW	1.0km	Residential Area	Class II
	18	Zhiliang plot	SW	1.4km	Residential Area	Class II
	19	Geertu village	S	1.1km	Residential Area	Class II
Noise	10	Zhenglabaying buildings	N	168m	Residential Area	Class II
	10	Zhenglabayings buildings	W	21m	Residential Area	Class II

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia, Jinqiao Heating Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

D. Socio-economic and Cultural Resources

1. Socioeconomic Status

a) IMAR and Hohhot

135. Hohhot, the capital of IMAR, is at the center of the region's politics, economy and culture. Located in south central IMAR, Hohhot is an important land and air hub-city, linking Beijing with northwest China. Hohhot Airport flies over forty air routes to various major domestic cities, and flies two direct routes to Mongolia and Russia.

136. Hohhot city is a prefecture level city, meaning that it administers both its urban area and the rural regions in its vicinity. The administrative area includes 4 urban districts (Huimin District, **Xincheng District**, Yuquan District and **Saihan District**), Hohhot Economic and Technological Development Zone, and 5 rural counties (Togtoh County, Wuchuan County, Horinger County, Qingshuihe County and Tumed Left Banner). They are further divided into 20 urban sub-districts, and 96 townships. The three heating zones under the Project are located in Xincheng and Saihan urban districts.

137. Hohhot has a total area of 17,224 km^2. The land area of the rural portion of Hohhot is 15,170 km^2 (88.1% of the total land area), while the urban area is 2,054.0 km^2 (11.9% of the total land area). The urban area includes a built-up (city) area of 79.2 km^2. Hohhot has a population of 2.9488 million (2012), including the urban area with a population of 1.9233 million and the rural area with a population of 1.0255 million.

138. Hohhot has 12 ordinary universities with over 200,000 students; 63 vocational schools with 33,000 students; 140 hospitals and health centers; 13 health epidemic prevention stations; and 21 maternity and child health centers.

139. General socio-economic data for IMAR and Hohhot is presented in **Table 31**.

Table 31: General socio-economic data of Hohhot and IMAR (2011).

Indicator	Unit	Hohhot	IMAR
Population	person	2,948,000	24,817,000
Urban	%	65.2	56.6
Ethnic minority	%	13.4	21.8
GDP	CNY billion	217.7	1,436.0
Primary sector	%	5.0	9.1
Secondary sector	%	36.3	56.0
Tertiary sector	%	58.7	34.9
Per capita GDP	CNY	75,266	57,974
Rural per capita income	CNY	10,038	6,642
Urban per capita income	CNY	28,877	20,408
Urban poor (Dibao)	%	6.5	8.0

Source: IMAR and Hohhot Statistical Yearbooks, in Social Analysis Report, IMAR District Heating Supply Project, Dec 2013.

b) Heating Zone Areas

140. General socioeconomic data for the two districts where the heating zones are to be implemented is presented are given in **Table 32**. The socioeconomic conditions of the two project districts are superior to that of Hohhot as a whole.

Table 32: Socioeconomic profiles of project districts (2012).

Indicator	Unit	Xincheng District (Haoqingying heating zone)	Saihan District (Xinjiaying and Jinqiao heating zones)
Population	person	367,522	416,897
Male	%	49.8	50.4
Female	%	50.2	49.6
Urban	%	86.3	63.3
Ethnic minority	%	20.4	17.5
Households	No.	128,464	143,078
Urban per capita income	CNY	31,741	30,808
Urban poor (Dibao)	person	8,543	11,637
Urban poor (Dibao)	%	2.7	4.4
HH size[19]	person	2.86	2.91
Employed per HH	person	1.26	1.35
Employment rate	%	49.4	49.4
Average per capita income	CNY	31,741	31,741

Source: Hohhot Statistical Yearbook (2012), in Social Analysis Report, IMAR District Heating Supply Project, Dec 2013.

c) Project Beneficiaries

141. The beneficiaries of the Project include both current and potential future heat users (**Table 33**). The potential future users include current residents with heating from small boilers and home stoves and residents who will settle in the heating zone areas. Using an average household (HH) size of 3.0 persons, by 2020 the Project will benefit an estimated 294,500 user HHs with a population of 883,500:

i) The Haoqingying heating zone will benefit 87,000 HHs with 261,000 residents.

ii) The Xinjiaying Heating zone will benefit 68,000 HHs with 204,000 residents.

iii) The Jinqiao Heating zone will benefit its current users of 66,500 HHs with 199,500 residents through peak regulation, and will benefit an additional 73,000 HHs with 219,000 residents as a result of increased capacity.

Table 33: Project beneficiary HHs (2020).

Heating zone	Current Beneficiaries		Potential Beneficiaries		Total	
	No. of HHs	No. of residents	No. of HHs	No. of residents	No. of HHs	No. of residents
Jinqiao	66,500	199,500	73,000	219,000	139,500	418,500
Xinjiaying			68,000	204,000	68,000	204,000
Haoqingying			87,000	261,000	87,000	261,000
Total	66,500	199,500	228,000	684,000	294,500	883,500
	22.6%		77.4%		100%	

Source: IA and consultants' estimations in Social Analysis Report, IMAR District Heating Supply Project, Dec 2013.

[19] Acording to the socioeconomic survey, average HH size is 3.11 and 3.02 for rural and urban HHs respectively.

2. Industry

142. Hohhot is a major industrial center within IMAR. It has the third-largest economy in the province, with a GDP of RMB 247.56 billion in 2012, accounting for approximately 15.5% of the province's total.

143. The city's six pillar-industries are dairy processing, electricity, electrical information, biopharmaceuticals, chemical metallurgy and machinery manufacturing. Hohhot is renowned as the “Home Town of Milk” in China, and its milk products are distributed to all of the major domestic markets.

144. As an economic center in IMAR, Hohhot has been expanding its urban area since the 1990s. The completion of a new office tower for the Hohhot Municipal Government in eastern Hohhot marked a shift of the city center to the eastern growth areas. Major economic indicators for Hohhot are presented in **Table 34**.

Table 34: Major economic indicators (2012).

Indicator	Value
Population (million)	2.95
GDP (RMB billion)	247.56
GDP Composition	
Primary Industry	4.90%
Secondary Industry (Industry & Construction)	36.40%
Tertiary Industry (Service)	58.70%
GDP Per Capita (RMB)	83,952
Unemployment Rate	3.63%
Fixed Asset Investment (RMB billion)	130.14
Utilized FDI (USD million)	616.94
Total Import & Export (USD million)	1,701.28
Export (USD million)	832.92
Import (USD million)	868.36
Sales of Consumer Goods (RMB billion)	102.23

Source: Hohhot Economic and Social Development Report 2012 (http://china-trade-research.hktdc.com).

3. Tourism and Physical Cultural Resources

145. Hohhot has only been capital of IMAR since 1947, and as a new capital historical and tourist sites are somewhat limited. Tourist attractions include cultural sites such as Wanbuhuayan Pagoda, Da Zhao Temple, Zhaojun Tomb, Wusutuzhao Temple, Xilituzhao Palace, and the Great Mosque, as well as natural sites such as Wusutu National Forest Park, the Hasu Sea, Da Qingshan Safari Park, and the plateau grasslands.

146. The Project sites are not on or near any tourism sites, and there are no know Physical Cultural Resources (PCRs) within or adjacent to the sites other than a tomb approximately 100 m south of the Jinqiao HSP boundary near the existing access road.[20]

[20] Physical cultural resources (PCRs): movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level. Within the Project area these could include:

- Funeral site: graves, cemeteries, shrines, stupas.

Care will need to be taken during construction to protect the tomb.

Figure 29: Tomb located south of the Jinqiao HSP site.

Source: The ADB PPTA consultant, 2014.

E. Environmental Baseline Monitoring

1. Overall Hohhot Air Quality

147. **Table 35** and **Figure 30** present summary air quality data for SO_2 and NO_2, the two primary pollutants of concern in natural gas fired boilers. The data was provided by the Hohhot EPB, and is drawn from a total of 8 automated continuous air quality monitoring stations (**Figure 31**). The data shows that air quality in Hohhot was generally in compliance with relevant standards for SO_2 although there was a peak in 2007, and that NO_2 levels have been well below the applicable standards. Both pollutants are showing a downward trend in annual average concentrations from peak levels in 2007.

- Religious buildings: Temples or Pagodas, complete or ruins.
- Religious objects: Buddhist images or sculpture.
- Sacred sites: sacred caves, forest, hills or cliffs.
- Historical sites or objects: artifacts, tools, relics, memorials.
- Spirit sites: sites residents believe are occupied by a spirit (house, tree, stone, etc.).

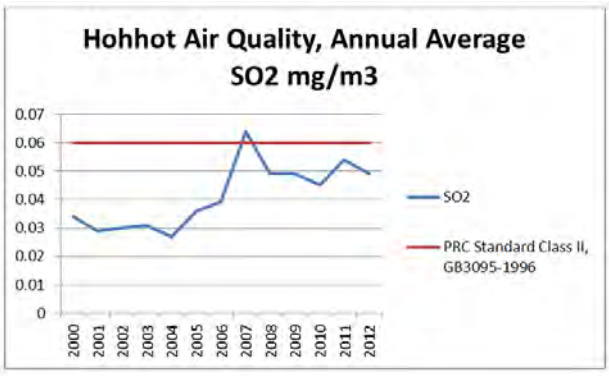
Table 35: Air Quality Monitoring Data of Hohhot City from 2000 to 2012, (Annual Average Air Quality in mg/m^3)

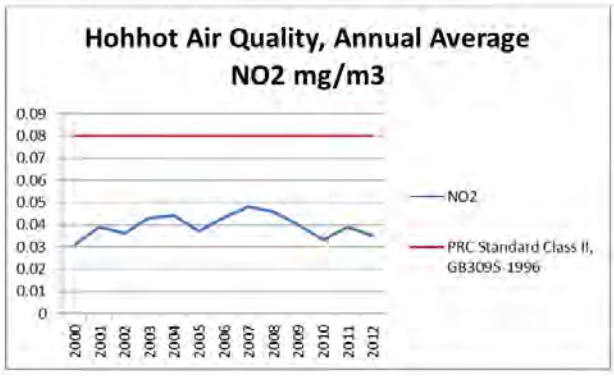
Year	SO_2	NO_2
2000	0.034	0.031
2001	0.029	0.039
2002	0.030	0.036
2003	0.031	0.043
2004	0.027	0.044
2005	0.036	0.037
2006	0.039	0.043
2007	**0.064**	0.048
2008	0.049	0.046
2009	0.049	0.040
2010	0.045	0.033
2011	0.054	0.039
2012	0.049	0.035
PRC Standard (Class II, GB3095-1996)	0.060	0.080

Source: Hohhot Municipal EPB, 2014

Notes:
1) Prior to 2001 monitoring was undertaken manually. Data from 2001 and on is averaged from 8 automated continuous monitoring stations (see Figure 3).
2) **Bold** denotes a standard exceedance. Please note that the above table, provided by EPB, refers to the previous PRC ambient air quality standards (GB3095-1996). In the new PRC ambient air quality standards (GB 3095-2012), the Class 2 annual average NO_2 standard is 0.04 mg/ m^3 while the Class 2 annual average SO_2 standard remains 0.060 mg/ m^3. These standards are phased-in beginning in 2012 for some cities and by 2016 for all cities nationwide.

Figure 30: Air Quality Monitoring Data of Hohhot City from 2000 to 2012, (Annual Average Air Quality in mg/m^3).





Source: Hohhot Municipal EPB, 2014.

Figure 31: Location of Hohhot EPB Automated Continuous Air Quality Monitoring Stations in Relation to Approximate Location of HSP Sites

Source: Hohhot Municipal EPB, 2014.

2. Site Specific Ambient Air Quality – Initial Assessment, January 2014

As part of the domestic EIA process, baseline environmental monitoring was conducted by Lvsejingcheng (Beijing) Physical and Chemical Testing Technology Ltd. at two locations at each heating zone site. Monitoring was undertaken continuously over a 7 day period from January 15 to 21, 2014 (e.g. during the heating season) for SO_2 and NO_2 (1-hour average concentrations) and TSP, PM_{10}, $PM_{2.5}$, SO_2 and NO_2 (24-hour average concentration). Wind direction, wind speed, air temperature, barometric pressure, cloud cover and other meteorological parameters were also monitored.

148. **Table 36** presents data for the monitoring sites, while **Figure 32, Figure 33 and Figure 34** show their locations. **Table 37** to **Table 42** presents summaries of the ambient monitoring results for all three heating zones. The results indicate that the overall air quality at the heating zone sites is good, and all results for TSP, PM_{10}, SO_2, and NO_2 were in compliance with Class II PRC standards. However $PM_{2.5}$ levels exceeded the 24-hour standards at all three heating zones. The most likely causes are vehicle exhaust and coal-fired flue emissions.

Table 36: Ambient air quality monitoring station locations and parameters monitored.

No	Heating Zone/ Monitoring Site	Direction from HSP	Distance from HSP (km)	Site Function	Standard (GB3095—2012)	Parameters Monitored
Haoqingying Heating Zone						
1	HSP site	--	--	--	Class II	SO_2, NO_2: 1-Hour Average
2	Xindian village	SSE	1.6	Residential area	Class II	TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2: 24-Hour Average
Xinjiaying Heating Zone						
1	HSP site	--	--	--	Class II	SO_2, NO_2: 1-Hour Average
2	East Gulou village	S	0.5	Residential area	Class II	TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2: 24-Hour Average
Jinqiao Heating Zone						
1	HSP site	--	--	--	Class II	SO_2, NO_2: 1-Hour Average
2	Geertu Village	S	1.1	Residential area	Class II	TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2: 24-Hour Average

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

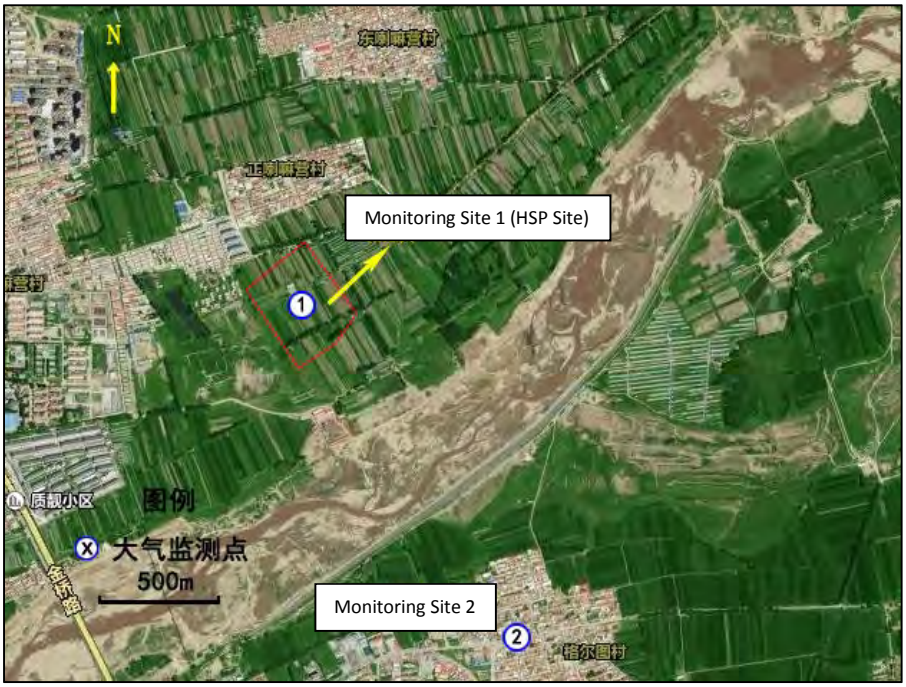
Figure 32: Ambient air quality monitoring sites, Haoqingying Heating zone.

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 33: Ambient air quality monitoring sites, Xinjiaying Heating zone.

Source: EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 34: Ambient air quality monitoring sites, Jinqiao Heating zone.



Source: EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Peak Adjustment Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 37: Haoqingying ambient air quality monitoring results, TSP, $PM_{10,}$ $PM_{2.5}$ 24-Hour Average.

No	Monitoring Site	TSP 24-Hour Average			
		Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	HSP site	0.267--0.269	0.300	0	-
2	Xindian Village	0.266--0.272		0	-
		PM_{10} 24-Hour Average			
No	Name	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	HSP site	0.130--0.136	.150	0	-
2	Xindian Village	0.131--0.136		0	-
		$PM_{2.5}$ 24-Hour Average			
No	Name	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	HSP site	0.081--0.092	.075	100	23
2	Xindian Village	0.083--0.094		100	25

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 38: Haoqingying ambient air quality monitoring results, SO_2 and $NO_{2,}$ 1-Hour and 24-Hour Averages.

No	Site	SO_2 1-Hour Average				SO_2 24-Hour Average			
		Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Sub-project	0.034--0.043	.500	0	-	0.038--0.039	.150	0	-
2	Xindian Village	0.033--0.046		0	-	0.038--0.039		0	-
		NO_2 1-hour average concentration				NO_2 24-Hour Average			
No	Name	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Sub-project	0.034--0.044	.200	0	-	0.036--0.037	.080	0	-
2	Xindian Village	0.034--0.042		0	-	0.036--0.037		0	-

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 39: Xinjiaying ambient air quality monitoring results, TSP, $PM_{10,}$ $PM_{2.5}$ 24-Hour Average.

No	Monitoring Site	TSP 24-Hour Average			
		Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Averaging Periods Exceeding Standard (%)
1	HSP site	0.281--0.291	0.030	0	-
2	East Gulou Village	0.281--0.283		0	-
		PM_{10} 24-Hour Average			
No	Name	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Averaging Periods Exceeding Standard (%)
1	HSP site	0.129--0.139	.150	0	-
2	East Gulou Village	0.130--0.137		0	-
		$PM_{2.5}$ 24-Hour Average			
No	Name	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Averaging Periods Exceeding Standard (%)
1	HSP site	0.086--0.097	.075	100	29
2	East Gulou Village	0.084--0.095		100	27

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 40: Xinjiaying ambient air quality monitoring results, SO_2 and $NO_{2,}$ 1-Hour and 24-Hour Averages.

No	Site	SO_2 1-Hour Average				SO_2 24-Hour Average			
		Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Sub-project	0.034--0.048	.500	0	-	0.039--0.040	.150	0	-
2	East Gulou	0.033--0.047		0	-	0.038--0.039		0	-
		NO_2 1-hour average concentration				NO_2 24-Hour Average			
No	Name	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Sub-project	0.035--0.045	.200	0	-	0.037--0.039	.080	0	-
2	East Gulou	0.034--0.044		0	-	0.037--0.038		0	-

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 41: Jinqiao ambient air quality monitoring results, TSP, $PM_{10,}$ $PM_{2.5}$ 24-Hour Average.

No	Monitoring Site	TSP 24-Hour Average			
		Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Averaging Periods Exceeding Standard (%)
1	HSP site	0.272--0.277	0.030	0	-
2	Geertu Village	0.244--0.263		0	-
No	**Name**	**PM_{10} 24-Hour Average**			
		Concentration Range (mg/m^3)	**Standard mg/m^3 (Class II, GB3095-2012)**	**Averaging Periods Exceeding Standard (%)**	**Averaging Periods Exceeding Standard (%)**
1	HSP site	0.126--0.136	.150	0	-
2	Geertu Village	0.125--0.135		0	-
No	**Name**	**$PM_{2.5}$ 24-Hour Average**			
		Concentration Range (mg/m^3)	**Standard mg/m^3 (Class II, GB3095-2012)**	**Averaging Periods Exceeding Standard (%)**	**Averaging Periods Exceeding Standard (%)**
1	HSP site	0.083--0.091	.075	100	21
2	Geertu Village	0.085--0.094		100	25

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 42: Jinqiao ambient air quality monitoring results, SO_2 and $NO_{2,}$ 1-Hour and 24-Hour Averages.

No	Site	SO_2 1-Hour Average				SO_2 24-Hour Average			
		Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	Concentration Range (mg/m^3)	Standard mg/m^3 (Class II, GB3095-2012)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Sub-project	0.033--0.043	.500	0	-	0.037--0.039	.150	0	-
2	Geertu Village	0.034--0.043		0	-	0.038--0.038		0	-
No	**Name**	**NO_2 1-hour average concentration**				**NO_2 24-Hour Average**			
		Concentration Range (mg/m^3)	**Standard mg/m^3 (Class II, GB3095-2012)**	**Averaging Periods Exceeding Standard (%)**	**Worst Case Exceedance of Standard (%)**	**Concentration Range (mg/m^3)**	**Standard mg/m^3 (Class II, GB3095-2012)**	**Averaging Periods Exceeding Standard (%)**	**Worst Case Exceedance of Standard (%)**
1	Sub-project	0.033--0.043	.200	0	-	0.036--0.037	.080	0	-
2	Geertu Village	0.034--0.042		0	-	0.035--0.037		0	-

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

3. Ambient Air Quality – Additional NO_2 and SO_2 Monitoring

149. The ambient air quality monitoring undertaken in January 2014 by the EIA institute was sufficient for the atmospheric dispersion modeling of SO_2 and NOx undertaken in the PRC EIAs using SCREEN3, a US EPA approved screening model. However, additional modeling was subsequently undertaken using AERMOD, a US EPA and PRC approved steady-state plume model, and this required additional and more comprehensive monitoring for NO_2 and SO_2, the two primary pollutants of concern in natural gas fired boilers (see Section V.C for additional information on dispersion modeling).

150. Monitoring was undertaken at 10 sites (**Table 43** and **Figure 35**). The sites were selected based on proximity to the HSPs, prevailing wind directions, and site sensitivity. Monitoring of NO_2 and SO_2 was undertaken continuously from Apr 12, 2014 to Apr 18, 2014. Sampling frequency and periods is presented in **Table 44**. Wind direction, wind speed, air temperature, barometric pressure, cloud cover and other meteorological elements were also monitored.

Table 43: Ambient air quality monitoring sites, SO_2 and NO_2.

No	Name	Function	Applicable Air Quality Standard (GB3095-2012)	Parameters Monitored
1	Halaqin village	Rural residential area	Class II	SO_2, NO_2
2	Tali village	Rural residential area	Class II	SO_2, NO_2
3	Shilandai village	Rural residential area	Class II	SO_2, NO_2
4	Inner Mongolia Museum	Mixed zone (commercial, transportation and residential)	Class II	SO_2, NO_2
5	Liujuniu village	Rural residential area	Class II	SO_2, NO_2
6	Babai village	Rural residential area	Class II	SO_2, NO_2
7	Qianbaimiao village	Rural residential area	Class II	SO_2, NO_2
8	Houqiaobao village	Rural residential area	Class II	SO_2, NO_2
9	Xiashitouxinying village	Rural residential area	Class II	SO_2, NO_2
10	West Dahei River village	Rural residential area	Class II	SO_2, NO_2

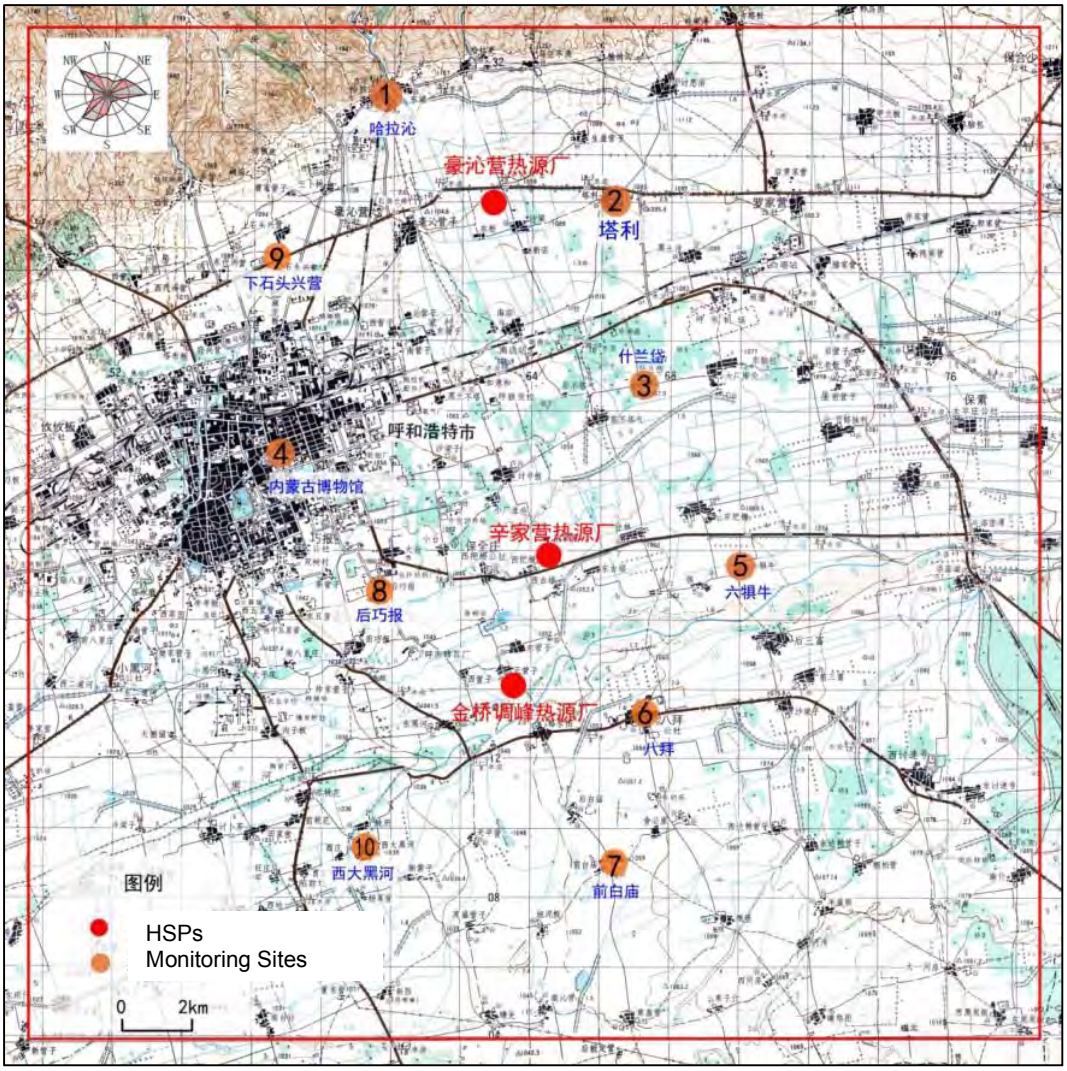
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 44: Ambient air quality monitoring sampling frequency, time and periods.

Pollutant	Sampling Frequency	Sampling Times	Sampling Period
SO_2, NO_2	4 times/day	One hour average: 02:00, 08:00, 14:00, 20:00	45 minutes sampling time for one hour concentration
SO_2, NO_2	1 time/day	Daily average: 4:00-24:00	20 hours sampling time for daily concentration

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 35: Ambient air quality monitoring sites, SO_2 and NO_2.



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

151. The monitoring results are presented in **Table 45** and **Table 46**. The results confirm the findings of the more limited monitoring undertaken in January 2014; SO_2 and NO_2 pollution levels in Hohhot are low. 1-hour hour average concentrations of SO_2 ranged from 12 to 54 μg/m³ while 24-hour average concentrations ranged from 13 to 24 $\mu g/m^3$. All concentrations were in compliance with the PRC standards (GB3095-2012). 1-hour average concentration of NO_2 ranged from 17 to 65 μg/m³, while 24-hour average concentrations ranged from 23-34 $\mu g/m^3$. Again, all concentrations were in compliance with the PRC standards (GB3095-2012).

Table 45: Ambient air quality monitoring results, SO_2.

No	Site	1- hour Average				24-hour Average			
		# of Averaging Periods	Concentration Range (μg/m^3)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	# of Averaging Periods	Concentration Range (μg/m^3)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Halaqin village	28	12-38	0	0	7	16-22	0	0
2	Tali village	28	14-43	0	0	7	18-23	0	0
3	Shilandai village	28	14-44	0	0	7	15-23	0	0
4	Inner Mongolia museum	28	18-52	0	0	7	13-24	0	0
5	Liujuniu village	28	14-54	0	0	7	17-23	0	0
6	Babai village	28	14-54	0	0	7	15-23	0	0
7	Qianbaimiao village	28	15-54	0	0	7	18-23	0	0
8	Houqiaobao village	28	16-52	0	0	7	18-24	0	0
9	Xiashitouxinying village	28	15-52	0	0	7	18-24	0	0
10	West Dahei River village	28	13-54	0	0	7	16-22	0	0

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 46: Ambient air quality monitoring results, NO_2.

No	Site	1- hour Average				24-hour Average			
		# of Averaging Periods	Concentration Range (μg/m^3)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)	# of Averaging Periods	Concentration Range (μg/m^3)	Averaging Periods Exceeding Standard (%)	Worst Case Exceedance of Standard (%)
1	Halaqin village	28	21-56	0	0	7	23-26	0	0
2	Tali village	28	21-63	0	0	7	24-30	0	0
3	Shilandai village	28	21-63	0	0	7	25-34	0	0
4	Inner Mongolia museum	28	20-62	0	0	7	24-30	0	0
5	Liujuniu village	28	17-65	0	0	7	24-32	0	0
6	Babai village	28	18-65	0	0	7	24-32	0	0
7	Qianbaimiao village	28	17-65	0	0	7	25-33	0	0
8	Houqiaobao village	28	20-62	0	0	7	25-33	0	0
9	Xiashitouxinying village	28	19-62	0	0	7	25-30	0	0
10	West Dahei River village	28	17-65	0	0	7	26-29	0	0

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

4. Groundwater Quality

152. Annual average groundwater quality data (2010) was sourced from the Hohhot Groundwater Quality Monitoring Station for wells at the following water supply plants: No 1-5 plants, the plant outside the east gate, the Jinchuan plant and the Ruyi plant (**Figure 36**). Of the 23 pollutants monitored, 8 are monitored on a monthly basis (pH, Total hardness, sulphate, chloride, potassium permanganate index, ammonia, fluoride and total coliforms), and 15 are monitored in January and July (volatile phenols, nitrate nitrogen, nitrite nitrogen, iron, manganese, copper, zinc, anionic surfactants, cyanide, mercury, arsenic, selenium, cadmium, chromium V and lead).

153. Annual average monitoring results are presented in **Table 47**. The results indicate that groundwater quality in Hohhot is relatively good and is in compliance with the relevant standard, Class III of *GB/T14848-93 Quality Standards for Ground Water.*

Figure 36: Location of Hohhot groundwater monitoring wells.

Source: HCDIO, 2014.

Table 47: Groundwater monitoring data from Hohhot water supply plants, 2010 (annual averages, units in mg/L except pH).

Parameter	No 1 plant	No 2 plant	No 3 plant	No 4 plant	No 5 plant	East gate plant	Jinchuan plant	Ruyi plant	Standard
pH	7.4	7.38	7.48	7.37	7.44	7.32	7.55	7.38	6.5-8.5
total hardness	193	208	181	248	195	296	226	211	≤450
ammonia nitrogen	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	≤0.2
permanganate index	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	≤3.0
sulfate,	15	17	10	28	14	25	21	15	≤250
nitrite	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	≤0.02
nitrate nitrogen	1.26	2.76	0.83	4.36	0.58	4.39	1.72	3.7	≤20
chloride	7.71	8.73	5.56	20	6.26	12.6	13.7	10	≤250
fluoride	0.35	0.32	0.31	0.3	0.3	0.28	0.29	0.3	≤1.0
arsenic	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	≤0.05
selenium	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	0.2×10^{-3}	≤0.01
mercury	0.005×10^{-3}	0.005×10^{-3}	0.005×10^{-3}	0.005×10^{-3}	0.005×10^{-3}	0.005×10^{-3}	0.005×10^{-3}	0.005×10^{-3}	≤0.001
chromium VI	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	≤0.05
iron	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	≤0.3
manganese	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	≤0.1
copper	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	≤1.0
cadmium	0.05×10^{-3}	0.05×10^{-3}	0.05×10^{-3}	0.05×10^{-3}	0.05×10^{-3}	0.05×10^{-3}	0.05×10^{-3}	0.05×10^{-3}	≤0.01
lead	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}	0.5×10^{-3}	≤0.05
zinc	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	≤1.0
volatile phenols	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	≤0.002
cyanide	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	≤0.05
total dissolved solids	260	285	235	340	242	420	318	244	≤1000
total coliform	<3	<3	<3	<3	<3	<3	<3	<3	≤3

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

5. Ambient Noise

154. Lvsejingcheng (Beijing) Physical and Chemical Testing Technology Ltd. was hired to undertake noise monitoring at the HSP boundaries and adjacent sensitive sites. The monitoring was carried out at over a 24-hour period on January 19, 2014. Weather conditions were sunny and cloudless with wind speed less than 5.0 m/s, which is in compliance with relevant PRC meteorological requirements for noise monitoring.

155. Monitoring was undertaken with HS 6298 and Aiwa AWA6218 multi-functional ambient noise detectors. Monitoring at the HSP site boundaries was undertaken in accordance with the relevant requirements in *PRC Noise Standards for Industrial Enterprises at Site Boundary* (GB12348-2008). Noise monitoring at adjacent sensitive sites was undertaken in accordance with the relevant requirements in PRC *Environmental Quality Standards for Noise* (GB3096-2008). **Table 48** presents the location of the

monitoring points (site boundaries and adjacent sensitive locations) for the three HSPs, while **Figure 37, Figure 38, and Figure 39** show their locations.

Table 48: Location of ambient noise monitoring sites.

Heating zone	Monitoring Sites at HSP Boundary	Monitoring at Adjacent Sensitive Areas	
		Location	Monitoring Sites
Haoqingying	Sites 1 to 6 around site boundary	Shaliang Village (southeast of project site), 2 story building	Site 1, outdoor monitoring point at 1st floor
Xinjiaying	Sites 1 to 9 around site boundary	Residential area to the east of the site, 6 story buildings	Site 1, 3 outdoor monitoring points at 1st, 3rd and 6th floors Site 2, 3 outdoor monitoring points at 1st, 3rd and 6th floors
Jinqiao	Sites 1 to 4 around site boundary	Zhenglabaying (north of project site), 2 story buildings	Site 1, outdoor monitoring point at 1st floor Site 3, outdoor monitoring point at 1st floor
		Zhenglabaying (northwest of project site), 6 story building	Site 2, 3 outdoor monitoring points at 1st, 3rd and 6th floors
		Zhenglabaying (northwest of project site), 2 story building	Site 4, outdoor monitoring point at 1st floor

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

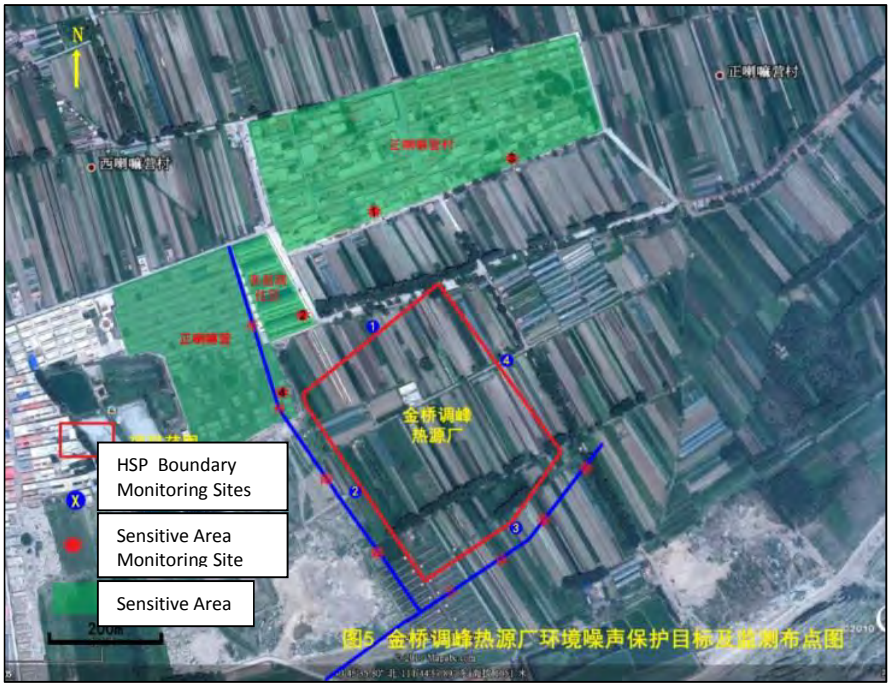
Figure 37: Ambient noise monitoring sites, Haoqingying Heating Zone.

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 38: Ambient noise monitoring sites, Xinjiaying Heating Zone.

Source: EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Xinjiaying Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 39: Ambient noise monitoring sites, Jinqiao Heating zone.



Source: EIA Tabular Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Heating Resource Plant of Hohhot City Development Company, January 25, 2014. Prepared by Zhong Ye Dong Fang Ltd.

156. The ambient noise monitoring results are presented in **Table 49**. The results indicate that daytime and nighttime noise levels at the at the site boundaries of all three heating zones meet the applicable Class II standards (60 dB(A) daytime, 50 dB(A) nighttime) in *PRC Noise Standards for Industrial Enterprises at Site Boundary* (GB12348-2008). The results also indicate that daytime and nighttime noise levels at the adjacent sensitive locations for all three heating zones meet the applicable Class II standards (60 dB(A) daytime, 50 dB(A) nighttime) in *PRC Environmental Quality Standards for Noise* (GB3096-2008).

Table 49: Ambient noise monitoring results.

Heating zone	Monitoring Location	Monitoring Site No. and Floor Location		Daytime Average Leq dB(A) (06:00 – 22:00)	Nighttime Average Leq dB(A) (22:00 – 06:00)
Haoqingying	HSP Boundary		1	54.1	48.7
			2	54.9	48.1
			3	53.2	47.3
			4	51.2	47.1
			5	52.1	47.0
			6	51.2	47.4
	Sensitive Area	1	1st floor	53.7	49.2
Xinjiaying	HSP Boundary		1	50.1	48.3
			2	51.2	47.7
			3	52.3	48.5
			4	52.7	49.2
			5	50.6	48.9
			6	51.3	49.8
			7	50.9	49.0
			8	51.8	48.5
			9	51.2	48.0
	Sensitive Areas	1	1st floor	49.8	49.1
			3rd floor	50.5	49.8
			3rd floor	50.2	49.6
		2	1st floor	52.4	49.8
			3rd floor	51.8	49.7
			3rd floor	50.9	49.5
Jinqiao	HSP Boundary		1	45.6	44.4
			2	47.9	45.8
			3	48.4	44.3
			4	47.0	44.8
	Sensitive Areas	1	1st floor	49.2	45.8
		3	1st floor	46.9	45.1
		4	1st floor	51.0	44.7
		2	1st floor	47.4	46.0
			3rd floor	46.3	45.2
			3rd floor	51.3	47.3

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

157. Anticipated positive and negative environmental impacts of the proposed Project were assessed based on the findings of the approved domestic EIA reports, supported by site visits, stakeholder consultations, additional surveys undertaken by national and international environmental consultants in 2014, and additional atmospheric modeling undertaken in 2014. Applicable and specific requirements of the PRC EIA regulations and the ADB's SPS (2009), and experiences from existing district heating projects in the PRC and elsewhere were considered carefully in assessing the environmental impacts.

158. Pre-construction, construction phase and operation phases were each considered separately. The results of the assessment analysis indicates that during the pre-construction phase issues are very limited, and are mostly associated with siting and ensuring appropriate incorporation of mitigation measures into the project design.

159. Potential negative construction phase environmental impacts are short-term and localized, and are associated with soil erosion, construction noise and fugitive dust, disruption of traffic and community services, and risks to worker health and safety. Potential negative operation phase impacts are associated with boiler emissions, waste and wastewater, noise, and health and safety risks to workers.

160. Potential positive operation phase impacts are significant and long-term, and are associated with emissions reductions compared to equivalent heat production from coal-fired boilers for district heating.

A. Anticipated Pre-construction Phase Impacts and Mitigation Measures

1. Siting and Land Acquisition

161. The social safeguards due diligence undertaken for the Project (natural gas-fired design) describe the land that was acquired for the three HSP sites:[21]

- Haoqingying HSP: 303 mu (20.2 ha) of land was acquired from the Shaliang Village in Xincheng District.
- Xinjiaying HSP: 157.6 mu (10.47 ha) of land was acquired from the Hohhot Municipal Land Purchase, Reserve and Auction Center in August 2013. The Land Reserve and Auction Center had previously obtained the land from two sources: (a) 60.3 mu of the Kubuqi Real Estate Ltd who acquisitioned the land from Donggulou Village in 2006; and (b) 97.3 mu of the government's land reserve that was acquired from Donggulou Village by Saihan District Government in 2011.
- Jinqiao HSP: 329.7 mu (22 ha) of waste land (a brick and tile factory abandoned over 15 years ago and other unused land) was acquired from Zhenglamaying Village in Saihan District.

162. Pipelines will be built with existing road right-of-ways, and will not require land acquisition. The HESs will be built on existing local government owned land that has been reserved for construction and also will not require land acquisition or resettlement.

[21] Inner Mongolia Autonomous Region District Heating Supply Project, Social Analysis Report. December, 2013.

163. Overall, the social safeguards due diligence indicates that the Project will not result in any involuntary land acquisition, resettlement or economic or physical displacement, and there will be no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and Indigenous Peoples.

2. Mitigation Measures and Monitoring during Detailed Design

164. Mitigation measures to be adopted during detailed design to minimize the impacts are as follows:

(i) **Detailed Design.** Environmental mitigation measures indicated in this EIA, the EMP and the domestic EIAs will be incorporated into the detailed design.

(ii) **Bidding Documents and Contracts.** Environmental mitigation measures indicated in this EIA, the EMP and the domestic EIAs will be included in contracts for civil constructions and equipment installations. All contractors will be required to strictly comply with the EMP.

(iii) **Environmental monitoring.** The environmental monitoring program (EMoP, see **Table A-4** in **Appendix I**) will be incorporated into the design to ensure that environmental impacts are closely monitored and activities of the Project construction and operating are closely supervised against the PRC environmental laws, regulations and standards, ADB SPS, and the Project EMP and approved domestic EIAs.

3. Grievance Redress Mechanism

165. In accordance with the Grievance Redress Mechanism (GRM) presented in Chapter VIII of the EIA, a Project Public Complaints Unit (PPCU) will be established within the Project Management Office (PMO); GRM training will be provided for PPCU members and GRM access points; and the PPCU's phone number, fax, address, and email will be disclosed to the public.

4. Training and Capacity Building

166. An institutional strengthening and training program will be delivered by loan implementation environmental consultants (LIEC) (see **Table A-2** in EMP). The program will include the development of construction and operation phase EHS plans for each heating zone. The training will focus on ADB's and PRC's environmental, health and safety laws, regulations and policies; implementation of the EMoP; the GRM; and international good EHS practices in natural gas-fired HSP operation. Training will be provided to the IA, relevant PMO staff, relevant three branch staff, contractors and Saihan District EPB that is responsible for environmental compliance issues at three heating zones.

167. The IA shall ensure that the training and capabilities of the Contractor's site staff are adequate to carry out the designated tasks. No operator shall be permitted to operate critical mechanical equipment without having proper certification.

B. Anticipated Construction Phase Impacts and Mitigation Measures

168. The following mitigation measures apply to all HSP sites, pipeline construction and HES construction sites, unless otherwise specified.

1. Erosion and Spoil

169. Construction activities such as land leveling, excavation and filling activities may lead to surface erosion. The most vulnerable soil erosion areas in the construction site include excavation sites, leveling sites, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. Soil erosion can also occur after completion of construction in areas if site restoration is inadequate. However, the HSP sites are generally flat and there are no rivers, streams, lakes that are likely to be affected, other than fish ponds to the northwest of the Jinqiao HSP site. Pipeline excavation and burial may also cause localized erosion and mudding of adjacent road. Construction activities may also generate surplus spoil.

170. These impacts can be mitigated through typical good practice construction erosion controls and site maintenance:

(i) HSP site storm water runoff will be assessed and estimated and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff.

(ii) Fish ponds along the northwestern boundary of the Jinqiao HSP will be protected by silt fences when nearby construction activities are underway.

(iii) Spoil will be reuse of on-site to the maximum extent feasible as fill to rehabilitate disturbed areas or for landscaping.

(iv) Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Sites will be restored at the conclusion of storage activities.

(v) Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site.

(vi) Spoil and aggregate piles will be covered with landscape material.

(vii) During earthworks the area of soil is exposed to potential erosion at any one time will be minimized.

(viii) Construction and material handling activities during periods of rains and high winds will be limited or halted.

(ix) Pipelines will be installed and backfilled in a sequenced section-by-section approach, with sections not exceeding 300 m in length. Open excavation areas during trenching activities will be minimized, and appropriate construction compaction techniques utilized.

(x) Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil.

(xi) Once construction is complete disturbed surfaces will be properly sloped and revegetated with native trees and grass (see greening plan, below).

2. Wastewater

171. There are no surface water bodies around the construction sites other than the fishponds northwest of the Jinqiao HSP. However, inappropriate disposal of domestic wastewater (from construction worker camps and/or workers) or construction wastewater (from washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs) may cause soil or groundwater resources contamination.

172. These impacts can be mitigated through typical good wastewater management practices:

(i) Adequate temporary sanitary facilities and ablutions will be provided for construction workers. Toilets will be equipped with septic tanks in accordance with PRC standards.

(ii) Septic tanks will be pumped out on an as needed basis, and the effluent will be transported to the nearest sewage treatment plant for treatment by the local sanitation department.

(iii) Wastewater from the canteen should be treated in an oil-water separator, and then discharged into the municipal sewer for final treatment at the Jinqiao wastewater treatment plant.

(iv) Construction wastewater will be directed to temporary detention and settling ponds prior to discharge to urban storm sewers.

(v) Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps.

3. Air Pollution

173. Anticipated sources of air pollution from HSP construction activities include: (i) dust generated from demolition, earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (iv) dust from aggregate preparation and concrete-mixing; and (v) emissions from construction vehicles (gaseous CO and NO_2) and heavy diesel machinery and equipment. Similarly, dust and air pollution will also be generated during the installation of the heat supply pipelines from (i) excavation, piling of materials; (ii) raw material transport and unloading; (iii) cement mortar preparation; (iv) pipeline backfilling; and, (v) emissions from construction vehicles and heavy diesel machinery and equipment.

174. Based on previous domestic project experience, worst case predicted TSP concentrations in clear weather conditions without watering are presented in **Table 50**. Dust impacts from pipeline and HES construction will be more limited in scope, and are expected to be within approximately a 20 m radius of both sides of the roads or HES sites.

Table 50: Worst case predicted TSP concentrations, clear weather without mitigations.

Construction Activity	Dust Sources	Wind speed (m/s)	Distance (m)	Concentration (mg/m3)
Earthworks	Excavation, backfilling, loading and unloading, transportation, site operation	2.4	50	11.7
			100	8.8
			150	5.0

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd. Based on experience with previous projects.

175. To reduce air quality impacts during the construction period the following air quality management measure will be implemented:

(i) HSP sites, HES sites and pipeline sections under construction will be fully enclosed by a 3 m high fence prior to the commencement of construction. Fence height will be increased near sensitive locations (residential areas, schools, clinics and hospitals).

(ii) Water will be sprayed on active construction sites where fugitive dust is being generated on a daily basis, and more frequently during windy days.

(iii) Construction activities will be halted during high wind events.

(iv) All construction piles with the potential to generate dust will be covered and/or regularly watered.

(v) Transport vehicles will be limited to low speeds in construction sites.

(vi) Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks.

(vii) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds.

(viii) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.

(ix) Vehicles and construction machineries will be maintained to a high standard (to be done off-site) to ensure efficient operating and fuel-burning and compliance with the PRC emission standards GB 11340-2005, GB 17691-2005, GB 18285 -2005 and GB 18352-2005.

(x) The use of coal for cooking on site, heating and hot water is prohibited.

(xi) Non-ozone depleting blowing agents will be utilized for the polyurethane foam (PUR) during the construction of pre-insulated bonded heating pipes.

4. Noise Impacts

a) Noise Intensity

176. A significant increase in localized noise is expected during construction. HSP construction activities will involve excavators, bulldozers, concrete-mixing plants, loaders, graders, rollers, and other heavy machinery, as well as noise from goods transportation. Noise during pipeline construction will be generated by trench excavators, rollers and other compaction machinery. Though noise levels may be high, the impacts will be temporary and localized, and with the exception of the pipelines and HESs, will be focused on the uninhabited HSP site areas. The major anticipated noise sources at each construction stage are presented in **Table 51**, while transportation noise sources are presented in **Table 52**.

Table 51: Primary noise sources at each construction stage.

Construction Stage	Primary Noise Source	Sound Level dB(A)
Demolition	Bulldozer	95
	Excavating machinery	90-96
Land Forming	Bulldozer	95
	Excavating machinery	90-96
	Loader	90
Foundation and earthworks	Loader	90
	Excavating machinery	78-96
Floor and Structure	Vibrator	90-100
	Reinforcement cutting shears	90-95
	Welder	90-95

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 52: Transportation vehicle noise sources, construction phase.

Noise Source	Large Truck	Light Truck
Sound level dB（A）	95	75

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

b) Noise Prediction

177. Construction equipment is considered a point noise source, and the predictive model is as follows:

$$L_2 = L_1 - 20\lg(r_2/r_1) \ (r_2 > r_1)$$

Where, L_1 and L_2 are equipment noise sound levels at locations R_1 and R_2, respectively.

178. Peak construction noise levels at different distances from the source at each construction stage are presented in **Table 53**. This assumes a worst case scenario: high noise equipment is operating without noise barriers or mitigations, and sound absorption in air is not included.

179. The worst case peak construction noise prediction results show that during the day some high noise activities within 20 m of the site boundaries in the daytime, and 100 m at nighttime, could be close to being in non-compliance with GB 12523－2011 which specifies the noise limit at construction site boundaries for Class II areas as 75 dB (A) during the daytime and 55 dB (A) during the nighttime. These impacts will be localized and short-term during the construction process, and the highest noise impacts will be within the HSP sites. However, mitigation measures to protect communities will nonetheless be implemented.

Table 53: Predicted noise levels of construction equipment by distance.

Construction Stage	Primary Noise Source	Noise value dB(A) at distance (m) from source							
		10 m	20 m	30 m	40 m	50 m	100 m	200 m	300 m
Foundation and Earthworks	Loader	70	64	60.5	58	56	50	44	38
	Excavating Machinery	67	61	57.5	55	53	47	41	34
	Piling Machines	80	74	70	68	66	60	54	47
Structure Construction	Vibrator	75	69	65.5	63	58.7	55	49	43
	Concrete pump	72.5	66.5	63	60.5	58.5	52.5	46.5	40.5
	Reinforcement cutting shears	73	67	63.5	61	59	53	47	41
	Chainsaw	69	63	59.5	57	55	49	43	37
	Lift	74	68	64	62	60	54	48	42

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

c) Mitigation Measures for Noise Impacts

180. To ensure construction activities meet PRC noise standards (*Noise Standards for Construction Site Boundary*, GB 12523-2011) and protect workers and adjacent residents, the following mitigation measures will be implemented:

(i) Construction activities will be restricted to 6:00-12:00 h and 14:00-22:00 h. Construction activities will be prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, EPB and other relevant departments.

(ii) When undertaking construction planning, simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during that day rather than evening hours. Similarly, construction sites will be planned to avoid multiple high noise activities or equipment from operating at the same location.

(iii) Low-noise equipment will be selected as much as possible.

(iv) Noise levels from equipment and machinery must conform to the PRC standard GB 12523-2011, will be equipped with mufflers, and will be properly maintained to minimize noise.

(v) Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum.

(vi) Noise personnel protective equipment (PPE) will be provided to workers.

(vii) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times.

(viii) Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals.

(ix) Given their location within residential areas, special attention will be paid to protect sensitive sites near HESs and along the pipeline routes:

- High noise construction activities will be positioned as far away from sensitive sites as possible.
- Low noise equipment will be utilized to the extent possible.
- Temporary or permanent noise barriers will be installed to protect sensitive sites.

5. Solid Waste

a) Waste Sources

181. Solid waste generated in the construction phase will include construction and domestic waste. Construction wastes include fill, various building materials such as steel, timbers, rubble, and other types of waste. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation.

b) Mitigation Measures

182. The following solid waste management measure will be implemented:

(i) Wastes will be reused or recycled to the extent possible.

(ii) Littering by workers will be prohibited.

(iii) Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements.

(iv) Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements.

(v) Excavated soil will be backfilled onsite to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site.

(vi) There should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited.

(vii) Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.

6. Hazardous and Polluting Materials

183. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials can cause soil, surface and groundwater contamination. To prevent this, the following mitigation measures will be implemented:

(i) A hazardous materials handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors.

(ii) Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes.

(iii) Suppliers of chemicals and hazardous materials must hold proper licenses. They will follow all relevant protocols in "Operation Procedures for Transportation, Loading and Unloading of Dangerous or Harmful Goods" (JT 3145-91).

(iv) A licensed company will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements.

(v) Vehicles and equipment will be properly maintained and refueled in designated service areas on impermeable surfaces provided with oil traps, at least 300 m from drainage structures and important water bodies.

7. Impacts to Flora and Fauna

184. Typical construction impacts on flora and fauna include removal of vegetation and disruption of the ecosystem during construction. If present, rare or endangered flora or fauna may also be impacted. However, the Project HSP sites are located in urban or semi-rural environments within the city limits, which have little or no vegetation cover other than recently established grasses and shrubs. Similarly, pipeline routes and HES sites are within urban environments. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special ecological significance which will be impacted by the Project. This conclusion has been confirmed by the Hohhot Forestry Bureau. Impacts on flora or fauna are thus expected to be minimal and short-term. Nonetheless, to address potential impacts:

(i) A greening plan will be implemented in each HSP:

a. HSP site vegetation plans will be developed, using appropriate native species. According to the domestic EIAs, the approximate area to be vegetated for each HSP is:

- Haoqingying greening area: 34,486 m^2
- Xinjiaying greening area: 27,226 m^2.
- Jinqiao greening area: 34,375 m^2.

b. Any vegetated areas impacted by pipeline works or construction of HESs will be restored post-construction using appropriate native species.

185. The Jinqiao heating zone will require one river crossing. To minimize potential impacts:

(i) Directional drilling will be used to embed the pipeline under the waterway.

(ii) The waterbody will be protected by siltation fences.

8. Impacts on Socio-Economic Resources

a) Community Disturbance and Safety

186. Project construction has the potential to cause significant community disturbance such as traffic congestion or delays, and public safety risks from construction activities, heavy vehicles and machinery traffic. For example, Project construction will require an estimated 212,000 trucks loads: 3,000 trucks of earth fill for HSPs, 300 trucks of steel, 4,500 trucks of concrete, 500 trucks of equipment, 1,300 trucks of pipeline, 200 trucks of fittings, 200 trucks of HES, 200 trucks of electric and control equipment, and 11,000 trucks of earth fill for installing pipelines. In addition, portions of the pipeline network and HESs are often located within sensitive residential or commercial areas. There is also the potential for interruptions in municipal services and utilities resulting from damage to pipelines for water supply, drainage, heating supply, and gas, as well as to underground power cables and communication cables.

187. Existing road access to the HSP sites is good. The Haoqingying HSP is located south of the national road 110, and traffic will not have a significant impact on any residential area. The Xinjiaying HSP will be constructed adjacent to an existing HSP, which owned by the HCHC. Again there is good existing access via Da Tian Road which does not have an impact on residential areas. The Jinqiao HSP can be accessed by the 3rd Ring Road to the south, Feng Zhou Road to the west, and La Ma Ying Road to the east with little or no impact on residential area. Nonetheless, mitigations will be implemented to address traffic and other community disturbance issues:

Traffic and Public Safety

(i) Traffic control plans, agreed to by the local traffic control authority, will be developed and implemented for each heating zone in order to minimize community disturbance:

- Local government, using information provided by the PMO, will inform residents, institutions, bossiness and other affected parties as to planned construction activities including schedule and duration of construction works, and expected traffic and other disruptions.
- Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times.
- Warning signs and cones will be installed along roads to protect workers and people in the neighborhood. Safety flags will be used if appropriate.
- Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals.
- During evening construction warning lights will also be used.
- Roadside earthworks should be completed as quickly as possible, and all spoil either backfilled or removed.
- Road crossing will use the pipe-jacking installation method where possible in order to minimize disruption.

(ii) Public access to construction sites and other areas of danger will be restricted and temporary barriers installed.

Access to Public Services, Private Properties and Businesses

(i) Local authorities will be consulted to minimize disruption of public services such as telephone, water, gas and power supply. Contactors will use good construction practices to avoid disruption of other services.

(ii) The Contractor shall take measures to minimize disruption of access to private properties and businesses where possible.

(iii) Temporary access to affected private properties, businesses and public service buildings will be provided including temporary crossings over pipeline trenches, and subsequently good quality permanent access will be provided.

b) Worker Occupational Health and Safety

188. Construction may cause physical hazards to workers from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, and others.

189. Contractors will implement adequate precautions to protect the health and safety of their workers.:

(i) Each contractor will implement the relevant construction phase EHS plan developed by the LIEC.

(ii) An EHS officer will be appointed by each contractor to implement and supervise the EHS management plan.

The EHS Plan will:

- Identify and minimize the causes of potential hazards to workers.
- Implement appropriate safety measures.
- Ensure the provision of adequate type and number of fire extinguishers and first aid facilities onsite.
- Provide training to workers on occupational health and safety and emergency response, especially with respect to using potentially dangerous equipment.
- Ensure that all equipment is maintained in a safe operating condition.
- Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.
- Provide appropriate personal protective equipment (PPE) to workers to minimize risks, including ear protection, hard hats and safety boots, and post adequate signage in risk areas.
- Provide procedures for limiting exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011).
- Provide training to workers on the storage, handling and disposal of hazardous wastes.
- Ensure regular safety meetings with staff.

9. Physical Culture Resources

190. There are no known cultural heritage or archaeological sites on the Project sites. However, there is a tomb approximately 100 m south of the Jinqiao HSP boundary near the existing access road, and care will need to be taken during construction to protect the tomb. In addition, construction activities may have the potential to disturb as yet unknown underground cultural relics.

191. To address these issues:

(i) The tomb south of the Jinqiao HSP (**Figure 29**) will be demarcated by fence and signs as a no-entry area.

(ii) A construction phase chance find procedure will be established and activated if any chance finds of PCRs are encountered:

- construction activities will be immediately suspended if any PCRs are encountered;
- destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations;
- the local Cultural Heritage Bureau will be promptly informed and consulted; and,
- construction activities will resume only after thorough investigation and with the permission of the local Cultural Heritage Bureau.

C. Anticipated Operation Phase Impacts and Mitigation Measures

192. The Project may cause some adverse environmental impacts during operation including air pollution from natural gas combustion, noise from HESs, wastewater and solid wastes, and fire and safety hazards.

1. Air Pollution

a) Air Pollution Emissions

193. The primary emissions to air from the combustion of fossil fuels are sulfur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM), carbon monoxide (CO), and greenhouse gases, such as carbon dioxide (CO_2). Natural gas generally produce negligible quantities of particulate matter and sulfur oxides, and levels of nitrogen oxides are about 60% of those from plants using coal (without emission reduction measures). Natural gas-fired plants also release lower quantities of carbon dioxide, a greenhouse gas.To minimize emissions and associated impacts, the Project will utilize low NOx natural gas-fired boilers and zero emission demonstration electrode boilers.

194. The domestic EIAs use a boiler NOx emission concentration of 137.31 mg/m^3, based on a 2007 survey of industrial natural gas boilers in the PRC. It's important to note that this emission level is in compliance with both the PRC natural gas boiler emission standard of 400 mg/m^3 and 200 mg/m^3 in sensitive areas (*PRC Emission Standards of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers* (GB 13217-2001)), and the 2007 IFC EHS guidelines of 240 mg/m^3 for natural gas boilers. However, to in order to maximize environmental benefits, the Project has committed to using low NOx natural gas boilers producing less than 100 mg/m^3 NOx emissions.

195. As noted above, the 1,560 MW of clean-burning natural gas-fired heating capacity and 50 MW of wind powered electrode heating capacity generated by the proposed Project

will replace heat that otherwise would have been generated by coal-fired power plants. When compared to the equivalent production of heat through traditional coal-fired sources, once operational the Project will: (i) result in the closure of 50 small urban low-efficiency and polluting coal-fired boilers; (ii) eliminate the use and transport through urban areas of 1.27 million tons of raw coal; (iii) result in energy savings equivalent to 848,500 ton of standard coal, thereby providing a global public good by avoiding the annual emission of 1,299,400 tons CO_2; (iv) improve local air quality through the estimated annual reduction of emissions of SO_2 by 11,800 tons, NO_x by 9,000 tons, PM by 26,000 tons, and fly and bottom ash by 191,000 tons (**Table 54**).

Table 54: Project emissions / coal use and savings vs coal-fired boilers.

Heating zone	**Pollutant / Coal Use**	**Predicted Project Emissions** (gas-fired district heating) ton/a	**Predicted Baseline Emissions** (equivalent heat production using coal-fired district heating) ton/a	**Emissions Reduction** ton/a
Haoqingying	CO_2	362,819	803,923	441,104
	NOx	348	3,726	3,378
	PM	-	9,895	9,895
	SO_2	74	4,555	4,481
	Fly Ash and Bottom Ash	-	72,566	72,566
	Standard Coal	-	322,472	322,472
	Raw Coal	-	482,514	482,514
Xinjiaying	CO_2	303,729	647,476	343,746
	NOx	291	3,001	2,710
	PM	-	7,970	7,970
	SO_2	62	3,669	3,606
	Fly Ash and Bottom Ash	-	58,445	58,445
	Standard Coal (1000 ton/a)	-	259,717	259,717
	Raw Coal	-	388,615	388,615
Jinqiao	CO_2	149,359	663,919	514,560
	NOx	143	3,077	2,934
	PM	-	8,172	8,172
	SO_2	31	3,762	3,731
	Fly Ash and Bottom Ash	-	59,929	59,929
	Standard Coal	-	266,313	266,313
	Raw Coal	-	398,483	398,483
Project Total	CO_2	815,907	2,115,318	1,299,411
	NOx	783	9,805	9,023
	PM	-	26,037	26,037
	SO_2	167	11,985	11,818
	Fly Ash and Bottom Ash	-	190,940	190,940
	Standard Coal	-	848,503	848,503
	Raw Coal	-	1,269,614	1,269,614

Sources: Based on EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014 and PPTA consultant calculations. Annex VI presents detailed calculations and assumptions.

b) Air Pollution Dispersion Modelling and Compliance with Air Quality Standards

196. The main pollutants of concern in natural gas-fired boiler emissions are NOx and SO_2. The domestic EIAs undertook preliminary atmospheric dispersion modeling for SO_2 and NOx. The results indicated that the worst case ground level concentrations (GLCs) of SO_2 and NO_2 are 0.88% and 9.96% respectively of the PRC standard, and the location with the maximum concentration is 970 m downwind of the pollution source. However, the modelling utilized SCREEN3, which is a screening model; only one boiler per HSP was modeled, (as opposed to the design of from 5 to 7 boilers); the modeling did not take into account the planned additional HSP at Haoqingying, and there was no "cumulative" modelling assessing impacts of all three HSPs simultaneously against background ambient levels. To address these issues, updated modeling was undertaken in April 2014 by the EIA Institute.[22]

i. Atmospheric Dispersion Model

197. Atmospheric dispersion modelling was undertaken utilizing AERMOD, a US EPA and PRC approved steady-state short range (up to 50 km) plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of all point, surface and body sources.[23] AERMOD can simulate the concentration distribution in both the short term (1-hour and daily average concentrations) and the long term (annual average concentrations). AERMOD is applicable for rural or urban districts and simple or complicated terrain. The impact of bottom flow of buildings (e.g. plume downwash) is also taken into account. AERMOD uses meteorological data for 1-hour continuous pre-treatment to simulate average concentration distribution in periods down to 1 hour. AERMOD includes two preprocessors: AERMET, which accepts surface meteorological data and upper air soundings, and then calculates atmospheric parameters needed by the dispersion model; and AERMAP, a terrain preprocessor which provide a physical relationship between terrain features and the behavior of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

ii. Modelling Scenarios

198. Atmospheric dispersion modeling was undertaken for the following scenarios:

Case 1 – HSPs and Cumulative

i) Worst case SO_2 and NO_x GLCs with Haoqingying, Xinjiaying and Jinqiao HSPs running simultaneously.

ii) Worst case SO_2 and NO_x GLCs with Haoqingying, Xinjiaying and Jinqiao HSPs running simultaneously superimposed over worst case background ambient air quality (cumulative assessment taking into account other pollution sources in the airshed).

Case 2 – HSPs, Additional Planned HSPs, and Cumulative

i) Worst case SO_2 and NO_x GLCs with Haoqingying, Xinjiaying and Jinqiao HSPs running simultaneously and with planned HSP expansion also taken into account (e.g. planned additional HSP at Haoqingying site).

[22] Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

[23] AERMOD is recommended model in Appendix A of *Guidelines for Environmental Impact Assessment of Atmospheric Environment* (HJ2.2-2008).

ii) Worst case SO_2 and NO_x GLCs with Haoqingying, Xinjiaying and Jinqiao HSPs running simultaneously and with planned HSP expansion also taken into account (e.g. planned additional HSP at Haoqingying site) superimposed over worst case background ambient air quality (cumulative assessment taking into account other pollution sources in the airshed).

iii) The modelling did not include other planned CHP or heat source plants under the Hohhot development plan due to uncertainty of their locations and timelines.

iii. Input Data

HSP Emission Parameters

199. The HSP emission parameters are presented in **Table 55**.

Table 55: HSP exhaust gas emission parameters.

Project	HSP	Emission height (m)	Inner diameter (m)	Exhaust Quantity (m^3/h)	Exhaust Temp. (^oC)	Emission Rate (kg/h)	
						SO_2	NO_x[24]
Low Carbon District Heating Project	Haoqingying HSP	30	2.5	5×179,045	120	5×5.26	5×17.90
	Xinjiaying HSP	30	2.5	7×107,061	120	7×3.14	7×10.71
	Jinqiao HSP	30	2.5	7×109,591	120	7×3.22	7×10.96
Planned HSP at Project site[a]	Haoqingying Phase II HSP	120	5	1,180,480	80	24.6	308.5

[a] The modelling was done using parameters that was indicated in the approved domestic EIA requirements for the original coal-fired HSP. It is note that the heating company already decided to switch from coal to natural gas for the planned Haoqingying Phase II HSP. A revised domestic EIA for gas-based was prepared and submitted for approval. Currently it is under the process of review by relevant authority. It is expected that environmental impact from Phase II HSP at project site would be significantly reduced compared to the expected impacts shown in modelling results.
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Meteorological Data

200. Meteorological data from the Hohhot National Basic Meteorological Station was obtained from the IMAR Atmospheric Sounding Technical Support Center. The meteorological station is located at East Hailaer Road in Hohhot, at an elevation of l063 masl. Topography at the station is similar to the HSP sites, and the station is approximately the same distance from all three heating zones. The meteorological station was established in 1951, and has more than 50 years of continuous observation records.

201. The modeling utilized one year of meteorological data for the year 2012, including

[24] Modeling needs to account for the conversion of nitrogen oxides (NO_x) emitted by a source into nitrogen dioxide (NO_2) in ambient air. In accordance with the *Guidelines for Environmental Impact Assessment of the Atmospheric Environment* (HJ2.2-2008), the modeling assumed that for 1-hour and 24-hour average concentrations, 90% of the NO_x is converted to NO_2, and for annual average concentrations 75% is converted to NO_2.

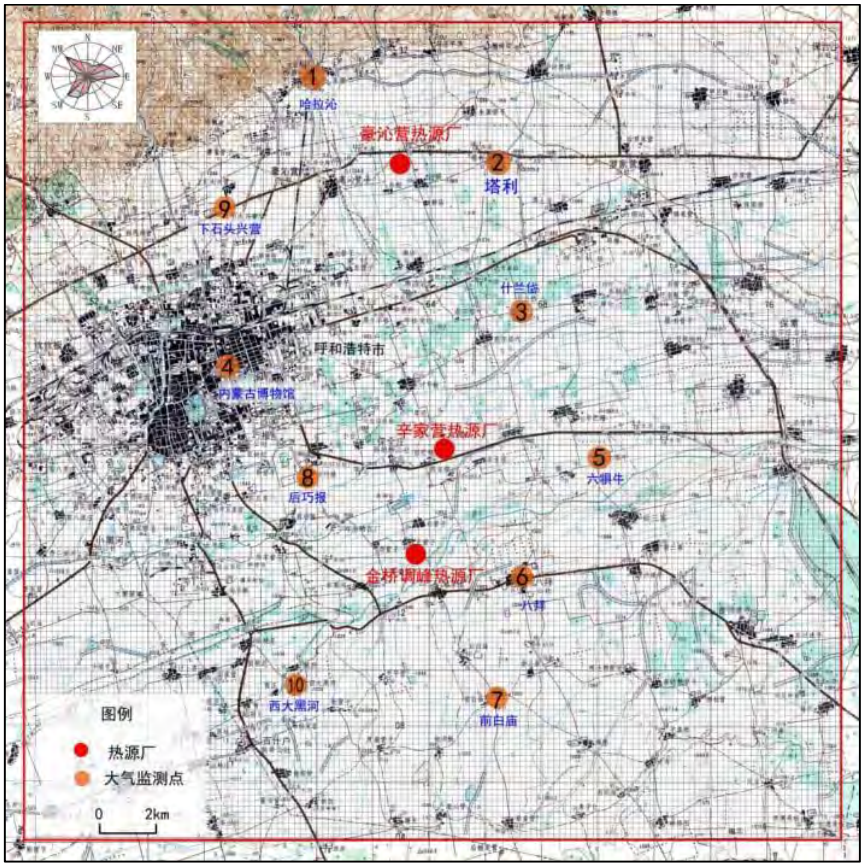
hourly wind directions and wind speed for each day in 2012, dry-bulb temperature, ground data like cloud cover (total cloud cover and low cloud cover), etc. Daily high altitude data was observed two times per day every 100m from 0-3000m. The AERMET estimate method was used for mixed layer height. The default of 200 calculated layers was utilized with a maximum altitude of 5000m.

202. Ground characteristic parameters required by AERMOD (surface albedo at high noon, Bowen at daytime and ground roughness) were set according to recommended parameters in the reference model suitable for the three heating zones. Atmospheric diffusion parameters mainly use ground meteorological data and sounding meteorological data to generate the predicted meteorological input document.

Receptor Grid System

203. Predictions of concentration were made for a 29km × 29km grid with the Xinjiaying HSP at the center. The grid consists of 200m x 200m cells with a total of 21,025 receptors. The southeast corner of the grid is the origin (0m x 0m) (**Figure 40**). Terrain was assumed to be flat.

Figure 40: 29 x 29 km AERMOD modelling grid.



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

GLC Parameters

204. The modelling predicted the following GLCs:

1- hour Average Concentrations
Worst case predicted 1-hour averaging period SO_2 and NO_2 GLCs over the entire 2012 modelling period (4320h); and worst case predicted 1-hour averaging period SO_2 and NO_2 GLCs + worst case ambient concentration at monitoring sites (cumulative assessment).

24-hour Average Concentrations
Worst case predicted 24-hour averaging period SO_2 and NO_2 GLCs over the entire 2012 modelling period (4320h); and worst case predicted 24-hour averaging period SO_2 and NO_2 GLCs + worst case ambient concentration at monitoring sites (cumulative assessment).

Annual Average Concentrations
Annual averaging period SO_2 and NO_2 GLCs over the entire 2012 modelling period (4320h). A cumulative assessment of annual averaging period SO_2 and NO_2 GLCs plus annual average ambient concentration at monitoring sites is not possible as annual average concentration data is not available for the monitoring sites.

iv. Results

Case 1 (Three HSPs; and Three HSPs + Background)

Worst case 1-hour average SO_2 and NO_2 GLCs

205. The ten worst case 1-hour average SO_2 and NO_2 GLCs and corresponding date and position are presented in **Table 56**. **Figure 41** and **Figure 42** show SO_2 and NO_2 concentration contour lines diagrams at the time when the maximum 1-hour average concentration of SO_2 and NO_2 occurred. The modelling shows that, under the meteorological conditions of 2012, the worst case 1-hour average GLC of SO_2 and NO_2 from the Project are 26.30 μg/m³ and 89.40 μg/m^3, equivalent to 5.26% and 44.70% respectively of the standard. The location is 310m from the Haoqingying HSP.

206. The worst case 1-hour average SO_2 GLCs at the monitoring sites range from 2.92 to 5.17 μg/m^3, while the worst case 1-hour average NO_2 GLCs at the monitoring sites range from 9.96 to 17.60 μg/m³. The worst case GLCs occur at Qianbaimiao Village. **Table 57** presents the cumulative Case 1 modelling results (e.g. worst case background concentration value from monitoring + worst case concentration predicted GLC). The results show that the worst case 1-hour GLCs combined with worst case background concentrations for SO_2 range from 42.29-59.17 μg/m³ and for NO_2 range from 70.60-82.60 μg/m³, which account for 8.46-11.83% and 35.30-41.30% of the corresponding standard, respectively.

Worst case 24-hour average SO_2 and NO_2 GLCs

207. The ten worst case 24-hour average SO_2 and NO_2 GLCs and corresponding date and position are presented in **Table 58**. **Figure 43** and **Figure 44** show SO_2 and NO_2 concentration contour lines diagrams at the time when the maximum 1-hour average concentration of SO_2 and NO_2 occurred. The modelling shows that, under the meteorological conditions of 2012, the worst case 1-hour average GLC of SO_2 and NO_2 from the Project are 4.16 μg/m³ and 14.20 μg/m^3, equivalent to 2.77% and 17.75% respectively of the standard. The location is 346m from the Xinjiaying HSP.

208. The worst case 24-hour average SO_2 GLCs at the monitoring sites range from 0.25 to 0.39 μg/m^3, while the worst case 24-hour average NO_2 GLCs at the monitoring sites range from 0.85 to 1.32 μg/m³. The worst case GLCs occur at Shilandai Village. **Table 59** presents the cumulative Case 1 modelling results (e.g. worst case background concentration value from monitoring + worst case concentration predicted GLC). The results show that the worst case 24-hour GLCs combined with worst case background concentrations for SO_2 range from 22.30-24.37 μg/m³ and for NO_2 range from 27.02-35.32 μg/m³, which account for 18.87-16.35% and 33.78-44.15% of the corresponding standard, respectively.

Worst case annual average SO_2 and NO_2 GLCs

209. The ten worst case annual SO_2 and NO_2 GLCs and corresponding date and position are presented in **Table 60**. **Figure 45** and **Figure 46** show SO_2 and NO_2 annual average concentration contour line diagrams. The modelling shows that, under the meteorological conditions of 2012, the worst case annual average GLCs of SO_2 and NO_2 from the Project are 0.715 μg/m³ and 2.44 μg/m^3, equivalent to 1.19% and 6.10% respectively of the standard. The locations are 404m from the Jinqiao HSP (SO_2) and 467m from the Xinjiaying HSP (NO_2).

Table 56: Case 1 ten worst case 1-hour SO_2 and NO_2 GLCs and corresponding date and positions.

Pollutant	Time	Meteorological conditions (wind direction in degrees, wind speed and temperature)	Worst case GLCs		Grid Position
			Predicted GLC concentration ($\mu g/m^3$)	Ratio of GLC concentration to Standard (%)	
SO_2	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	26.30	5.26	23600, 23800
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	24.70	4.94	25200, 13600
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	24.40	4.88	23600, 23800
	10pm, 15 Apr	308, 7.3m/s, T=14.2℃	24.20	4.84	25200, 13600
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	24.10	4.82	25200, 13600
	9pm, 23 June	305, 6.7m/s, T=20.2℃	22.60	4.52	25200, 13600
	8pm, 30 Apr	315, 7.7m/s, T=18.1℃	22.50	4.50	24200, 9800
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	21.90	4.38	24000, 10000
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	21.00	4.20	24200, 10000
	5pm, 21 Jan	307, 7m/s, T=-6.1℃	20.40	4.08	25200, 13600
NO_2	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	89.40	44.70	23600, 23800
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	84.20	42.10	25200, 13600
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	83.10	41.55	23600, 23800
	10pm, 15 Apr	308, 7.3m/s, T=14.2℃	82.50	41.25	25200, 13600
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	82.10	41.05	25200, 13600
	9pm, 23 June	305, 6.7m/s, T=20.2℃	77.10	38.55	25200, 13600
	8pm, 30 Apr	315, 7.7m/s, T=18.1℃	76.60	38.30	24200, 9800
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	74.50	37.25	24000, 10000
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	71.30	35.65	24200, 10000
	5pm, 21 Jan	307, 7m/s, T=-6.1℃	69.60	34.80	25200, 13600

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 57: Case 1 worst case 1-hour SO_2 and NO_2 cumulative (worst case predicted + background) GLCs at monitoring sites.

Pollutant	Monitoring Site	Worst case background concentration* (μg/m^3)	Worst case concentration contributed from Project (μg/m^3)	Worst case cumulative concentration (μg/m^3)	Ratio of cumulative concentration to standard (%)
SO_2	Halaqin village	38	4.29	42.29	8.46
	Tali village	43	3.47	46.47	9.29
	Shilandai village	44	4.00	48.00	9.60
	Inner Mongolia museum	52	2.92	54.92	10.98
	Liujuniu village	54	2.99	56.99	11.40
	Babai village	54	4.39	58.39	11.68
	Qianbaimiao village	54	5.17	59.17	11.83
	Houqiaobao village	52	3.43	55.43	11.09
	Xiashitouxinying village	52	2.98	54.98	11.00
	West Dahei River village	54	4.01	58.01	11.60
NO_2	Halaqin village	56	14.60	70.60	35.30
	Tali village	63	11.80	74.80	37.40
	Shilandai village	63	13.60	76.60	38.30
	Inner Mongolia museum	62	9.96	71.96	35.98
	Liujuniu village	65	10.20	75.20	37.60
	Babai village	65	15.00	80.00	40.00
	Qianbaimiao village	65	17.60	82.60	41.30
	Houqiaobao village	62	11.70	73.70	36.85
	Xiashitouxinying village	62	10.20	72.20	36.10
	West Dahei River village	65	13.70	78.70	39.35

Note: background concentration is the maximum concentration recorded at the site during the ambient air quality monitoring.

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 58: Case 1 ten worst case 24-hour SO_2 and NO_2 GLCs and corresponding date and positions.

Pollutant	Time	Meteorological conditions (wind direction in degrees, wind speed and temperature)	Worst case GLCs		Grid Position
			Predicted GLC concentration ($\mu g/m^3$)	Ratio of GLC concentration to Standard (%)	
SO_2	12pm, 23 Apr	82, 1.8m/s, T=11.5℃	4.16	2.77	25200, 14000
	12pm, 23 Apr	82, 1.8m/s, T=11.5℃	3.41	2.27	24200, 10400
	12pm, 18 Oct	318, 0.5m/s, T=4.8℃	3.40	2.27	25200, 13600
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	3.34	2.23	24200, 9800
	12pm, 16 Oct	202, 1.7m/s, T=8.2℃	3.24	2.16	25200, 13600
	12pm, 21 Jan	14, 1m/s, T=-5.9℃	3.18	2.12	25200, 13600
	12pm, 17 May	279, 3.1m/s, T=9.6℃	3.15	2.10	24200, 10400
	12pm, 29 Jun	312, 1.5m/s, T=20.8℃	3.13	2.09	25200, 13600
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	2.98	1.99	25200, 13600
	12pm, 17 May	279, 3.1m/s, T=9.6℃	2.93	1.95	25200, 14000
NO_2	12pm, 23 Apr	82, 1.8m/s, T=11.5℃	14.20	17.75	25200, 14000
	12pm, 23 Apr	82, 1.8m/s, T=11.5℃	11.60	14.50	24200, 10400
	12pm, 18 Oct	318, 0.5m/s, T=4.8℃	11.60	14.50	25200, 13600
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	11.40	14.25	24200, 9800
	12pm, 16 Oct	202, 1.7m/s, T=8.2℃	11.00	13.75	25200, 13600
	12pm, 21 Jan	14, 1m/s, T=-5.9℃	10.80	13.50	25200, 13600
	12pm, 17 May	279, 3.1m/s, T=9.6℃	10.70	13.38	24200, 10400
	12pm, 29 Jun	312, 1.5m/s, T=20.8℃	10.70	13.38	25200, 13600
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	10.20	12.75	25200, 13600
	12pm, 17 May	279, 3.1m/s, T=9.6℃	10.00	12.50	25200, 14000

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 59: Case 1 worst case 24-hour SO_2 and NO_2 cumulative (worst case predicted + background) GLCs at monitoring sites.

Pollutant	Monitoring Site	Worst case background concentration* ($\mu g/m^3$)	Worst case concentration contributed from Project ($\mu g/m^3$)	Worst case cumulative concentration ($\mu g/m^3$)	Ratio of cumulative concentration to standard (%)
SO_2	Halaqin village	22	0.30	22.30	14.87
	Tali village	23	0.29	23.29	15.53
	Shilandai village	23	0.39	23.39	15.59
	Inner Mongolia museum	24	0.26	24.26	16.18
	Liujuniu village	23	0.25	23.25	15.50
	Babai village	23	0.31	23.31	15.54
	Qianbaimiao village	23	0.34	23.34	15.56
	Houqiaobao village	24	0.37	24.37	16.25
	Xiashitouxinying village	24	0.31	24.31	16.21
	West Dahei River village	22	0.33	22.33	14.89
NO_2	Halaqin village	26	1.02	27.02	33.78
	Tali village	30	0.99	30.99	38.74
	Shilandai village	34	1.32	35.32	44.15
	Inner Mongolia museum	30	0.90	30.90	38.63
	Liujuniu village	32	0.85	32.85	41.07
	Babai village	32	1.06	33.06	41.33
	Qianbaimiao village	33	1.16	34.16	42.70
	Houqiaobao village	33	1.27	34.27	42.84
	Xiashitouxinying village	30	1.06	31.06	38.83
	West Dahei River village	29	1.12	30.12	37.65

Note: background concentration is the maximum concentration recorded at the site during the ambient air quality monitoring.

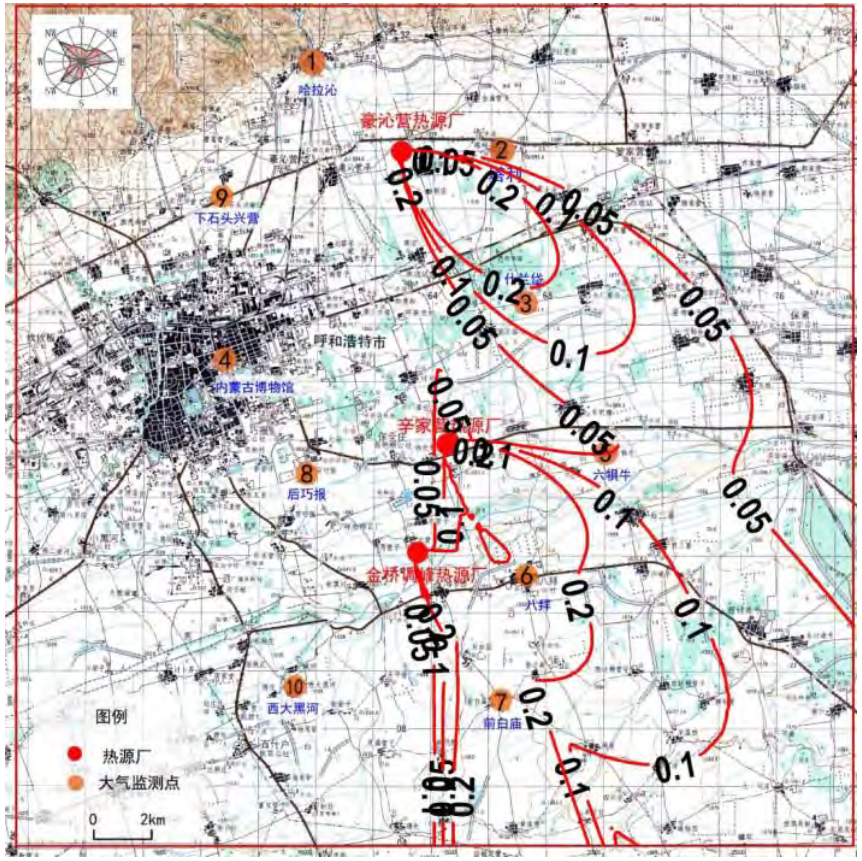
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 60: Case 1 ten worst annual average SO_2 and NO_2 GLCs and corresponding positions.

Pollutant	Position	Worst case GLC (μg/m^3)	Ratio of GLC concentration to Class II standard limit (%)
SO_2	14200, 10400	0.715	1.19
	15200, 14200	0.715	1.19
	13600, 24200	0.675	1.13
	13600, 24400	0.638	1.06
	15000, 14200	0.627	1.05
	14000, 10400	0.620	1.03
	14200, 10600	0.614	1.02
	13800, 24400	0.565	0.94
	15200, 14400	0.555	0.93
	15200, 14000	0.552	0.92
NO_2	15200, 14200	2.44	6.10
	14200, 10400	2.44	6.10
	13600, 24200	2.30	5.75
	13600, 24400	2.17	5.43
	15000, 14200	2.14	5.35
	14000, 10400	2.11	5.28
	14200, 10600	2.09	5.23
	13800, 24400	1.92	4.80
	15200, 14400	1.89	4.73
	15200, 14000	1.88	4.70

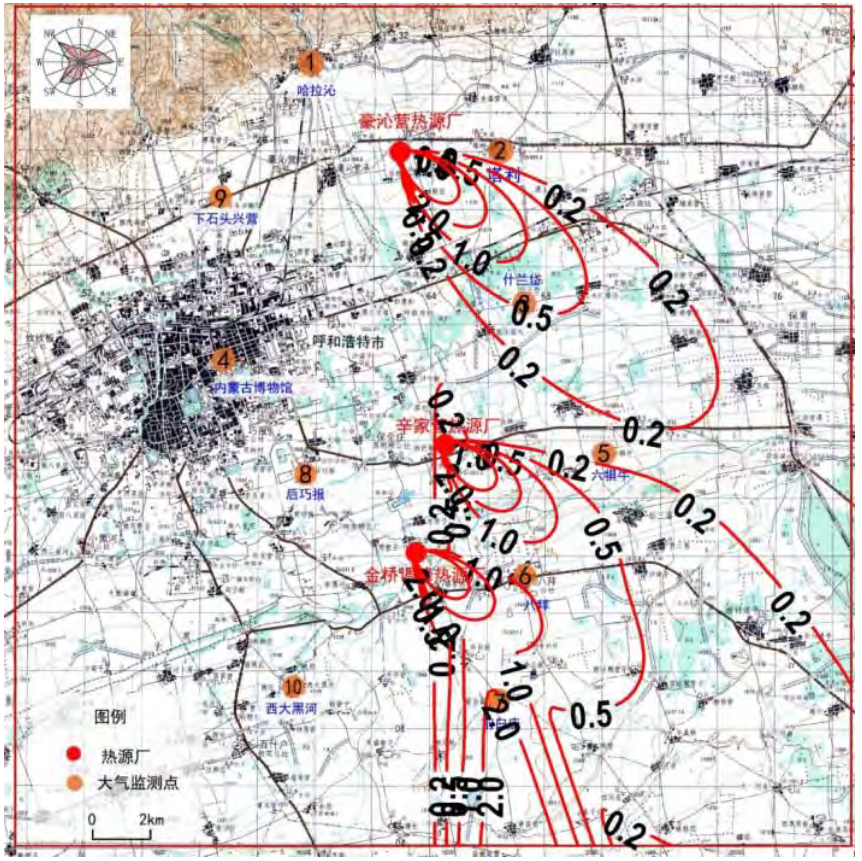
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 41: Case 1 SO_2 contour map at time of worst case 1-hour average concentration of SO_2 and NO_2 contribution from the Project (8pm, 19 Apr 2012). Unit: μg/Nm^3



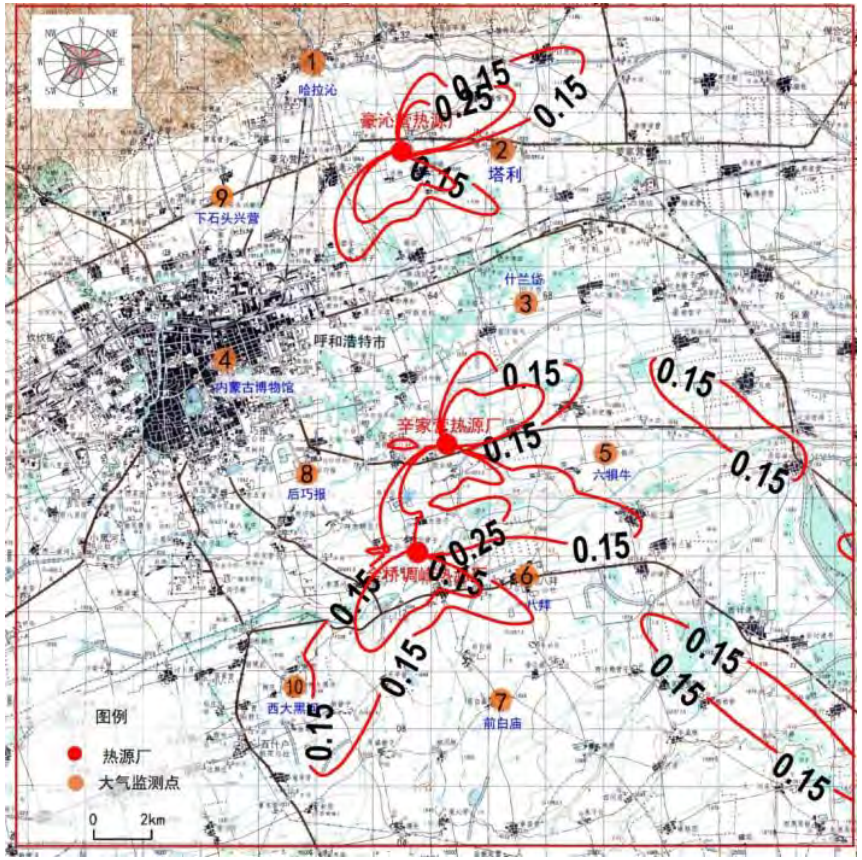
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd..

Figure 42: Case 1 NO_2 contour map at time of worst case 1-hour average concentration of SO_2 and NO_2 contribution from the Project (8pm, 19 Apr 2012). Unit: μg/Nm^3



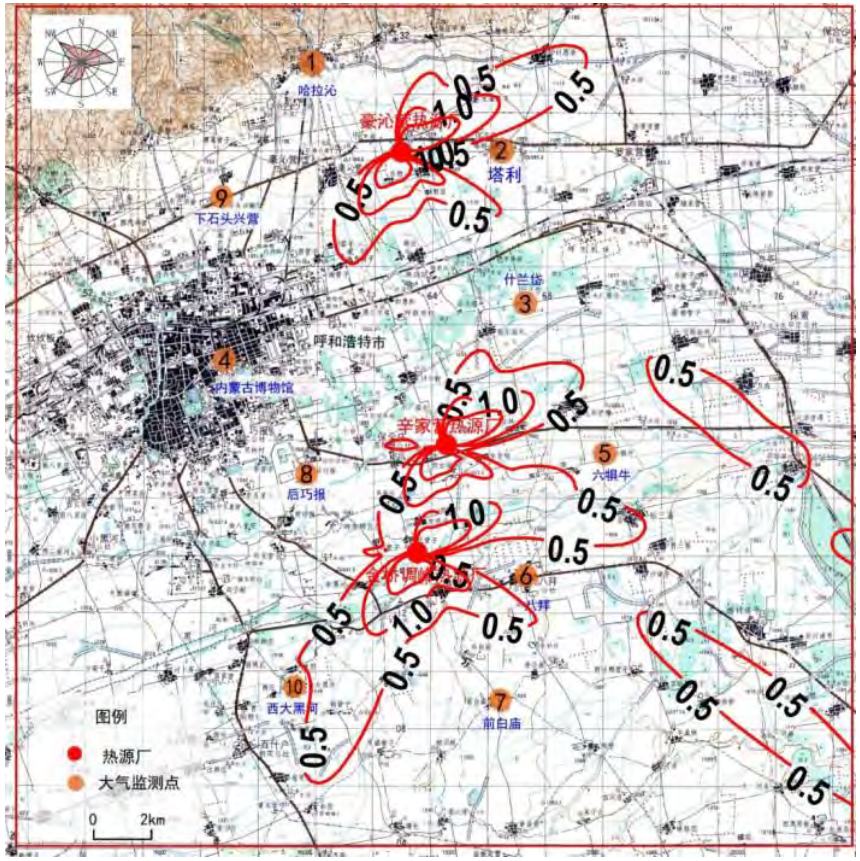
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd

Figure 43: Case 1 SO_2 contour map at time of worst case 24-hour average concentration of SO_2 and NO_2 contribution from the Project (8pm, 23 Apr 2012). Unit: μg/Nm^3



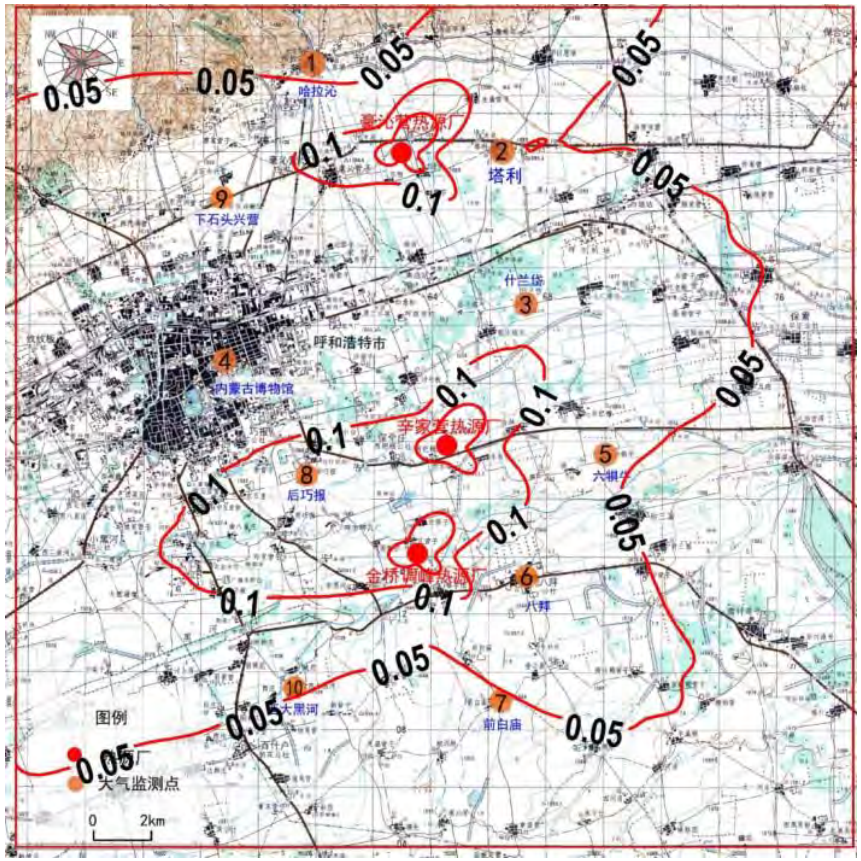
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd..

Figure 44: Case 1 NO_2 contour map at time of worst case 24-hour average concentration of SO_2 and NO_2 contribution from the Project (8pm, 23 Apr 2012). Unit: μg/Nm^3



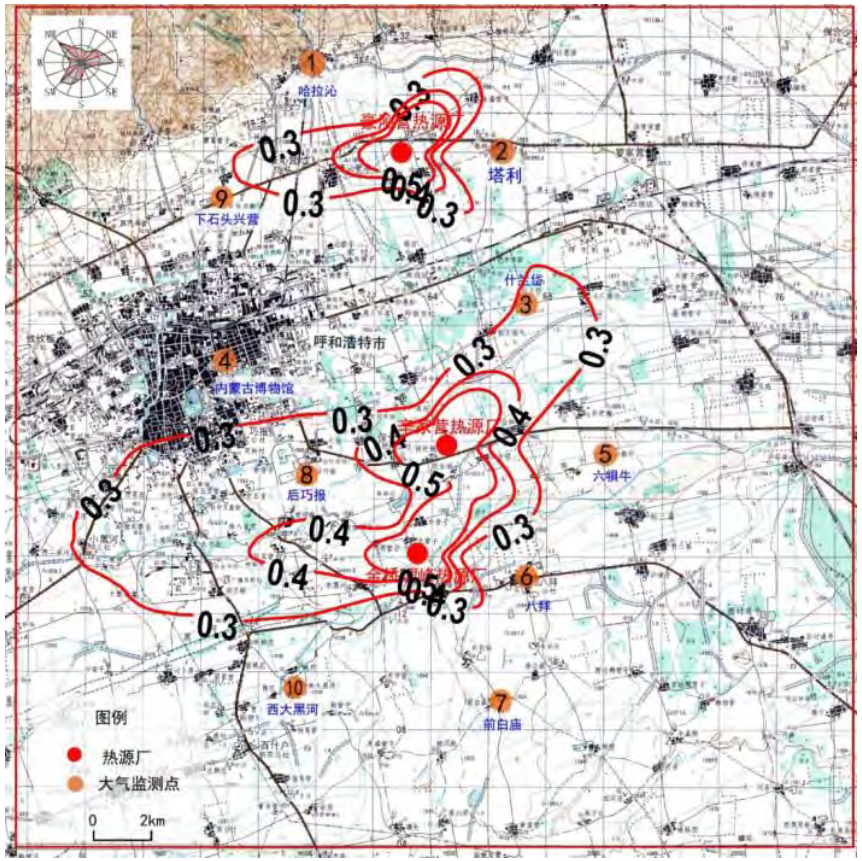
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd

Figure 45: Case 1 SO_2 contour map at time of annual average concentration of SO_2 and NO_2 contribution from the Project Unit: μg/Nm^3



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd..

Figure 46: Case 1 NO_2 contour map at time of annual average concentration of SO_2 and NO_2 contribution from the Project. Unit: μg/Nm^3



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd

Case 2 (Three HSPs + Haoqingying Phase II; and Three HSPs + Haoqingying Phase II + Background)

Worst case 1-hour average SO_2 and NO_2 GLCs

210. The ten worst case 1-hour average SO_2 and NO_2 GLCs and corresponding date and position resulting from the Project + Haoqingying Phase II HSP are presented in **Table 61**. **Figure 47** and **Figure 48** show SO_2 and NO_2 concentration contour lines diagrams at the time when the maximum 1-hour average concentration of SO_2 and NO_2 occurred. The modelling shows that, under the meteorological conditions of 2012, the worst case 1-hour average GLC of SO_2 and NO_2 from the Project and the Haoqingying Phase II HSP are 26.30 μg/m³ and 89.40 μg/m^3, equivalent to 5.26% and 44.70% respectively of the standard. The location is 310m from the Haoqingying HSP.

211. The worst case 1-hour average SO_2 GLCs at the monitoring sites range from 3.13 to 6.47 μg/m^3, while the worst case 1-hour average NO_2 GLCs at the monitoring sites range from 17.70 to 49.50 μg/m³. The worst case GLCs occur at Tali Village. **Table 62** presents the cumulative Case 2 modelling results (e.g. worst background concentration value from monitoring + worst case concentration predicted GLC from the Project + Haoqingying Phase II HSP). The results show that the worst case 1-hour GLCs for SO_2 range from 43.59-59.81 μg/m³ and for NO_2 range from 81.10-112.50 μg/m³, which account for 8.72-11.96% and 40.55-56.25% of the corresponding standard, respectively.

Worst case 24-hour average SO_2 and NO_2 GLCs

212. The ten worst case 24-hour average SO_2 and NO_2 GLCs and corresponding date and position are presented in **Table 58**. **Figure 49** and **Figure 50** show SO_2 and NO_2 concentration contour lines diagrams at the time when the maximum 1-hour average concentration of SO_2 and NO_2 occurred. The modelling shows that, under the meteorological conditions of 2012, the worst case 1-hour average GLC of SO_2 and NO_2 from the from the Project and the Haoqingying Phase II HSP are 4.16 μg/m³ and 17.30 μg/m^3, equivalent to 2.77% and 21.63% respectively of the standard. The locations are 346m from the Xinjiaying HSP and 733m from the Haoqingying HSP, respectively.

213. The worst case 24-hour average SO_2 GLCs at the monitoring sites range from 0.25 to 0.49 μg/m^3, while the worst case 24-hour average NO_2 GLCs at the monitoring sites range from 1.41 to 3.26 μg/m³. The worst case GLCs occur at Shilandai Village and Tali Village, respectively. **Table 64** presents the cumulative Case 2 modelling results (e.g. worst background concentration value from monitoring + worst case concentration predicted GLC from the Project and the Haoqingying Phase II HSP). The results show that the worst case 24-hour GLCs for SO_2 range from 22.36-24.41 μg/m³ and for NO_2 range from 28.50-36.59 μg/m³, which account for 14.92-16.28% and 35.63-45.74% of the corresponding standard, respectively.

Worst case annual average SO_2 and NO_2 GLCs

214. The ten worst case annual SO_2 and NO_2 GLCs and corresponding date and position are presented in **Table 65**. **Figure 51** and **Figure 52** show SO_2 and NO_2 annual average concentration contour line diagrams. The modelling shows that, under the meteorological conditions of 2012, the worst case annual average GLCs of SO_2 and NO_2 from the Project and the Haoqingying Phase II HSP are 0.814 μg/m³ and 4.65 μg/m^3, equivalent to 1.36% and 11.63% respectively of the standard. The locations are 500m and (SO_2) and 777m (NO_2) from the Haoqingying HSP.

Table 61: Case 2 ten worst case 1-hour SO_2 and NO_2 GLCs and corresponding date and positions.

Pollutant	Time	Meteorological conditions (wind direction in degrees, wind speed and temperature)	Worst case GLCs		Grid Position
			Predicted GLC concentration from Project + Haoqingying Phase 2 ($\mu g/m^3$)	Ratio of GLC concentration to Standard (%)	
SO_2	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	26.30	5.26	13600, 23800
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	24.70	4.94	15200, 13600
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	24.40	4.88	13600, 23800
	10pm, 15 Apr	308, 7.3m/s, T=14.2℃	24.20	4.84	15200, 13600
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	24.10	4.82	15200, 13600
	9pm, 23 Jun	305, 6.7m/s, T=20.2℃	22.60	4.52	15200, 13600
	8pm, 30 Apr	315, 7.7m/s, T=18.1℃	22.50	4.50	14200, 9800
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	21.90	4.38	14000, 10000
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	21.00	4.20	14200, 10000
	5pm, 21, Jan	307, 7m/s, T=-6.1℃	20.40	4.08	15200, 13600
NO_2	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	89.40	44.70	13600, 23800
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	84.20	42.10	15200, 13600
	7pm, 19 Apr	311, 8.4m/s, T=17.1℃	83.10	41.55	13600, 23800
	10pm, 15 Apr	308, 7.3m/s, T=14.2℃	82.50	41.25	15200, 13600
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	82.10	41.05	15200, 13600
	9pm, 23 Jun	305, 6.7m/s, T=20.2℃	77.10	38.55	15200, 13600
	8pm, 30 Apr	315, 7.7m/s, T=18.1℃	76.60	38.30	14200, 9800
	8pm, 19 Apr	310, 8.8m/s, T=15.4℃	74.50	37.25	14000, 10000
	7am, 12, Aug	86, 0.8m/s, T=18.9℃	73.10	36.55	11800, 24000
	7am, 12, Aug	86, 0.8m/s, T=18.9℃	73.00	36.50	12000, 24000

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 62: Case 2 worst case 1-hour SO_2 and NO_2 cumulative (worst case predicted + worst case background) GLCs at monitoring sites.

Pollutant	Monitoring Site	Worst case background concentration* (μg/m^3)	Worst case predicted concentration from Project + Haoqingying Phase 2 (μg/m^3)	Worst case cumulative concentration (μg/m^3)	Ratio of cumulative concentration to standard (%)
SO_2	Halaqin village	38	5.59	43.59	8.72
	Tali village	43	6.47	49.47	9.89
	Shilandai village	44	4.89	48.89	9.78
	Inner Mongolia museum	52	3.23	55.23	11.05
	Liujuniu village	54	3.13	57.13	11.43
	Babai village	54	4.96	58.96	11.79
	Qianbaimiao village	54	5.81	59.81	11.96
	Houqiaobao village	52	3.43	55.43	11.09
	Xiashitouxinying village	52	4.57	56.57	11.31
	West Dahei River village	54	4.08	58.08	11.62
NO_2	Halaqin village	56	35.20	91.20	45.60
	Tali village	63	49.50	112.50	56.25
	Shilandai village	63	36.60	99.60	49.80
	Inner Mongolia museum	62	22.80	84.80	42.40
	Liujuniu village	65	22.40	87.40	43.70
	Babai village	65	24.50	89.50	44.75
	Qianbaimiao village	65	25.60	90.60	45.30
	Houqiaobao village	62	19.10	81.10	40.55
	Xiashitouxinying village	62	32.40	94.40	47.20
	West Dahei River village	65	17.70	82.70	41.35

Note: background concentration is the maximum concentration recorded at the site during the ambient air quality monitoring.

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 63: Case 2 ten worst case 24-hour SO_2 and NO_2 GLCs and corresponding date and positions.

Pollutant	Time	Meteorological conditions (wind direction in degrees, wind speed and temperature)	Worst case GLCs		Grid Position
			Predicted GLC concentration from Project + Haoqingying Phase 2 (μg/m^3)	Ratio of GLC concentration to Standard (%)	
SO_2	12pm, 23 Apr	82, 1.8m/s, T=11.5℃	4.16	2.77	15200, 14000
	12pm, 23 Apr	82, 1.8m/s, T=11.5℃	3.41	2.27	14200, 10400
	12pm, 18 Oct	318, 0.5m/s, T=4.8℃	3.40	2.27	15200, 13600
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	3.35	2.23	14200, 9800
	12pm, 21 Jun	142, 1.0m/s, T=23℃	3.29	2.19	13600, 23600
	12pm, 16 Oct	202, 1.7m/s, T=8.2℃	3.24	2.16	15200, 13600
	12pm, 21 Jan	14, 1m/s, T=-5.9℃	3.19	2.13	15200, 13600
	12pm, 29 Jun	312, 1.5m/s, T=20.8℃	3.17	2.11	15200, 13600
	12pm, 17 May	279, 3.1m/s, T=9.6℃	3.15	2.10	14200, 10400
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	3.13	2.09	13600, 23600
NO_2	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	17.30	21.63	13800, 23400
	12pm, 24 Jul	16, 2.2m/s, T=22.3℃	17.00	21.25	13000, 23400
	12pm, 6 Jun	324, 4.5m/s, T=17.6℃	16.90	21.13	13800, 24400
	12pm, 21 Jun	142, 1.0m/s, T=23℃	16.90	21.13	13800, 23400
	12pm, 7 Sep	69, 1.3m/s, T=10.8℃	16.60	20.75	12600, 23800
	12pm, 21 Jun	142, 1.0m/s, T=23℃	16.30	20.38	13600, 23400
	12pm, 21 Jun	142, 1.0m/s, T=23℃	15.90	19.88	13600, 23600
	12pm, 6 May	97, 0.6m/s, T=17.9℃	15.90	19.88	13800, 24400
	12pm, 12 Mar	220, 1.5m/s, T=0.4℃	15.80	19.75	14000, 23200
	12pm, 24 Jul	16, 2.2m/s, T=22.3℃	15.70	19.63	12800, 23400

Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 64: Case 2 worst case 24-hour SO_2 and NO_2 cumulative (worst case predicted + background) GLCs at monitoring sites.

Pollutant	Monitoring Site	Worst case background concentration* ($\mu g/m^3$)	Worst case predicted GLC concentration from Project + Haoqingying Phase 2 ($\mu g/m^3$)	Worst case cumulative concentration ($\mu g/m^3$)	Ratio of cumulative concentration to standard (%)
SO_2	Halaqin village	22	0.37	22.37	14.92
	Tali village	23	0.45	23.45	15.63
	Shilandai village	23	0.49	23.49	15.66
	Inner Mongolia museum	24	0.31	24.31	16.20
	Liujuniu village	23	0.25	23.25	15.50
	Babai village	23	0.33	23.33	15.55
	Qianbaimiao village	23	0.39	23.39	15.59
	Houqiaobao village	24	0.39	24.39	16.26
	Xiashitouxinying village	24	0.41	24.41	16.28
	West Dahei River village	22	0.36	22.36	14.91
NO_2	Halaqin village	26	2.50	28.50	35.63
	Tali village	30	3.26	33.26	41.58
	Shilandai village	34	2.59	36.59	45.74
	Inner Mongolia museum	30	1.99	31.99	39.99
	Liujuniu village	32	1.41	33.41	41.76
	Babai village	32	1.48	33.48	41.85
	Qianbaimiao village	33	1.74	34.74	43.43
	Houqiaobao village	33	1.90	34.90	43.63
	Xiashitouxinying village	30	2.51	32.51	40.64
	West Dahei River village	29	1.76	30.76	38.45

Note: background concentration is the maximum concentration recorded at the site during the ambient air quality monitoring.

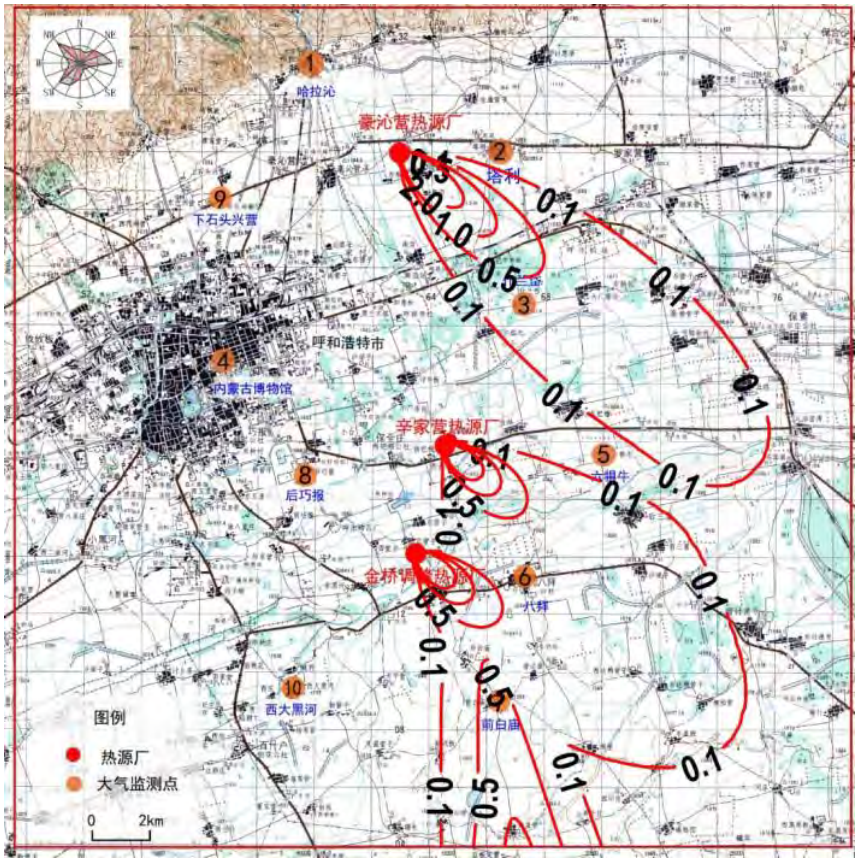
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 65: Case 2 ten worst annual average SO_2 and NO_2 GLCs and corresponding positions.

Pollutant	Position	Worst case GLC concentration from Project + Haoqingying Phase 2 (μg/m^3)	Ratio of GLC concentration to Class II standard limit (%)
SO_2	13600, 24400	0.814	1.36
	13800, 24400	0.776	1.29
	13600, 24200	0.754	1.26
	15200, 14200	0.723	1.21
	14200, 10400	0.722	1.20
	13800, 24600	0.713	1.19
	13600, 24600	0.677	1.13
	15000, 14200	0.635	1.06
	14000, 24600	0.628	1.05
	14000, 10400	0.626	1.04
NO_2	13800, 24600	4.65	11.63
	13800, 24400	4.57	11.43
	13600, 24400	4.38	10.95
	13600, 24600	4.25	10.63
	14000, 24600	4.24	10.60
	13800, 24800	4.05	10.13
	14000, 24800	3.94	9.85
	14000, 24400	3.86	9.65
	13600, 24800	3.62	9.05
	14200, 24600	3.50	8.75

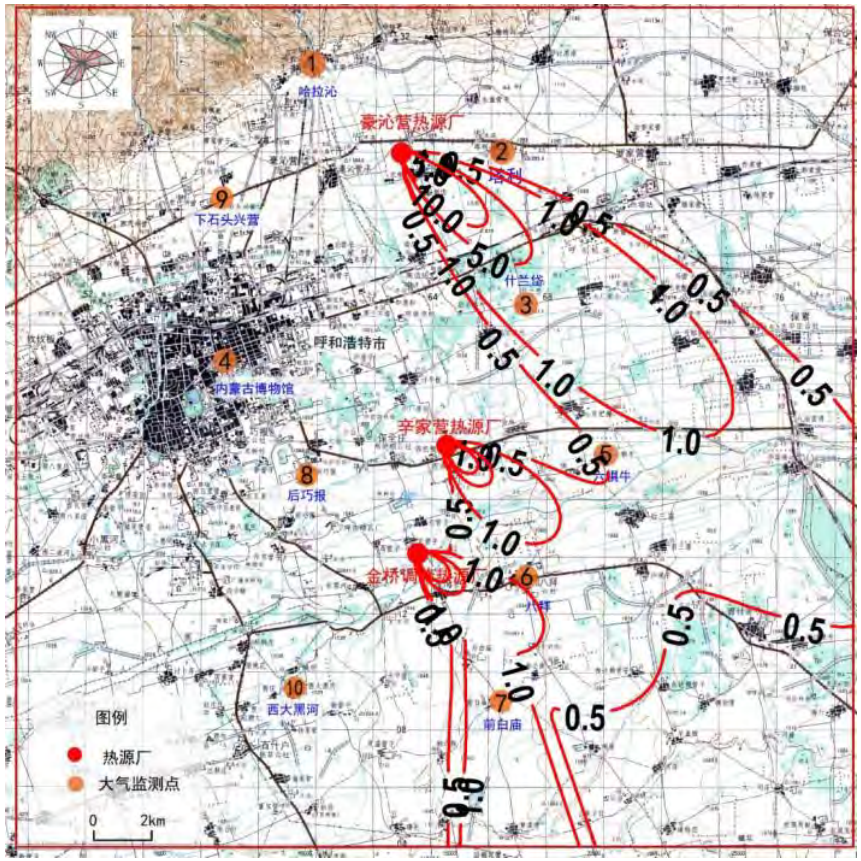
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd.

Figure 47: Case 2 SO_2 contour map at time of worst case 1-hour average concentration of SO_2 and NO_2 contribution from Project and Haoqingying Phase II (8pm, 19 Apr 2012). Unit: μg/Nm^3



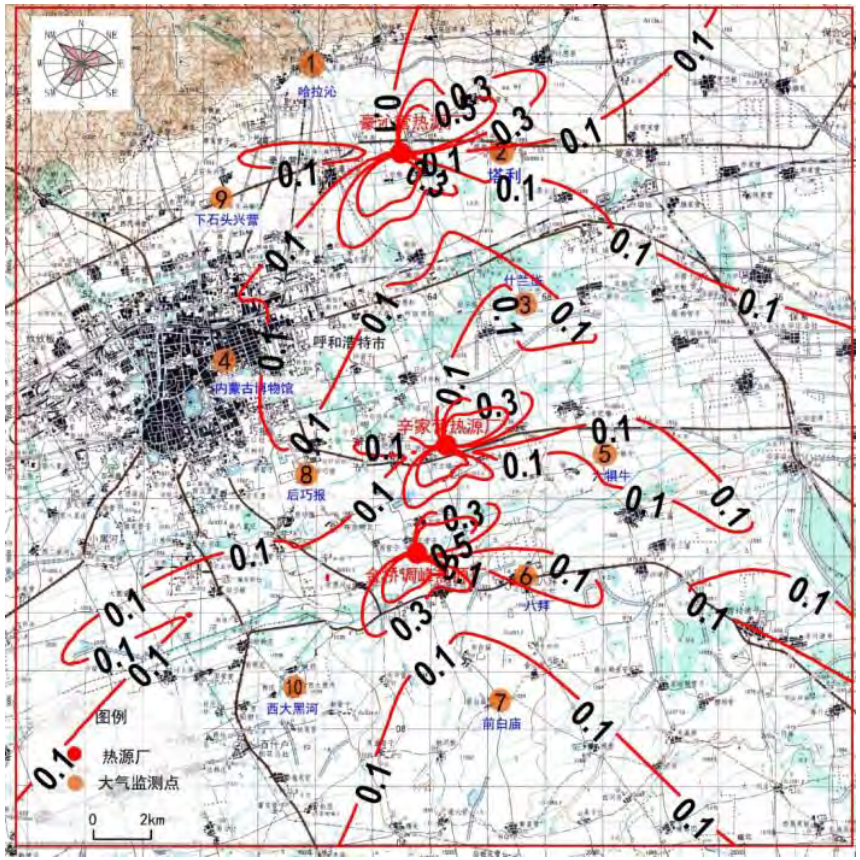
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd..

Figure 48: Case 2 NO_2 contour map at time of worst case 1-hour average concentration of SO_2 and NO_2 contribution from Project and Haoqingying Phase II (8pm, 19 Apr 2012). Unit: μg/Nm^3



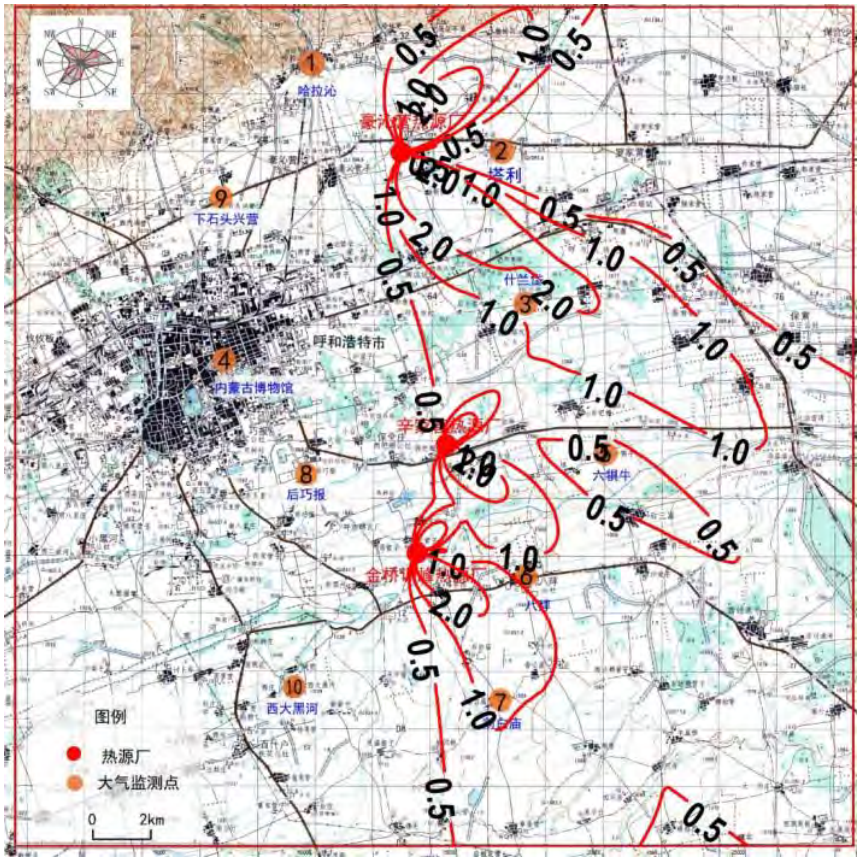
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd

Figure 49: Case 2 SO_2 contour map at time of worst case 24-hour average concentration of SO_2 and NO_2 contribution from Project and Haoqingying Phase II (8pm, 23 Apr 2012). Unit: μg/Nm^3



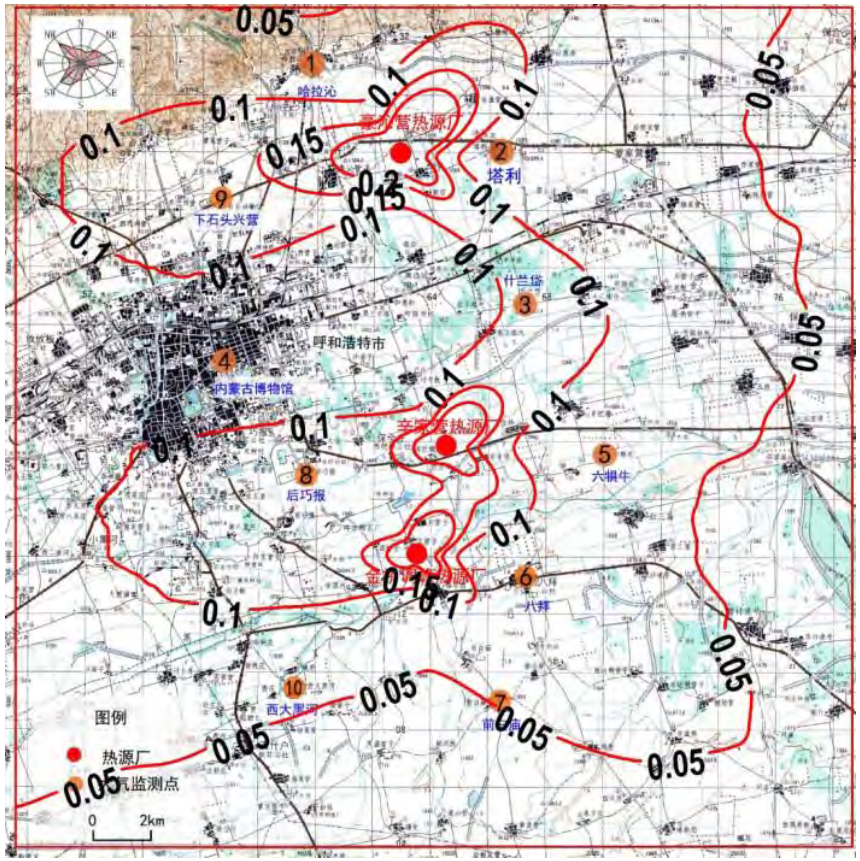
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd..

Figure 50: Case 2 NO_2 contour map at time of worst case 24-hour average concentration of SO_2 and NO_2 contribution from Project and Haoqingying Phase II (8pm, 23 Apr 2012). Unit: μg/Nm^3



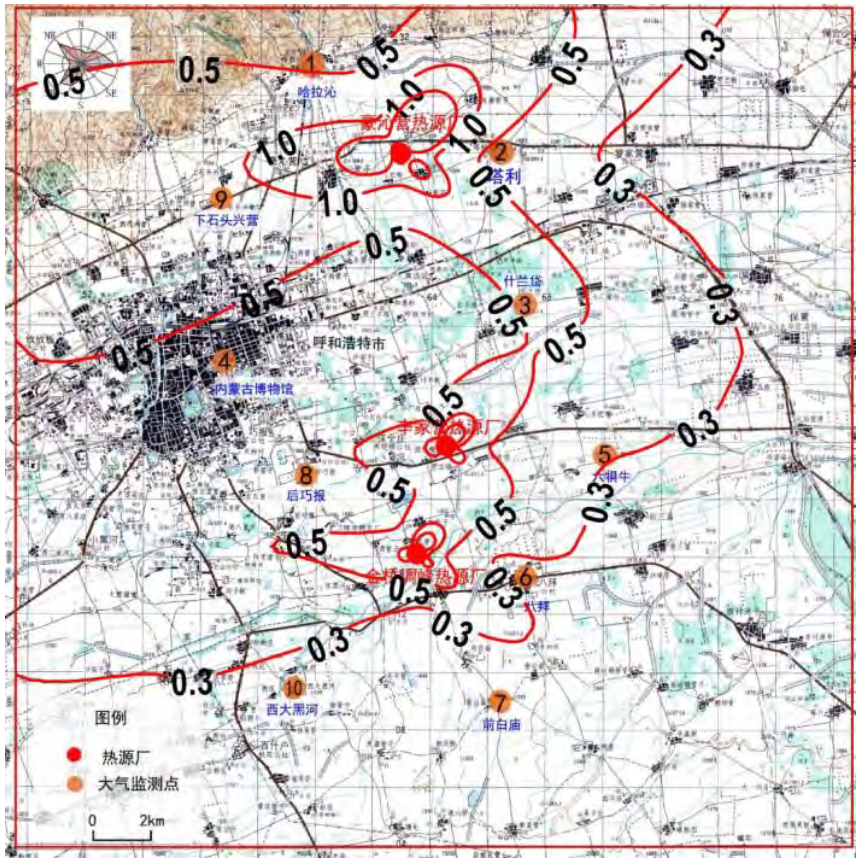
Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd

Figure 51: Case 2 SO_2 contour map at time of annual average concentration of SO_2 and NO_2 contribution from Project and Haoqingying Phase II. Unit: μg/Nm^3



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd..

Figure 52: Case 2 NO_2 contour map at time of annual average concentration of SO_2 and NO_2 contribution from Project and Haoqingying Phase II. Unit: μg/Nm^3



Source: Air Quality Modeling Assessment, Low Carbon Heating Project of Inner Mongolia, May 2014. Prepared by Zhong Ye Dong Fang Ltd

v. Conclusion

217. The results of Case 1 AERMOD dispersion modeling show that the Project's low NO_x natural gas-fired and electrode boilers will have minimal negative air quality impacts. Even the top ten worst case GLC Project contributions of SO_2 and NO_2, which occurred at 0.05% of the receptors and only one time each per year, are fully in compliance with PRC standards, and contributions over the rest of the modeling grid are a very small fraction of the applicable standards. Cumulative worst case modelling (worst case GLC Project contributions + worst case background concentrations) are also fully in compliance with PRC standards. Case 2 modeling with worst case contributions from the Project + the planned Phase II Haoqingying HSP were similarly fully in compliance with PRC standards, as was cumulative Case 2 modelling. In summary, the modeling results indicate that even the worst case cumulative GLCs, which occur only a few times per year at a few specific locations, are fully in compliance with PRC Standards.

2. Water Consumption

218. The Project will utilize an estimated 962,580 m³ of municipal water during the 183 day heating season for domestic and production water and fire protection systems (Xinjiaying and Jinqiao water consumption will be 1620 m³/d each, and Haoqingying water consumption will be 2020 m³/d).

219. Hohhot's municipal water supply capacity is 460,000 m³/d (260,000 m³/d from groundwater and 200,000 m³/d from the Yellow River), or 168.9 million m³/year. The total Project water consumption is 962,580 m³/year, which is equivalent to 0.57% of Hohhot's water supply capacity. This is not expected to result in any significant impact on Hohhot's water supply. Appendix V presents letters from the Hohhot Municipal Water Supply Company confirming the ability of the municipal water supply system to supply the required water.

3. Wastewater

220. The Project will generate both domestic and production wastewater. Production wastewater includes:

(i) Wastewater from the HSP water treatment plants: Make-up water for the boilers and associated equipment will be filtered, pre-treated, softened and the oxygen content will be reduced. Ion exchange will be utilized to remove Ca^{2+} and Mg^{2+}. Wastewater will be generated during backwashing and regeneration processes.

(ii) Boiler blowdown: The water that is intentionally wasted from a boiler in order to avoid concentration of impurities during continuing evaporation of steam.

221. Domestic wastewater will be produced from worker sanitation facilities. Domestic wastewater will be treated in digestion tanks, and then in combination with the production wastewater, will be discharged to the Hohhot municipal sewerage system for treatment at the Jinqiao wastewater treatment plant (WWTP), located west of Hangkai Road.[25] Each HSP will be equipped with an emergency wastewater overflow tank (1200 m^3 capacity for

[25] The WWTP provides treatment in compliance with *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB 18918-2002).* Treated effluent from the WWTP is used by Hohhot municipality as reclaimed water for landscape watering along the Xiaohei River, irrigation water for afforestation in the Jinqiao development zone, and road spraying.

Haoqingying and Jinqiao, and 1500 m^3 capacity for Xinjiaying). **Table 66** summarizes the annual wastewater discharges for the three HSPs. All emission concentration of SS, COD, BOD_5 and ammonia nitrogen will be in compliance with Class III standard requirements of *Integrated Wastewater Discharge Standard* (GB8978-1996), which sets the emission standards for wastewater discharged to a municipal sewerage system.

Table 66: Predicted wastewater concentrations and mass per year, pre and post treatment.

Heating zone	Wastewater Parameter	Pollutant concentration and quantity before treatment		Pollutant concentration and quantity after treatment		Discharge Standard (Class III, GB8978-1996)
		Concentration (mg/l)	Mass (t/a)	Concentration (mg/l)	Mass (t/a)	Concentration (mg/l)
Haoqingying	Quantity	-	91,315.2	-	91,315.2	
	SS	71.56	6.97	63.81	6.21	400
	COD	56.45	5.51	52.05	5.08	500
	BOD_5	23.02	2.19	22.10	2.10	300
	NH^3	2.88	0.26	2.88	0.26	-
Xinjiaying	Quantity	-	75,590.4	-	75,590.4	
	SS	80	6.05	74.2	5.61	400
	COD	68.67	5.19	64.04	4.84	500
	BOD_5	28.97	2.19	27.81	2.1	300
	NH^3	3.48	0.26	3.48	0.26	-
Jinqiao	Quantity	-	40,859.4	-	40,859.4	
	SS	98.94	4.04	88.22	3.6	400
	COD	110.05	4.5	101.47	4.15	500
	BOD_5	53.6	2.19	51.45	2.1	300
	NH^3	6.43	0.26	6.43	0.26	-

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

4. Solid Waste

222. The Project will generate an estimated 390 kg of domestic waste per day or 71.2 t/a, which if not properly managed can cause visual and environmental impacts.[26] To mitigate this risk, the following measures will be implemented:

(i) Waste bins will be provided at all facilities.

(ii) Wastes will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site.

(iii) No permanent on-site solid waste disposal will be permitted at HSPs or HESs.

(iv) No burning of wastes will be permitted at HSPs or HESs..

(v) All structures and/or components replaced during maintenance activities will be reused or recycled to the extent possible. Non-recyclable parts will be disposed at an approved waste disposal site.

223. Once the HSP is operational, 50 small coal-fired boilers in the Jinqiao heating zone will be decommissioned. The decommissioning is outside of the scope of the Project, and

[26] Based on 200 workers at Haoqingying and 180 at Xinjiaying and Jinqiao, and a waste production factor of 0.5 kg/worker/day.

will be undertaken by the Hohhot municipal government's Public Utilities Bureau. The decommissioning will be in compliance with the Hohhot municipal government policy *Notice to Substituting Gas-fired Heating Boiler for Coal-fired Heating Boiler* (Notice No. 142, issued by the Hohhot municipal government in 2013). The policy requires that all relevant municipal departments (construction, gas supply, heating supply, environment, finance), etc., to support the transition to gas fired heating. The decommissioning will be done under the supervision of the Hohhot EPB, which will be responsible for ensuring appropriate treatment and disposal of waste.

5. Chemicals and Hazardous Materials

224. Toxic, hazardous, and harmful materials present in the operation of HSPs include petroleum products, solvents, scale and corrosion inhibitors, and chemicals used for water analysis and purification. Chemicals used to assess water quality include:

- EDTA standard solution, $C_{(EDTA)}$ =0.02 mmol/L；
- Silver nitrate standard solution, $C_{(AgNO3)}$ =0.0282 mmol/L；
- Dilute sulphuric acid standard solution, $C_{(1/2H2SO4)}$ =0.10 mmol/L；
- Potassium chromate indicator (10%)
- Erio-chrome black T indicator (1%)
- Methyl orange indicator (1g/L)
- Ammonia - ammonium chloride buffer solution (pH=10)
- Sodium hydroxide solution (2 mol/L)
- Phenolphthalein indicator (5g/L)

225. Between 3 to 5 liters of the above chemicals will be required annually, and will be stored off-site at an independent laboratory.

226. Scale and corrosion inhibitor will be used in the boilers and the primary pipe network at a concentration of 15-20 g/t. Approximately 0.5 to 1 ton will be required annually for each HSP. Caustic soda will be used for pH adjustment of water in the boilers and primary pipe networks. Up to 200 kg will be required per heating zone per annum.

227. Chemicals can have impacts on human health and the environment if not appropriately managed. Special care will be taken to mitigate these risks, including:

(i) A register of all activities that involve the handling of potentially hazardous substances will be developed, including protocols for the storage, handling and spill response. This will include all fuels, oils, grease, lubricants, and other chemicals.

(ii) All chemicals, toxic, hazardous, and harmful materials will be transported in spill proof tanks with filling hoses and nozzles in working order,

(iii) All chemicals, toxic, hazardous, and harmful materials will be stored in secure areas with impermeable surfaces and protective dikes such that spillage or leakage will be contained from affecting soil, surface water or groundwater systems. Their usage will be strictly monitored and recorded. Some chemicals will be stored off-site, such as water quality analysis chemicals which will be stored at an independent laboratory.

(iv) Material safety data sheets (MSDSs) will be posted for all hazardous materials.

(v) Oil absorbents will be readily accessible in marked containers.

(vi) Good housekeeping procedures will be established to avoid the risk of spills.

(vii) Spills will be dealt with immediately, and personnel will be trained and tasked with this responsibility.

(viii) Workers will be properly trained before handling hazardous wastes and have the requisite PPE.

(ix) Hazardous waste will be temporarily stored in closed containers away from direct sunlight, wind, water and rain in secure designated areas with impermeable surfaces and protective dikes such that spillage or leakage will be contained.

(x) Hazardous wastes will be collected and disposed by licensed contractors on an as needed basis.

6. Noise

228. Noise sources during operation will mainly be from HSP and HES operation, and will include blowers, transformers, pumps, and cooling equipment. The noise level of the equipment ranges from 85 to 100 dB(A).

229. To mitigate noise impacts the Project design will use low-noise equipment as far as possible, and will also utilize noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls. These measures can typically reduce noise intensity by approximately 20 dB(A) (**Table 67**). All plant and equipment, including vehicles will be properly maintained in order to minimize noise. Also, appropriate personal noise protective equipment (PPE) will be provided to the workers who are likely to be exposed to high noise level environments.

Table 67: Main Project noise sources and mitigation measures.

No	Noise Source	Estimated Noise Emission dB(A)	Number per Heating zone	Mitigation Measures	Estimated Mitigated Noise Emission dB(A)
1	**Process equipment**				
1	Blower	100	5 – 7	Blower room, sound absorber, noise deadener	80
2	Circulating water pump	95	4 -5	Pump station, sound absorber, vibration attenuation	80
3	Water supplement pump	90	3	Pump station, sound absorber, vibration attenuation	75
2	**Heat-supply pipe network**				
1	Circulating water pump of heat-supply pipe network	90	88 - 174	Pump station, sound absorber, vibration attenuation	75
2	Water supplement pump	85	44 - 87	Pump station, sound absorber, vibration attenuation	70

Sources: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

230. Estimated site boundary noise levels are presented in **Table 68** to **Table 70**. The results indicate that with appropriate mitigations, total noise levels at the boundaries will

meet the relevant Class II standard in *Noise Standards for Industrial Enterprises at Site Boundary* (GB12348-2008) during the daytime (60 dB(A) and the nighttime (50 dB(A). In addition, estimated noise levels at adjacent sensitive points will meet the relevant Class II standard in *Environmental Quality Standards for Noise* (GB3096-2008) during the daytime (60 dB(A) and the nighttime (50 dB(A). Noise levels at HESs will also meet the Class II standard in *Noise Standards for Industrial Enterprises at Site Boundary* (GB12348-2008) during the daytime (60 dB(A) and the nighttime (50 dB(A).

231. With appropriate mitigations, Project operation is not expected to have any significant noise impacts on surrounding areas.

Table 68: Predicted noise levels at site boundary and sensitive locations, Haoqingying Heating zone.

Location	Site	Daytime Leq(dBA)			Nighttime Leq(dBA)		
		Ambient Noise Level	Estimated Noise Emission of the Heating zone	Total Superimposed Noise Emission	Ambient Noise Level	Estimated Noise Emission of the Heating zone	Total Superimposed Noise Emission
Site boundary	1	50.1	45.31	51.34	48.3	45.31	50.07
	2	51.2	43.16	51.83	47.7	43.16	49.01
	3	52.3	30.91	52.33	48.5	30.91	48.57
	4	52.7	29.87	52.72	49.2	29.87	49.25
	5	50.6	24.12	50.61	48.9	24.12	48.91
	6	51.3	21.94	51.31	49.8	21.94	49.81
	7	50.9	24.24	50.91	49.0	24.24	49.01
	8	51.8	29.60	51.83	48.5	29.60	48.56
	9	51.2	40.23	51.53	48.0	40.23	48.67
Sensitive Areas[a]	1 1st floor	49.8	21.61	49.81	49.1	21.61	49.11
	1 3rd floor	50.5	29.92	50.54	49.8	29.92	49.84
	1 6th floor	50.2	29.91	50.24	49.6	29.91	49.65
	2 1st floor	52.4	21.01	52.40	49.8	21.01	49.81
	2 2nd floor	51.8	25.26	51.81	49.7	25.26	49.72
	2 6th floor	50.9	25.25	50.91	49.5	25.25	49.52

[a.] Table 48 indicates the location of sensitive areas for noise monitoring.

Sources: EIA Table Reports Low Carbon Heating Project of Inner Mongolia, Haoqingying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 69: Predicted noise levels at site boundary and sensitive locations, Xinjiaying Heating zone.

Location	Site	Daytime Leq(dBA)			Nighttime Leq(dBA)		
		Ambient Noise Level	Estimated Noise Emission of the Heating zone	Total Superimposed Noise Emission	Ambient Noise Level	Estimated Noise Emission of the Heating zone	Total Superimposed Noise Emission
Site Boundary	1	54.1	30.13	54.12	48.7	30.13	48.76
	2	54.9	25.72	54.91	48.1	25.72	48.13
	3	53.2	23.02	53.20	47.3	23.02	47.32
	4	51.2	28.79	51.22	47.1	28.79	47.16
	5	52.1	36.27	52.21	47.0	36.27	47.35
	6	51.2	40.43	51.55	47.4	40.43	48.20
Sensitive Areas[a]	1 1st floor	53.7	22.64	53.70	49.2	22.64	49.21

[a.] Table 48 indicates the location of sensitive areas for noise monitoring.
Source: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Xinjiaying Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

Table 70: Predicted noise levels at site boundary and sensitive locations, Jinqiao Heating zone.

Location	Site	Daytime Leq(dBA)			Nighttime Leq(dBA)		
		Ambient Noise Level	Estimated Noise Emission of the Heating zone	Total Superimposed Noise Emission	Ambient Noise Level	Estimated Noise Emission of the Heating zone	Total Superimposed Noise Emission
Site boundary	1	45.6	30.25	-	44.4	30.25	-
	2	47.9	32.71	-	45.8	32.71	-
	3	48.4	29.91	-	44.3	29.91	-
	4	47.0	30.20	-	44.8	30.20	-
Sensitive points[a]	1 1st floor	49.2	22.91	49.21	45.8	22.91	45.82
	3 1st floor	46.9	20.02	46.91	45.1	20.02	45.11
	4 1st floor	51.0	35.80	51.13	44.7	35.80	45.23
	2 1st floor	47.4	28.83	47.46	46.0	28.83	46.08
	2 3rd floor	46.3	35.86	46.68	45.2	35.86	45.68
	2 6th floor	51.3	35.80	51.42	47.3	35.80	47.60

[a.] Table 48 indicates the location of sensitive areas for noise monitoring.
Source: EIA Table Reports: Low Carbon Heating Project of Inner Mongolia, Jinqiao Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

7. Occupational Health and Safety

232. Plant operation poses risks to workers. Accidental release of chemicals, and hazardous materials may present health and safety risks to workers. Natural gas also presents fire, burn and explosive hazards.

233. To minimize risks associated with leaks of natural gas:

(i) All natural gas works will be in compliance with relevant PRC building code requirements, including the *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92).

(ii) Independent gas regulation stations will be constructed at least 14 meters away from other buildings and 30 m from the site boundary, to minimize the risk of explosion damaging other Project facilities or the public.[27] The China Gas Company of Hohhot will construct and operate the gas regulation stations.

(iii) The gas regulation stations will be specially designed to withstand and contain explosions.

(iv) Gas regulation stations and the connection to the boilers will be equipped with flammable gas detection, alarm and fire suppression systems. In case of a gas leak, automatic shutdown valves will shut down the gas supply, the system will generate audible and visual alarms, and the emergency ventilation system will exhaust gas from the stations so as to protect the building and operators. Normal air change for the stations will be six times per hour, but in emergencies the ventilation system will change the air 12 times per hour. Electrical devices within the explosion risk area will be safety equipped.

(v) The gas pipelines feeding into the pressure regulation stations will be embedded underground, and will be coated with three layers of PE corrosion protection sleeves. The gas lines exiting the gas pressure regulation stations will be suspended overhead, and will be treated 4 times with anti-corrosion paint. Pipelines will be grounded and equipped with anti-lightning devices where applicable.

(vi) All other at risk areas will have flammable gas detection and alarm systems able generate audible and visual alarms, and automatic fire suppression systems.

(vii) All gas related devices will be brightly colored and equipped with warning signs.

234. To mitigate potential health and safety risks to workers, the following measures will be taken:

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[27] In the *Code for Design of City Gas* Engineering (GB 50028-2006) the recommended distance from a gas regulation station with no more than 1.6 MPa inlet pressure to other buildings is 9 m. In the Project, the minimum distance from gas regulation stations to the nearest building is 21 m in the Xinjiaying HSP, 15 m in the Jinqiao HSP, and 14 m in the Haoqingying HSP respectively, which fully conforms to the national code requirement.

Gas regulation stations are defined as Class II explosion risks. Space within 4.5 meter away from a regulation station is included in the explosion risk region, as regulated in *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92). The minimum distance from a gas regulation station to a site boundary fence is 30 meter in three HSPs, which confines the explosion risk within the plant sites; explosions will not impact areas outside the site boundaries.

(i) Pperation phase EHS plans for each heating zone including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation.

(ii) The HSP general arrangements will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risk, and fire-resistant buildings/structures will include fire-proof doors and windows.

(iii) Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly.

(iv) The process control system will include an out-of-limit alarm to ensure all hazardous materials are safety under control at all time.

(v) PPE, including goggles, gloves, safety shoes, will be provided to workers.

(vi) Naked fire sources, hot surfaces, electric sparks, electrostatic sparks and ignition sources will be strictly controlled, especially near natural gas.

(vii) Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems.

(viii) No unauthorized personnel should be allowed into HSPs or HESs.

(ix) Authorized personnel must have appropriate PPE at all times.

8. Emergency Response Plan

235. An emergency risk and response plan for each heating zone will be established in accordance with the "*National Environmental Emergency Plan*" (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the World Bank EHS guidelines with respect to occupational and community health and safety. Major elements of the emergency response plan are presented in **Table A-3** of **Appendix I**.

D. Anticipated Positive Operation Phase Impacts

236. The 1,560 MW of clean-burning natural gas-fired heating capacity and 50 MW of wind powered electrode heating capacity generated by the proposed Project will replace heat that otherwise would typically have been generated by coal-fired power plants. Once operational the Project will: (i) result in the closure of 50 small urban low-efficiency and polluting coal-fired boilers; (ii) eliminate the use and transport through urban areas of 1.270 million tons of raw coal; (iii) result in energy savings equivalent to 848,500 ton of standard coal, thereby providing a global public good by avoiding the annual emission of 1,299,400 tons CO_2; (iv) improve local air quality through the estimated annual reduction of emissions of SO_2 by 11,800 tons, NO_x by 9,000 tons, PM by 26,000 tons, and fly and bottom ash by 191,000 tons (see Appendix VI for additional information).

237. The construction of the demonstration wind powered electrode boilers will play a role in utilizing renewable natural resources, saving non-renewable fossil energy, reducing pollution and protecting the environment, and supporting the sustainable development of energy, economy and society.

VI. ALTERNATIVE ANALYSIS

238. An analysis of Project alternatives was undertaken during the feasibility stage to determine the most financially and technically feasible way of achieving the Project objectives while minimizing environmental and social impacts.

A. No Project Alternative

239. The district heating area in Hohhot increased from 14.74 million m^2 in 2004 to 86.81 million m^2 in 2012, an annual growth rate of 24.81%. According to the Hohhot Urban Heating Plan, by 2015 the total urban heating area will increase to 151.3 million m^2, and by 2020 it will reach 243.1 million m^2. With rapid urban expansion heat demand increases dramatically, leading to an urgent need to construct new heating infrastructure.

240. If the Project is not implemented, heat from traditional coal-fired HSPs will be required to meet the increasing demand for district heating in Hohhot, and existing polluting small coal-fired boilers may continue to be used. The Project's implementation will improve air quality and significantly reduce coal consumption and GHG emissions. It will also provide valuable hands on experience and mitigate some of the technology risks associated with demonstration projects. Successful wind-powered electrode boiler demonstration will help lead to market acceptance and expand deployment in the PRC. For these reasons the "no project" alternative is considered unacceptable.

B. Heat Source

241. There are several heat sources options for district heating, including combined heat and power (CHP) plants, large coal, natural gas or biomass-fired heat source plants (HSPs), solar energy, industrial or residential waste heat, geothermal energy, and heat pumps.

242. CHPs and HSPs are considered the most proven, economically viable, energy efficient and environmentally friendly heat source options for northern China. In Jinqiao there is an existing CHP which will cover the heating base load, and the Project will install a natural gas-fired HSP to cover the peak load. In Haoqingying and Xinjiaying there are no CHPs planned under the Hohhot Urban Heating Plan, and the Project will install HSPs including 50 MW of demonstration wind powered electrode boilers in Haoqingying.

C. HSP Fuel

243. It was initially conceived that the three HSPs would be coal-fired. However, due to concerns raised by the PRC Government and the ADB respect to SO_2, NOx and PM emissions, the Project was subsequently redesigned to utilize natural gas-fired boilers and 50 MW of demonstration wind powered electrode boilers.

244. Natural gas is the recommended fuel source in the IFC *EHS Guidelines*. Natural gas generally produce negligible quantities of particulate matter and sulfur oxides, and levels of nitrogen oxides are about 60% of those from plants using coal (without emission reduction measures). Natural gas-fired plants also release lower quantities of carbon dioxide, a greenhouse gas.

245. The use of natural gas and electrode boilers in the Project will contribute to energy efficiency improvement and emissions reduction in Hohhot. In addition, gas-fired boilers do not require large coal storage sheds or ash storage silos, and do not need water and

electricity for coal, fly and bottom ash and slag treatment. Thus, the use of natural gas-fired instead of coal-fired HSPs will require less land and will consume less water and electricity. Furthermore, the transmission of natural gas by pipeline will eliminate the negative impacts of coal transportation through urban areas by truck or train.

246. Biomass-fired CHPs were not considered practical due to the limited available biomass fuel resources in the Hohhot region.

D. Low NOx Gas Boilers

247. The domestic EIAs indicates that boiler NOx emission will be 137.31 mg/m^3, based on a 2007 survey of industrial natural gas boilers in PRC. It's important to note that this emission level is in compliance with both the PRC natural gas boiler emission standard of 400 mg/m^3 and 200 mg/m^3 in sensitive areas (*PRC Emission Standards of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boilers* (GB 13217-2001)), and the 2007 IFC *EHS Guidelines* of 240 mg/m^3 for boilers. However, to in order to maximize environmental benefits, the Project has committed to using low NOx natural gas boilers producing less than 100 mg/m^3 NOx emissions.

E. Piloting Electrode Boilers

248. The Project will pilot the use of wind powered electric boilers. Electric boilers have several key advantages over fossil fuel fired boilers: they have extremely quick response times; they are flexible for cyclical or intermittent operations; they are clean firing, produce no combustion emissions and do not require stacks; they are greater than 99% efficient; and they are smaller in volume and footprint than fossil fired boilers.

249. There are two main types of electric boilers:

Electrode Boilers
- Works by passing current through the water between two electrodes. The resistance of the water produces heat.
- Supply voltage: 6 – 14 kV.
- Power output: 6 to 100 MW.

Electric Resistance Boilers
- Works by passing current through an electrically resistive element to transfer heat to the water.
- Supply voltage: 380 – 690 V.
- Power output: up to 6 MW.

250. Electrode boilers have been selected for the Project due to their higher output which requires fewer units, and their higher supply voltage (electrode boilers use high voltage connection which eliminates the need for step-down transformers; resistive boilers utilize low voltage so more transformers are required). Based on the heating needs of the Haoqingying zone, the required HSP footprint, and the investment cost associated with different types of electric boilers, it was determined that the Project will pilot the use of two 25 MW wind powered high-efficiency zero-emission demonstration 10 kV electric powered boilers instead low voltage small scale electric boilers. If small scale electric boilers are used, it will occupy much larger space, which will lead to 2.7 times higher investment cost for HSP building construction comparing to the electrode boiler option.

F. Heat System Connection

251. District heating systems utilize direct or indirect connections between the heat

source and the customers.

252. A direct connection supplies hot water directly from the boiler to the consumer's radiators. The advantages of a direct connection system are that it is simple and requires less capital investment than an indirect connection. The system has only one closed loop that connects the heat source and transmission pipelines to the consumer's system. However, should a problem arise in any portion of the system, such as a pipeline leak or rupture, the entire system will be affected. Direct connection is only suitable for smaller heating systems with a hot water temperature less than 100°C.

253. An indirect connection system uses heat exchange stations (HESs) between the heat source and the customers. The system has two closed loops, a primary loop and a secondary loop. Both loops work independently of each other without direct interference allowing a higher temperature and pressure heat source. This higher supply temperature and greater temperature difference between the supply and the return can be handled in a smaller transmission pipe, lowering the capital costs for the heat transmission system. The disadvantage of the indirect system is that there are additional costs for the HESs, including capital, operational, maintenance and land acquisition.

254. Based on the advantages and disadvantages of the two systems, indirect connection systems were selected for the heating zones. The proposed indirect connection systems will includes the heat sources, primary heating networks and HESs. The primary heating network working pressure will be 1.6 MPa, the supply water temperature will be 120°C and the return water temperature will be 60°C. The heating zones will not include the secondary networks between the HESs and end-users.

G. Pipeline

255. The Project will utilize direct-buried pre-insulated bonded pipeline, which is by far the most commonly used technology for both new district heating and cooling systems and for rehabilitation of existing systems. Steel pipes and insulation materials made of polyurethane foam (PUR) and high density polyethylene (HDPE) are bonded into one piece in a sandwich-like structure. Compared to onsite insulated pipe buried in a tunnel, direct-buried pre-insulation bonded pipe has many advantages including lower capital costs, reduced heat losses and improved energy efficiency, better anti-corrosive and insulation performance, longer service life, limited land acquisition requirement and shorter installation cycles. Although pre-insulated bonded pipe is designed for direct-bury installation, some sections of pipeline may need to run overhead and/or use trench laying modes, depending on local site conditions.

H. Piloting Building Level HESs

256. The Project will utilize a combination of traditional large sized HESs and smaller building-level HESs. In the PRC, most HESs used in district heating system are large sized and serve multiple buildings. Compared to building-level HESs, they require more secondary network and more complicated control apparatus to meet the demand of different buildings. As most of the secondary network is constructed by real estate enterprises or building owners, there will be cost reduction for a heating company. Yet, poor construction quality by housing developers may lead to energy and water loss in secondary pipe networks and may require additional maintenance cost for the heating company that are usually in charge of pipeline maintenance and operation.

257. In recent years some projects have piloted using building-level HESs in the PRC. In a building-level HES, all equipment and auxiliary parts are be installed in one small

prefabricated package.[28] They are installed very close to user, typically in the basement of the building to be served. Usually it does not require large size expensive pipes, neither the secondary pipe networks. More importantly, control methods tailored to each building can be developed. Using building-level HES will result in less transmission loss, improved hydraulic balance and improved efficiently in utilizing heat energy. It will also conserve energy, land and space, and reduce fuel costs compared to traditional sized HESs.

258. The Project will construct a total of 180 HESs. After carefully considering local conditions and the practicality of locate building-level HESs in building basements, it was decided to install 11 building-level HESs as a pilot in IMAR. Once the pilot HESs are proven successfully in the ADB project, more building-level HESs could be used in the future.

I. Overall Alternative Analysis

259. Base on the overall analysis of alternatives, the Project has selected the most appropriate heat source, fuel type, low NOx burner, electric boiler, heat system connection, pipeline type and installation method, and HES type.

[28] Building level HESs will be approximately 2 m long, 1.5 m wide and 2 m high. The final dimensions will be dependent on the manufacturer.

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. PRC and ADB Requirements for Public Consultation

1. PRC Requirements

260. Relevant provisions in the PRC *Environmental Impact Assessment Law* (2003) and the *Regulations on the Administration of Construction Project Environmental Protection* (No. 253 Order of the State Council, 1998) require that an EIA study for a construction project shall solicit opinions from affected residents, as well as other organizations and concerned stakeholders. However, the requirements for public consultation are different for various sectors and projects. For an environmental Category A project (such as a coal-fired power plant), full EIA reports are required including two rounds of public consultations, while for a Category B project (such as the district heating projects), only a simplified tabular EIA is required without a requirement for any public consultation.

2. ADB Requirements

261. ADB's SPS has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

262. In order to make key documents widely available to the general public, the SPS requires submission of a finalized EIA for Category A projects, and a final IEE for Category B projects, to ADB for posting on the ADB website. The SPS requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to affected peoples and stakeholders.

263. The SPS also requires that the borrower carry out consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.

B. Public Consultation and Information Disclosure

264. The HCHC and the HCDIO undertook public consultation and information disclosure in accordance with the *Interim Guidelines on Public Consultation for EIA* (2006). The two phase process began when the Project design still incorporated coal-fired HSPs, and continued when the design was revised to natural gas-fired HSPs.

1. Phase 1: Public Consultation and Information Disclosure, Coal-Fired HSPs

a) Information Disclosure

265. The HCHC and the HCDIO disclosed Project information in three steps:

i) The first public project information notice was posted on the HCDIO website in August 2011, early in the EIA preparation process. The information in the first public notification is listed below:

a) Project name and summary of the three heating zones.

b) Name and contact information of the proponent.

c) Name and contact information of the institute responsible for preparing the domestic EIAs of the three heating zones.

d) Domestic EIA procedures and content.

e) Type of domestic EIA notification notice.

f) Request for questions, suggestions and feedback from the public.

ii) A second public information notice was posted on the HCDIO website from September 28, 2011 to October 14, 2011, prior to the submission of the EIAs to the Hohhot EPB. . The notice included Project name and summary of the three heating zones

a) Name and contact information of the proponent.

b) Name and contact information of the institute responsible for preparing the domestic EIAs of the three heating zones.

c) Potential project environmental impacts and mitigation measures.

d) Key conclusions of the domestic EIA reports

e) Contact information to get abridged versions of the domestic EIA reports.

iii) A public project information notice was posted on page 5 of the Inner Mongolia Morning Post on February 18, 2012.

266. No public feedback was received in response to any of the project information notices.

b) Beneficiary Survey

267. In early October 2011 the EIA Institute conducted surveys in each of the three heating zone areas. The questionnaires targeted beneficiaries and potentially affected persons in the immediate vicinity of the heating zone sites. In each location a total of 50 questionnaires were distributed. In Haoqingying 47 completed questionnaires were collected, but 1 was invalid; in Xinjiaying 49 completed questionnaires were collected; and in Jinqiao 43 completed questionnaires were collected, but one was invalid. The questionnaire is presented in **Table 71**. **Figure 53** presents a sample completed questionnaire.

268. **Table 72** presents summary information on the questionnaire respondents. The survey covered a wide age range. 60% of respondents were male and the remainder female. 80% were Han and 17% were Mongolian. Over 55% of respondents had an education level of college and above, while 20% of participants had only completed high school. The occupations of the respondents were quite diverse, representing the opinions of a wide range of Project stakeholders.

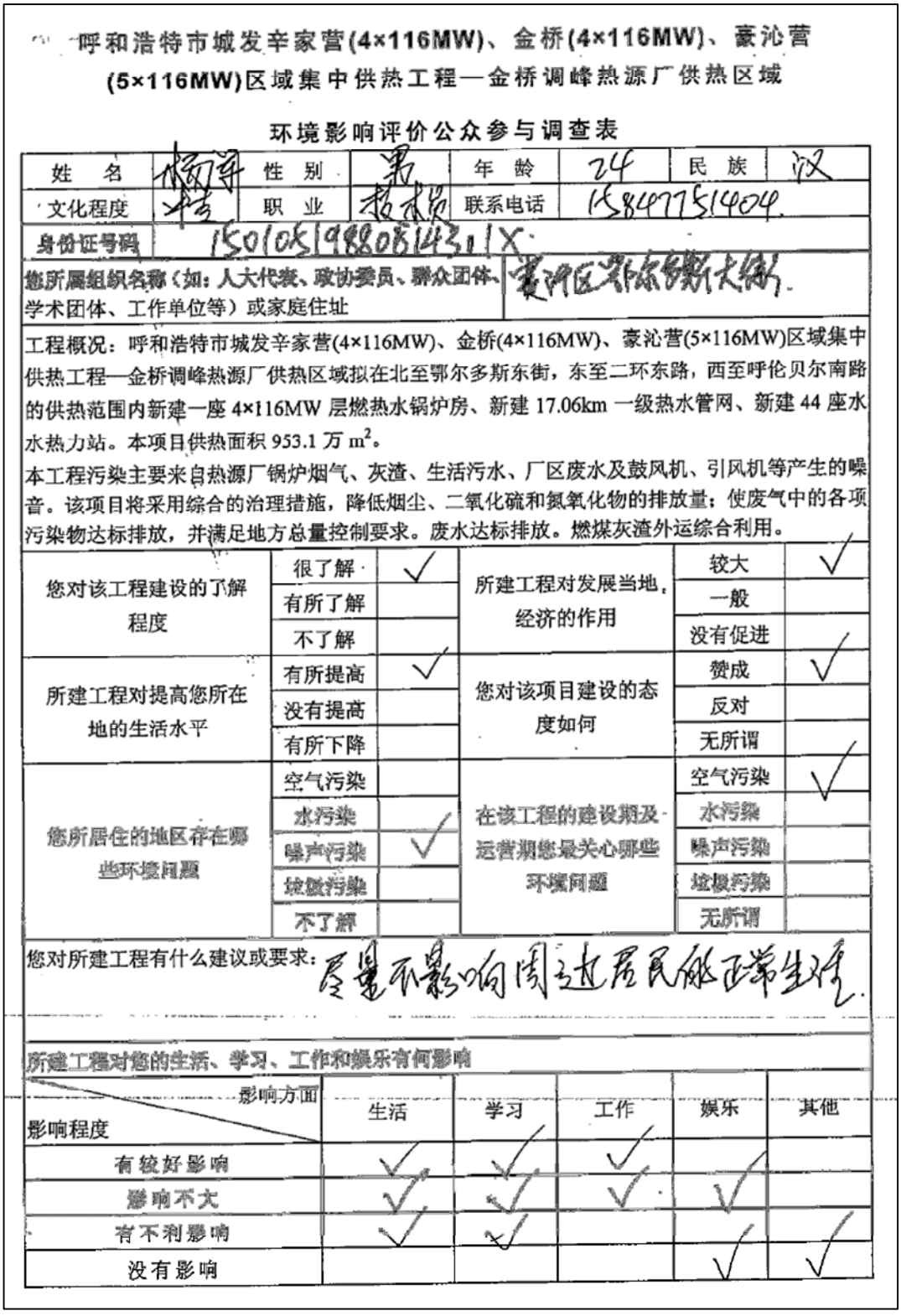
Table 71: Project public consultation questionnaire, coal-fired boilers (2011).

Name	**Sex**	**Age**	**Nationality**	**Education level**	**Occupation**	**ID number**
Address						
Project information (a project summary was provided here)						
Understanding of the Project	Good understanding			**Project's anticipated effect on the local economy**	Large effect	
	Moderate understanding				Moderate effect	
	Low understanding				No effect	
Project's anticipated effect on the local living standards	Positive effect			**Attitude to the project**	Agree	
	No effect				Disagree	
	Negative effect				No opinion	
Environmental issues in your home area	Air pollution			**Environmental issues of highest concern during construction and operation periods**	Air pollution	
	Water pollution				Water pollution	
	Noise				Noise	
	Solid waste pollution				Solid waste pollution	
	Don't know				No opinion	
Suggestions or requirements for the project:						

Project's effect on lifestyle, education and learning, work and entertainment					
Effect	**Lifestyle**	**Education and Learning**	**Work**	**Entertain-ment**	**Other**
Positive effect					
Limited effect					
Negative effect					
No effect					

Sources: EIA Reports: District Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, October 2011. Prepared by Zhong Ye Dong Fang Ltd. Translated from original Chinese.

Figure 53: Sample completed questionnaire, coal-fired boilers (2011).



呼和浩特市城发辛家营(4×116MW)、金桥(4×116MW)、豪沁营(5×116MW)区域集中供热工程—金桥调峰热源厂供热区域

环境影响评价公众参与调查表

姓名	杨*	性别	男	年龄	24	民族	汉
文化程度	中专	职业	技术员	联系电话	15847751404		
身份证号码	150105198806142*1X						
您所属组织名称（如：人大代表、政协委员、群众团体、学术团体、工作单位等）或家庭住址	赛汗区鄂尔多斯大街						

工程概况：呼和浩特市城发辛家营(4×116MW)、金桥(4×116MW)、豪沁营(5×116MW)区域集中供热工程—金桥调峰热源厂供热区域拟在北至鄂尔多斯东街，东至二环东路，西至呼伦贝尔南路的供热范围内新建一座 4×116MW 层燃热水锅炉房、新建 17.06km 一级热水管网、新建 44 座水水热力站。本项目供热面积 953.1 万 m^2。

本工程污染主要来自热源厂锅炉烟气、灰渣、生活污水、厂区废水及鼓风机、引风机等产生的噪音。该项目将采用综合的治理措施，降低烟尘、二氧化硫和氮氧化物的排放量；使废气中的各项污染物达标排放，并满足地方总量控制要求。废水达标排放。燃煤灰渣外运综合利用。

您对该工程建设的了解程度	很了解	✓	所建工程对发展当地经济的作用	较大	✓
	有所了解			一般	
	不了解			没有促进	
所建工程对提高您所在地的生活水平	有所提高	✓	您对该项目建设的态度如何	赞成	✓
	没有提高			反对	
	有所下降			无所谓	
您所居住的地区存在哪些环境问题	空气污染		在该工程的建设期及运营期您最关心哪些环境问题	空气污染	✓
	水污染			水污染	
	噪声污染	✓		噪声污染	
	垃圾污染			垃圾污染	
	不了解			无所谓	

您对所建工程有什么建议或要求：尽量不影响周边居民的正常生活。

所建工程对您的生活、学习、工作和娱乐有何影响

影响方面 / 影响程度	生活	学习	工作	娱乐	其他
有较好影响	✓	✓	✓	✓	
影响不大	✓	✓	✓	✓	
有不利影响	✓	✓			✓
没有影响				✓	✓

Sources: EIA Reports: District Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, October 2011. Prepared by Zhong Ye Dong Fang Ltd.

Table 72: Summary data on questionnaire respondents, coal-fired boilers (2011).

Parameter	Indicator	Jinqiao		Xinjiaying		Haoqingying	
		No.	%	No.	%	No.	%
Sex	Male	29	69.0	28	57.1	25	54.3
	Female	13	31.0	21	42.9	21	45.7
Age	Below 30	9	21.4	25	51.0	10	21.7
	31-40	19	45.2	16	32.7	14	30.4
	41-50	11	26.2	6	12.2	17	37.0
	Above 50	3	7.1	2	4.1	4	8.7
	No Response					1	2.2
Nationality	Han people	35	83.3	35	71.4	39	84.8
	Mongolian	5	11.9	14	28.6	5	10.9
	Other	2	4.8	0	0	2	4.3
Education level	Primary School or Below	0	0	0	0	0	0
	Junior school	11	26.2	17	34.7	0	00
	High school, including technical secondary school	9	21.4	18	36.7	5	10.8
	Bachelor degree or above, including junior college	22	52.4	14	28.6	41	89.1
Occupation	Farmer	9	21.4	13	26.5	0	0
	Worker	6	14.3	15	30.6	15	32.6
	Self-employed entrepreneurs	-	-	7	14.3	-	-
	Civil servant	0	0	0	0	0	0
	Other	27	64.3	14	28.6	31	67.4

Sources: EIA Reports: District Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, October 2011. Prepared by Zhong Ye Dong Fang Ltd.

269. **Table 73** and **Table 74** present the survey results. Over 90% of the respondents indicated that they had either good or moderate knowledge of the proposed Project, indicating that the Project information had been well disseminated. When the participants were asked to identify the main environmental impacts during construction and operation, air pollution and noise were most commonly identified, both which are effectively addressed in the mitigation measures. Over 85% of respondents believe the Project will have a positive effect on the local standard of living, 80% believe it will have a positive effect on the local economy, and 60% believe the project will have a positive effect on their work. Overall, 97% of respondents are supportive of the Project (3% didn't respond to that question).

Table 73: Survey results (respondents understanding of Project impacts, respondent's attitude towards project, key local environmental issues).

Question	Option	Jinqiao		Xinjiaying		Haoqingying	
		No.	%	No.	%	No.	%
Understanding of the Project	Good understanding	22	52.4	3	6.1	3	6.5
	Moderate understanding	18	42.9	45	89.8	35	76.1
	Low understanding	2	4.8	2	4.1	8	17.4
Project's anticipated effect on local living standards	Positive effect	40	95.2	47	93.9	33	71.7
	No effect	2	4.8	3	6.1	12	26.1
	Negative effect	0	0	0	0	1	2.2
Environmental issues in your home area (can select more than one)	Air pollution	8	19.0	44	60.6	14	30.4
	Water pollution	3	7.1	1	1.4	8	17.4
	Noise	23	54.8	25	35.2	14	30.4
	Solid waste pollution	6	14.3	1	1.4	3	6.5
	Don't know	8	19.0	1	1.4	13	28.3
Project's anticipated effect on local economy	Large effect	38	90.5	47	93.9	26	56.5
	Moderate effect	3	7.1	3	6.1	19	41.3
	No effect	1	2.4	0	0	1	2.2
Attitude to the project	Agree	42	100	46	91.8	46	100
	Disagree	0	0	0	0	0	0
	No opinion	0	0	4	8.2	0	0
Environmental issues of high concern during construction and operation periods (can select more than one)	Air pollution	13	31.0	41	42.3	13	28.3
	Water pollution	2	4.8	3	3.1	15	32.6
	Noise	5	11.9	47	47.4	18	39.1
	Solid waste pollution	7	16.7	5	5.2	4	8.7
	No opinion	7	16.7	1	1.0	3	6.5
	No response	12	28.6	0	0	0	0

Sources: EIA Reports: District Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, October 2011. Prepared by Zhong Ye Dong Fang Ltd.

Table 74: Survey results (respondents views on Project impact on lifestyle, education and learning, work and entertainment).

Heating zone /	Lifestyle		Education/Learning		Work		Entertainment		Other	
Effect	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Haoqingying										
Positive effect	25	54.3	9	19.6	26	56.5	8	17.4	8	17.4
Limited effect	17	37.0	25	54.3	17	37.0	20	43.5	17	37.0
Negative effect	0	0	0	0	1	2.2	0		0	
No effect	4	8.7	12	26.1	2	4.3	18	39.1	2	4.3
No Response	0	0	0	0	0	0	0		19	41.3
Xinjiaying										
Positive effect	42	85.7	45	91.8	46	93.9	3	6.1	0	0
Limited effect	3	6.1	2	4.1	3	6.1	2	4.1	3	6.1
Negative effect	1	2.1	0	0	0	0	2	4.1	0	0
No effect	1	2.1	2	4.1	0	0	42	85.7	46	93.9
No Response	2	4.1	0	0	0	0	0	0	0	0
Jinqiao										
Positive effect	15	35.7	9	21.4	13	31.0	9	21.4	8	19.0
Limited effect	19	45.2	22	52.4	19	45.2	20	47.6	2	4.8
Negative effect	0	0	0	0	0	0	0	0	0	0
No effect	7	16.7	10	23.8	9	21.4	12	28.6	26	61.9
No Response	1	2.4	1	2.4	1	2.4	1	2.4	6	14.3

Sources: EIA Reports: District Heating Project of Inner Mongolia, Haoqingying, Xinjiaying and Jinqiao Heating Resource Plants of Hohhot City Development Company, October 2011. Prepared by Zhong Ye Dong Fang Ltd.

2. Phase 2: Public Consultation and Information Disclosure, Natural Gas-Fired HSPs

a) Beneficiary Social Analysis Surveys

270. As part of the social safeguards due diligence undertaken for the Project (natural gas-fired design), a social analysis was undertaken to (i) assess social patterns influenced by the Project including the identification of any adverse effects; (ii) assess the current status of poverty within the heating zone areas and analyzed the poverty reduction impact resulting from the Project; and (iii) analyze and proposes activities which would complement the Project by enhancing the livelihood of the vulnerable people within the heating zone areas, including the preparation of a reemployment plan for the workers of small boilers which are to be closed as a result of the Jinqiao heating zone.

271. The methodology for the social analysis included socioeconomic surveys (carried out from October – November 2013) and local consultations. The consultants visited all heating zones and held meetings with the IA and various district government agencies including the development and reform committees, land administration bureaus, civil affairs bureaus, ethnic minority affairs bureaus, urban construction bureaus and women's federations, etc.

272. The social analysis indicates that the by 2020 the Project will benefit an estimated 294,500 user HHs with a population of 883,500. The social analysis results are partially presented in Chapter VII, and are presented in full in the social analysis report.[29]

b) EIA Disclosure

273. The EIAs prepared for the revised design incorporating natural gas-fired boilers is, at the time of writing, being disclosed on the HCDIO website. The links are provided below:

http://www.hhhtscf.com/info.asp?id=438
http://www.hhhtscf.com/info.asp?id=439
http://www.hhhtscf.com/info.asp?id=440

c) Project Information Disclosure and Public Consultation Meeting

274. A public consultation meeting for the natural gas-fired project design was held April 10th, 2014. A public project information notice was posted in the Hohhot Daily newspaper for two weeks prior to the meeting. The notice provided updated basic project information, and invited residents in the project areas to attend the meeting (**Figure 54**). The meeting was held at the Xinjiaying heat supply branch office, which is centrally located amongst the three heating zones. The meeting was attended by 52 participants.

275. During the meeting information was presented about the project status, potential environmental impacts and proposed mitigation measures (**Figure 55**). Participants were asked to complete a brief questionnaire (**Table 75**). A total of 42 completed questionnaires were received (**Figure 56**). **Table 76** presents summary data on the questionnaire respondents.

[29] Inner Mongolia Autonomous Region District Heating Supply Project, Social Analysis Report. December, 2013.

Figure 54: Public notice in Hohhot Daily newspaper, natural gas-fired boilers, March/April 2014.

呼市城发公司召开内蒙古呼和浩特市低碳供热项目公众磋商会的公告

为解决呼和浩特市东部区域日益突出的供热需求，满足城市实施可持续发展的需要，加强节能减排，保护大气环境，呼和浩特市城发投资经营有限责任公司正在申请亚洲开发银行贷款，建设内蒙古呼和浩特市低碳供热项目——辛家营、金桥、毫沁营区域集中供热工程，建设内容包括19台燃气热水锅炉，总容量1560MW，2台电锅炉，总容量50MW，增加供热能力2971.13万平方米。

本项目符合国家相关产业政策、节能减排要求，符合《呼和浩特市城市总体规划纲要（2005-2020年）》和《呼和浩特市城市供热规划（2010-2020年）》，并在筹建中得到了国家发展和改革委员会、国家财政部、内蒙古自治区、呼和浩特市两级政府、地方发改委、财政部门以及亚洲开发银行的大力支持，目前项目各项前期工作正在顺利进行中。

为增加本项目建设的透明度，扩大市民的知情权、参与权和监督权，我公司与亚洲开发银行将召开公众磋商会，诚意邀请本项目区域居民、政府有关部门和关心项目建设的社会各界热心人士参加，交流本项目的施工建设、环境保护、社会影响和效益等方面问题，提出宝贵意见建议。

会议时间：暂定2014年4月10日上午9时

会议地点：呼和浩特市赛罕区西把栅乡辛家营村南城发辛家营供热分公司

联系电话：0471-5103421

Unofficial Translation:

Public consultation meeting notice of low carbon heat supply project in Hohhot, Inner Mongolia by Hohhot urban investment and management Limited Liability Company

Hohhot Urban Investment and Management Limited Liability Company- Chengfa - is applying for a loan from ADB for purpose of addressing the needs of heat supply in east Hohhot urban area, achieving sustainable development of Hohhot, enhancing energy saving, and reducing pollution and protecting the ambient environment. The loan will be used for low carbon heat supply project in Hohhot, Inner Mongolia- Xinjiaying, Jinqiao and Haoqingying district heat supply projects. The project includes 19 gas fired hot water boilers with a total capacity of 1560 MW and 2 electrical boilers with a total capacity of 50 MW. The project will increase heat supply area by 29.7113 million m^2.

The project is consistent with relevant national industrial policy, energy saving and pollution reduction requirements, and also consistent with *Hohhot Master Plan Outline (2005-2020)* and *Hohhot Urban Heating Plan (2005-2020)*. During project preparation process, the project received strong support from National Development and Reform Commission, National Finance Ministry, Inner Mongolia Autonomous Region Government, Hohhot Government, Hohhot Municipal Development and Reform Commission, Hohhot Finance Department and ADB. Now preliminary work of the project is proceeding smoothly.

Chengfa and ADB will hold a public consultation meeting for the purpose of making the project more transparent and giving the public more rights to know, participate and supervise. Residents in the project site, relevant government departments and social persons who concern about the project are cordially invited to the meeting. Problems on project construction, environmental protection, social impact and benefits etc. will be communicated and discussed in the meeting. Suggestions and advice on the project are welcomed.

Meeting time: 9 am of Apr 10th, 2014 (tentative)
Meeting place: The meeting will be held in one branch company of Chengfa- Xinjiaying heat supply company which is located at south of Xinjiaying Village, Xibazha Township, Saihan District, Hohhot.
Contact No: 0471- 5103421

Source: HCDIO, 2014.

Figure 55: Public consultation photographs, natural gas-fired boilers (2014).

HCDIO senior staff and environmental consultants present information about the proposed Project.

Public consultation participants.

Public consultation discussion.

Questionnaires being completed by public consultation participants.

Source: HCDIO, 2014.

276. **Table 77** presents a summary of the questionnaire results. All (100%) of the respondents indicated that they agreed or conditionally agreed with the proposed Project. When the participants were asked to identify the main environmental impacts during construction and operation, water pollution, air pollution and noise were most commonly identified, all of which are effectively addressed in the mitigation measures.

C. Future Consultation Activities

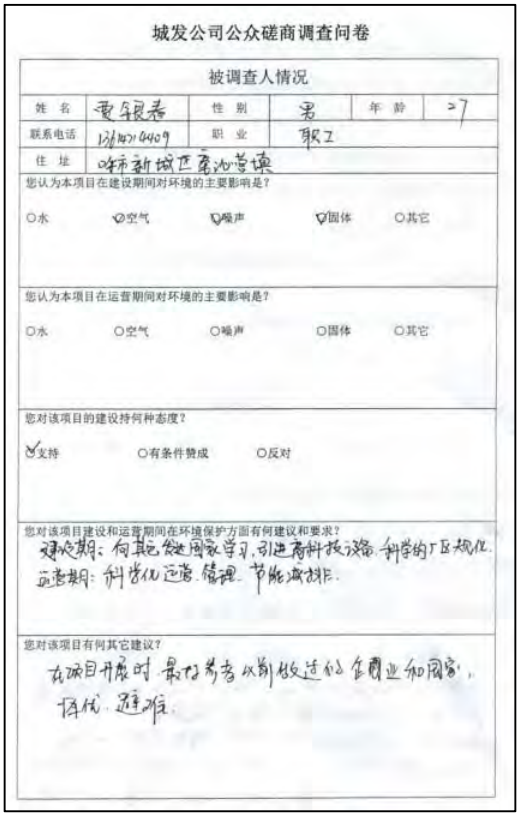
277. HCDIO will continue to conduct regular community liaison activities during the construction and operations phases, including the implementation of the grievance redress mechanism (GRM, see Chapter VIII).

Table 75: Project public consultation questionnaire, natural gas-fired boilers (2014).

Status of Participants					
Name		Sex		Age	
Contact number		Occupation			
Address					
What are the project's main environment impacts during construction phase in your opinion? ○Water ○ Air ○ Noise ○ Solid waste ○ Other (dust etc.)					
What are the project's main environment impacts during operation phase in your opinion? ○Water ○ Air ○ Noise ○ Solid waste ○ Other (dust etc.)					
Attitude to the project ○ Agree ○ Conditional agree ○ Disagree					
Suggestions or requirements for environment protection of the project:					
Other suggestions or requirements for environment protection of the project:					

Source: HCDIO, 2014.

Figure 56: Sample completed questionnaire, coal-fired boilers (2011).



城发公司公众磋商调查问卷

被调查人情况

姓名	曹乐银	性别	男	年龄	>7
联系电话	13430104409	职业	职工		
住址	咏春新城世嘉沙龙				

您认为本项目在建设期间对环境的主要影响是?

○水 ☑空气 ☑噪声 ☑固体 ○其它

您认为本项目在运营期间对环境的主要影响是?

○水 ○空气 ○噪声 ○固体 ○其它

您对该项目的建设持何种态度?

☑支持 ○有条件赞成 ○反对

您对该项目建设和运营期间在环境保护方面有何建议和要求?

建设期: 向其它先进国家学习,引进高科技设备,科学的厂区规化.

运营期: 科学化运营.管理.节能减排.

您对该项目有何其它建议?

在项目开展时,最好考虑到被迁的企业和国家,

拆伐.迁移.

Source: HCDIO, 2014.

Table 76: Summary data on questionnaire respondents, natural gas-fired boilers (2014).

Parameter	Indicator	No.	%
Sex	Male	31	73.8
	Female	11	26.2
Age	Below 30	10	23.8
	31-40	19	45.2
	41-50	5	11.9
	Above 50	7	16.7
	No Response	1	2.4
Occupation	Farmer	5	11.9
	Worker	8	19.0
	Self-employed entrepreneurs	2	4.8
	No response	14	57.1
	Civil servant	3	7.1

Source: HCDIO, 2014.

Table 77: Public consultation questionnaire results, natural gas-fired boilers (2014).

	Options	No	%
What are the project's main environment impacts during construction phase in your opinion? (can select more than one)	Water	12	28.6
	Air	22	52.4
	Noise	22	52.4
	Solid waste	4	9.5
	Other (dust etc.)	0	0
What are the project's main environment impacts during operation phase in your opinion? (can select more than one)	Water	10	23.8
	Air	31	73.8
	Noise	15	35.7
	Solid waste	4	9.5
	Other (dust etc.)	10	0
Attitude to the project	Agree	38	90.5
	Conditional agree	4	9.5
	Disagree	0	0

Source: HCDIO, 2014.

VIII. GRIEVANCE REDRESS MECHANISM

A. Introduction

278. A Project grievance can be defined as an actual or perceived Project related problem that gives ground for complaint by an affected person (AP). As a general policy, HCDIO will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the Project has strong public support and will not involve any involuntary land or property acquisition or resettlement, significant grievance are unlikely. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. In order to address complaints if or when they arise, a Project grievance redress mechanism (GRM) has been developed in accordance with ADB requirements and Government practices. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's Project-related grievances transparently and in a reasonable period of time.

B. ADB's GRM Requirements

279. The ADB's SPS requires the IA to establish a GRM to receive and facilitate resolution of affected person's concerns and complaints about the project's environmental performance during construction as well as operation phase of the project. The GRM should be scaled to the risks and adverse impacts of the project; should address affected people's concerns and complaints promptly, using an understandable and transparent process; should be readily accessible to all sections of the community at no cost and without retribution; and, should not impede access to the PRC's judicial or administrative remedies.

C. Current Practice in the PRC

280. At the national level a framework to address grievance has been established. State Council Decree No. 431 "Regulations on Letters and Visits" (January 2005) codifies a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. The Ministry of Environmental Protection (MEP) "Decree No. 34 Environmental Letters and Visits System" provides specific guidelines to establish a system and address environmental complaints.

281. Currently, when APs are negatively affected by project activities, such as noise, dust or safety issues caused by construction activities, they may complain to the contractors and the project IA by themselves or through their community organizations, or complain directly to local EPBs. If the issue is not resolved they may take legal action, though that is typically considered as a last option.

282. In the case of issues occurring during the construction period, an AP can complain to the contractors first if the construction activities are the source of the problem. If the contractors do not respond to the complaint or their responses cannot resolve the issue, the AP may contact municipal EPBs or the district/county EPBs, who will record the complaints and then visit the sites to investigate and obtain the contractors' side of the story. Sometimes, the two sides might contradict, each defending its own argument. In such cases, the local EPBs will need to consult with the contractor or the supervising engineer to acquire relevant project information and collect data. This kind of fact-finding or site investigation is usually time-consuming, thus delaying the implementation of appropriate mediation

measures.

283. Weaknesses of the current practice includes: (i) lack of specialized units to address grievances at the project level; and (ii) lack of specific timeframes for actions and responses to be undertaken to resolve the complaints. These weaknesses have been addressed in the Project GRM.

D. Proposed Project GRM

284. The HCHC will establish a Project Public Complaints Unit (PPCU). The PPCU will be coordinated by at least two staff members. The contact persons for the different GRM entry points (residential community leaders, neighborhood organizations, local authorities, district EPB, contractors and operators) will be defined prior to construction and operation. Organizational charts of the GRM, including the contact persons of the entry points will be disclosed at each heating zone construction site. The Project will provide training to the members of the PMO and the contact persons of the GRM entry points to ensure that responsibilities and procedures are clear. The concept of the proposed project GRM is shown in **Figure 57**.

1. Grievance Types, Documentation, and Eligibility Assessment

285. Public grievances will most likely relate to environmental issues encountered during the construction phase. Grievances may include vehicle operation and transportation of heavy equipment and materials; fugitive dust emissions and construction noise; soil erosion and haphazard disposal of waste materials in inappropriate places; and safety measures for the protection of the general public and construction workers. Construction-related grievances can be numerous, and managing them is the contractor's responsibility under its contract with the IA. Operation related grievances may occur due to complaints about HSP or EHS environmental performance.

286. All complaints will be recorded in a systematic fashion by the PPCU. Effective tracking and documentation will promote timely resolution; assist in keeping concerned parties (the complainant and appropriate Project personnel) informed about the status of the case and progress being made toward resolution; record responses and outcome(s) so as to promote fairness and consistency; provide a record of settlements; and assist when assessing the effectiveness of the process and action(s) to resolve complaints.

287. Once a complaint has been appropriately recorded, the PPCU will identify if the complaint is eligible. Eligible complaints include those where (i) the complaint pertains to the project, and (ii) the complaint falls within the scope of environmental issues that the GRM is authorized to address. Ineligible complaints include those where (i) the complaint is clearly not project-related; (ii) the nature of the issue is outside the mandate of the environment GRM (such as issues related to resettlement, allegations of fraud or corruption); and (iii) other company or community procedures are more appropriate to address the issue. If the complaint is rejected, the complainant will be informed of the decision and the reasons for the rejection.

2. GRM Steps and Timeframe

288. The GRM consists of 5 escalating steps. A key goal of the GRM is to solve problems early at the lowest step. A conceptual diagram of the GRM is presented in **Figure 57** and each step is described below:

Step 1: If a concern arises, the AP should try to resolve the issue of concern directly with the contractor/operator and/or the IA project manager. If the concern is resolved successfully, no further follow-up is required. Nonetheless, the contractor/operator and/or the project manager shall record any complaint and actions taken to resolve the issues and report the results to the PPCU. If no solution is found within 15 working days or if the complainant is not satisfied with the suggested solution under Step 1, proceed to Step 2.

Step 2: The AP will submit the grievance to the PPCU, either directly or via other entry points such as District EPBs or community leaders. The PPCU must assess the eligibility of the complaint, identify a solution, and give a clear reply within 15 working days to the complainant and to HCDIO and the contractor (if relevant) with the suggested solution. The contractor, during construction, and HCDIO, during operation, shall implement the redress solution and convey the outcome to the PPCU within 7 working days.

Step 3: If no solution is identified by the PPCU or if the complainant is not satisfied with the suggested solution under Step 2, the PPCU will organize, within two weeks, a multi-stakeholder meeting where all relevant stakeholders, including the complainant, HCDIO, the contractor/operator, and local District EPB will be invited. The meeting will aim to find in a solution acceptable to all, and identify responsibilities and an action plan. The contractor during construction and HCDIO during operation will implement the agreed-upon redress solution and convey the outcome to the PPCU within 7 working days.

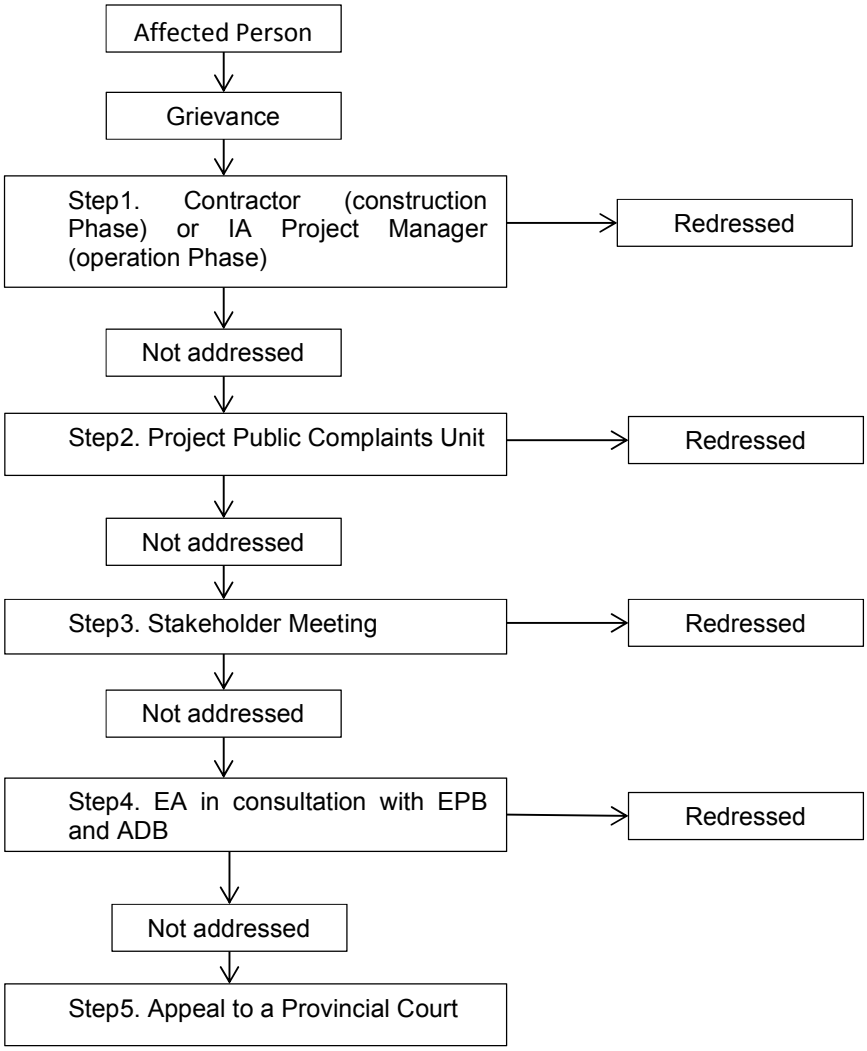
Step 4: If the multi-stakeholder hearing process under Step 3 is not successful, the PPCU, through HCDIO, will inform the EA, the Hohhot EPB and the ADB accordingly. The EA with the consultation from the Hohhot EPB and ADB will review the situation and attempt to develop an alternative approach to resolve the complaint within 15 working days.

Step 5: If the complainant is not satisfied with the suggested solution under Step 4 the AP may advance the grievance to the Provincial Court. If the AP is not satisfied with the Provincial Court judgment, there may be an opportunity for appealing to a higher level of court.

289. The PPCU as well as the District EPBs will accept the complaints and grievances lodged by the affected persons free of charge. Any costs incurred should be covered by contractor or HCDIO or from the contingency of the contract.

290. A summary of GRM activities will be reported by HCDIO in the annual project progress reports and sent to ADB. The GRM will be operational during the entire construction phase and during the operations until the project completion.

Figure 57: Project GRM



ADB = Asian Development Bank, AP = affected person, EPB = environmental protection bureau, IA = implementation agency, PPCU = Project Public Complaints Unit

IX. CONCLUSIONS

291. The proposed Low Carbon District Heating Project in Hohhot, Inner Mongolia Autonomous Region, (the Project), will upgrade and expand district heating in three heating zones in Hohhot city. The Project will provide 1,560 megawatts (MW) of clean-burning natural gas-fired heating capacity and 50 MW of demonstration wind powered electrode heating capacity, which in combination will heat approximately 30 million m^2 of public and residential building space.

292. The Project will bring significant positive environmental benefits. Air quality dispersion modelling results indicate that even the worst case cumulative operation phase pollutant ground level concentrations (GLCs), which occur only a few times per year at a few specific locations, are fully in compliance with PRC Standards. When compared to the equivalent production of heat through traditional coal-fired sources, once operational the Project will: (i) result in the closure of 50 small urban low-efficiency and polluting coal-fired boilers; (ii) eliminate the use and transport through urban areas of 1.270 million tons of raw coal; (iii) result in energy savings equivalent to 848,500 ton of standard coal, thereby providing a global public good by avoiding the annual emission of 1,299,400 tons CO_2; and (iv) improve local air quality through the estimated annual reduction of emissions of SO_2 by 11,800 tons, NO_x by 9,000 tons, PM by 26,000 tons, and fly and bottom ash by 191,000 tons. By 2020 the Project will provide low-emission high efficiency district heating to an estimated 294,500 households with a population of 883,500.

293. Through the environmental assessment process the Project has (i) selected an appropriate technology to reduce the emission of pollutants; (ii) identified negative environment impacts and appropriately established mitigation measures; (iii) received public support from the majority of Project beneficiaries and affected people; (iv) established an effective Project GRM; (v) assessed the capacity of the implementing agency; (vi) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

294. Based on the analysis conducted it is concluded that overall the Project will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Overall, any minimal adverse environmental impacts associated with the Project can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that:

i) the Project's categorization as ADB environment category A is confirmed;

ii) this EIA is considered sufficient to meet ADB's environmental safeguard requirements for the Project, and no additional studies are required; and

iii) the Project be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the EA and IA to ensure these commitments are effectively and expediently implemented.

APPENDIX I: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. This is the Environmental Management Plan (EMP) for the proposed Low Carbon District Heating Project in Hohhot, Inner Mongolia Autonomous Region (IMAR). The Project will provide 1,560 megawatts (MW) of clean-burning natural gas-fired heating capacity and 50 MW of demonstration wind powered electrode heating capacity, which in combination will heat approximately 30 million m^2 of public and residential building space.

2. The objectives of the EMP are to ensure (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting; and (iii) the Project compliance with the PRC's relevant environmental laws, standards and regulations and ADB's Safeguard Policy Statement (SPS). Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting.

B. Implementation Arrangements

3. The Government of IMAR (GIMAR) is the executing agency (EA) and the Hohhot Chengfa Heating Company is the implanting agency (IA). Hohhot City Development Investment and Operation Company (HCDIO, commonly referred to as the "Chengfa Company") is engaged to provide supervision to project implementation and good governance. The HCHC and the HCDIO jointly established a Project Management Office (PMO) with a Project Manager. The PMO will include an appropriately staffed Environment, Health and Safety Unit (EHSU), and will be supported by a Loan Implementation Environment Consultant (LIEC). The PMO EHSU will include the Project Public Complaints Unit (PPCU). The Haoqingying, Xinjiaying and Jinqiao Branches of the HCHC will be responsible for the direct management of the three heating zones, and each branch will also form an EHSU. A conceptualized project management chart is presented in **Figure A-1**.

4. The PMO will be responsible for day-to-day project implementation management including procurement and contract management, and payment to contractors.

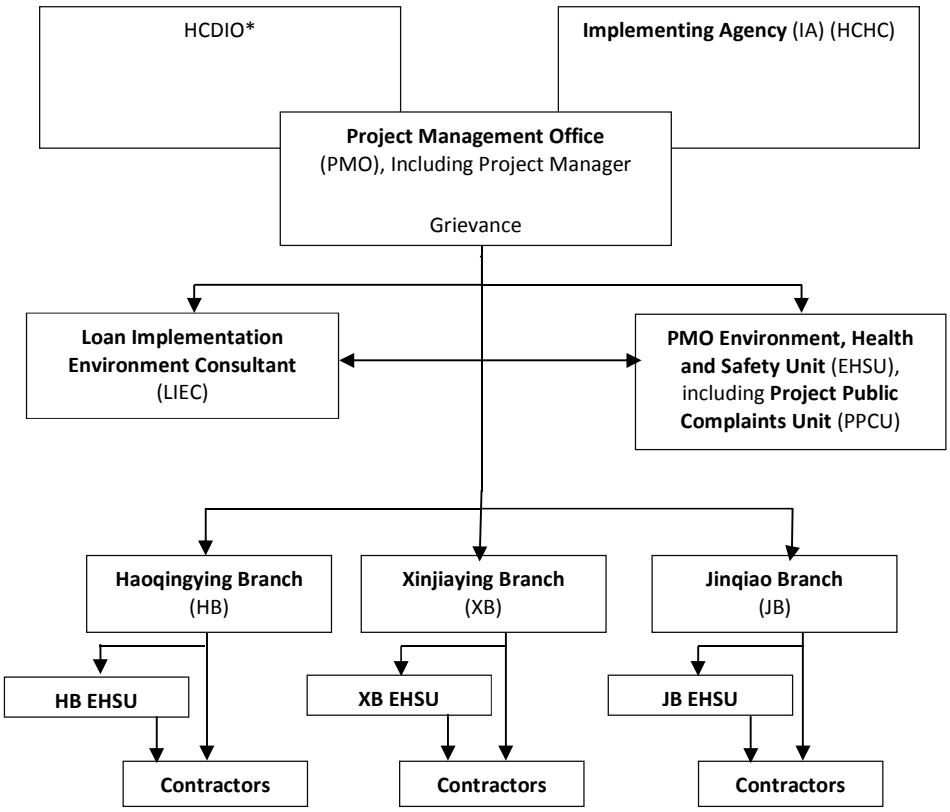
5. The EHSU within the PMO will consist of an EHSU leader and an appropriate number of staff. To ensure the EMP requirements are incorporated into construction contracts, the PMO EHSU will prepare and provide the following specification clauses to incorporate in the bidding procedures: (i) a list of environmental management requirements to be budgeted by the bidders in their tendering documents; (ii) environmental clauses for contractual terms and conditions; and (iii) environmental monitoring requirements in domestic EIAs, the EIA and the EMP. The PMO EHSU will oversee EMP implementation, provide specific mitigation implementation guidance to the Branch EHSUs and contractors, and prepare EMP monitoring reports semi-annually during construction and annually during operation. The EHSU will prepare and submit the EMP monitoring reports to the PMO who will review the reports and submit them to ADB and to the Saihan District EPB.[1]

6. The PMO through the EHSU will be responsible for contracting the Hohhot Environmental Protection Bureau (EPB) Environment Monitoring Station (EMS) to

[1] The Saihan District EPB has been delegated by Hohhot EPB to be responsible for environment protection supervision and inspection during the construction phase.

undertake construction and operation phase ambient monitoring.

Figure A-1: Conceptualized Project Management Structure.



*Note: The HCDIO will provide management oversight to the IA and will (i) liaise with the GIMAR, and Hohhot municipal government; (ii) sign onlending agreements with the GIMAR, through Hohhot municipal government, and will onlend to the HCHC; (iii) be directly responsible for making equity contributions; (iv) provide support and supervision in the project procurement with the IA; and (v) provide timely managerial and technical support to the IA to ensure the timely project implementation as well as good governance of the project. The HCDIO and HCHC will jointly establish a project management office (PMO).

7. A LIEC will provide project management and technical support to the PMO. The LIC will be a part-time consultant who will support the PMO EHSU in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances. The LIEC will develop construction and operation phase EHS plans.

8. The Branch EHSUs will have day-to-day responsibility for ensuring mitigation implementation in their respective heating zones. They will respond to complaints, and support the PMO EHSU in monitoring and reporting.

9. The Contractors will be responsible for implementing relevant mitigation measures during construction. Following the award of the construction contract, the Contractors will prepare Construction Site Environmental Management Plans (CSEMPs) which detail the means by which the Contractors will comply with the EMP. The Contractors will implement

the CSEMPs, and will take all reasonable measures to minimize the impact of construction activities on the environment.

10. The PMO EHSU and the LIEC will be responsible for regular internal inspections of mitigation measures at the construction site, in accordance with the Environmental Monitoring Plan (EMoP). The Hohhot Environmental Protection Bureau (EPB) Environment Monitoring Station (EMS) will undertake construction and operation phase ambient monitoring as per the EMoP. It is anticipated that the Saihan District EPB will also undertake random environmental compliance inspections during construction and operation. The Saihan District EPB will also conduct an environmental acceptance inspection after a three months trial operation period.

11. ADB will be responsible for reviewing the overall environmental performance of the Project. ADB will review the semi-annual and annual environmental monitoring reports submitted by the PMO and will disclose the reports on its website. ADB will conduct due diligence of environment issues during the project review missions. If the PMO fails to meet safeguards requirements described in the EMP, ADB will seek corrective measures and advise the IA on items in need of follow-up actions.

12. Key Project institutions and their EMP implementation responsibilities are summarized in **Table A-1.**

C. Institutional Strengthening and Capacity Building

13. The institutional strengthening and capacity building focusses on the development of construction and operation phase EHS plans by the LIEC (one plan per heating zone) in accordance with relevant PRC laws and regulations, and the provision of training on the EHS plan implementation as well as implementation of the EMP and ADB and PRC safeguard requirements. In addition to typical good construction EHS practices, the EHS plans and capacity building will emphasize worker and community safety for natural gas boilers.

14. In the construction phase significant works should not be undertaken until the construction EHS plan has been developed and training provided on its implementation. Similarly, heating zone operation should not commence until the operation phase EHS plan has been developed, and training provided on its implementation.

15. Development of the EHS plans, training topics, contents, estimated budgets and number of participants are presented in **Table A-2**.

Table A-1: Summary of Institutions and Responsibilities for EMP Implementation

Institution	Responsibilities
HCHC - Implementing Agency (IA)	Together with the HCDIO, jointly establish appropriately staffed Project Management Unit (PMO) and hire LIEC and EMS; provide overall project management guidance to PMO;
HCDIO	Together with the HCHC, jointly establish appropriately staffed Project Management Unit (PMO) and hire LIEC and EMS; provide supervision and guidance to the HCHC in order to ensure smooth and effective project management and good governance; Provide overall project management guidance to PMO.
Project Management Office (PMO)	Establish appropriately staffed Environment, Health and Safety Unit (PMO EHSU); provide overall management and direction to EHSU.
PMO Environment, Health and Safety Unit (EHSU)	Ensure incorporation of EMP requirements into bidding documents and contracts; oversee EMP implementation; provide mitigation implementation guidance to the Branch EHSUs and contractors; undertake compliance inspections of mitigation measures at the construction sites, in accordance with the EMoP; establish a Project Public Complaints Unit (PPCU) and ensure implementation of grievance redress mechanism (GRM); recruit and supervise the Hohhot Environmental Protection Bureau (EPB) Environment Monitoring Station (EMS) to undertake construction and operation phase ambient monitoring; prepare EMP monitoring reports semi-annually during construction and annually during operation; coordinate the role of the LIEC.
Loan Implementation Environment Consultant (LIEC)	Provide technical assistance to the PMO EHSU in all aspects of EMP implementation; develop construction and operation phase EHS plans and provide training to the staff of the IA and contractor on EMP and EHS, utilizing additional consultants as required; assist and coordinate environmental monitoring, including undertaking compliance inspections and assisting EMS with ambient monitoring; assist PMO EHSU in addressing any environmental issues that may arise, including grievances; and assist the PMO EHSU in preparing semi-annual and annual environmental EMP monitoring reports.
Branch EHSUs	Day-to-day responsibility for mitigation implementation; assisting PMO EHSU and LIEC for compliance and ambient monitoring; assisting in implementation of GRM.
Contractors	Develop and implement Construction Site Environmental Management Plans (CSEMPs) in accordance with the EMP and other contract conditions; implement all required mitigations during construction; report all spills and accidents, and take appropriate actions.
Hohhot EPB EMS	Conduct ambient monitoring according to the EMP monitoring plan (EMoP).
Saihan District EPB	Inspect the facilities during construction and operation to ensure compliance; enforce applicable the PRC's environmental laws and regulations; review EMP monitoring reports; and conducting an environmental acceptance inspection after a three months trial operation period. Ensure the boiler decommissioning activities led by Hohhot Utility Bureau will be performed in accordance with relevant PRC environmental laws and regulations and other all relevant domestic requirements. Ensure the gas company to follow a domestic EIA approval procedures and requirements and perform their gas pipe construction in accordance with all the relevant PRC environmental laws and regulations, and other domestic requirements, including their domestic EIA requirements. Ensure a planned Phase II HSP to meet all domestic approval requirements to minimize cumulative impact at project site.
ADB	Monitor and supervise the overall environmental performance of the project; review the environmental monitoring reports and disclose the project

Institution	Responsibilities
	monitoring reports on its website; conduct due diligence of environment issues during the project review missions.

Table A-2: Institutional Strengthening and Training Program

Training Topic	Trainers	Attendees	Contents	Times	Period (days)	# Persons	Budget (USD)	Source of Funds
Construction Phase EHS Plan Development and Training	LIEC	IA, PMO, EHSU, Branch PMOs, Saihan District EPB, Contractors	**ADB and PRC EHS laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC EHS laws, policies, standards and regulations International environmental, health and safety management practice in civil constructions **GRM** – GRM structure, responsibilities, and timeframe Types of grievances and eligibility assessment **Implementation of EMoP** – Impacts and mitigation measures during construction and operation – Monitoring and auditing mechanism – Reporting requirements Corrective actions for EMP **Implementation of Heating zone Construction Phase EHS Plans** – Plan descriptions – Roles and responsibilities	6 (2 per sub-project)	3	15	**EHS Plan Development** (fees and per diem): 3 plans x 10 days/plan x 350/day = $10,500 **EHS Plan Training Course Development** (fees and per diem): 10 days x $350/day = $3500 **Course Delivery** (fees and per diem): 6 x 5 days x 350/day = $10,500 (fixed costs): $1000 per course delivery x 6 = $6000 **TOTAL = $30,500**	ADB

Training Topic	Trainers	Attendees	Contents	Times	Period (days)	# Persons	Budget (USD)	Source of Funds
Operation Phase EHS Plan Training	LIEC	IA, PMO, EHSU, Branch PMOs, Saihan District EPB	**International good practices in natural gas-fired HSP operation** – Environmental, health and safety issues associated with natural gas-fired HSPs. **Implementation of Operation Phase EHS Plans** – Plan descriptions – Roles and responsibilities	6 (2 per sub-project)	3	15	**Course EHS Plan Development** (fees and per diem): 3 plans x 10 days/plan x 350/day = $10,500 **EHS Plan Training Course Development** (fees and per diem): 10 days x $350/day = $3500 **Course Delivery** (fees and per diem): 6 x 5 days x 350/day = $10,500 (fixed costs): $1000 per course delivery x 6 = $6000 **TOTAL = $30,500**	ADB
			Total	**12**	**36**	**180**	**$70,000**	

D. Potential Impacts and Mitigation Measures

16. The potential impacts of the project during construction and operation have been identified and appropriate mitigation measures developed (see Chapter V of the EIA). Detailed impacts and mitigation measures are presented in **Table A-3.**

E. Environment Monitoring Plan

17. An environment monitoring plan (EMoP) to monitor the environmental impacts of the Project and assess the effectiveness of mitigation measures is presented in **Table A-4**. The EMoP includes both compliance inspection undertaken by the PMO EHSU supported by the LIC EHSS, and ambient and discharge air, noise, wastewater and flue gas monitoring undertaken during both construction and operation phases. The monitoring methods and standard for ambient and discharge monitoring parameters are presented in **Table A-5.**

18. The data and results of environmental compliance inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline data collected before the project implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if non-compliance is observed.

Table A-3: Environment Impacts and Mitigation Measures

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
A. Pre-construction Phase					
Incorporate Mitigation Measures and Monitoring in Detailed Design and Bidding and Contracting	Include mitigation measures and monitoring program in detailed designs	– Environmental mitigation measures identified in this EIA, the EMP including health and safety requirements, landscaping, etc, and the domestic EIAs will be incorporated in the engineering design.	EHSU supported by LIEC	PMO, ADB	Detailed Design Budget
	Include mitigation measures and monitoring program in bidding documents	– Environmental mitigation measures identified in this EIA and the domestic EIAs will be incorporated in the bidding documents for the project, and will be included in contract documents for civil constructions and equipment installations. All contractors shall be required to strictly comply with the EMP.	EHSU supported by LIEC	PMO, ADB	Detailed Design Budget
	Environmental monitoring incorporated into design.	– The environmental monitoring program (EMoP, see Table A-4 in Appendix I) will be incorporated into the design to ensure that environmental impacts are closely monitored and activities of the Project construction and operating are closely supervised against the PRC environmental laws, regulations and standards, ADB SPS, and the Project EMP and approved domestic EIAs.	EHSU supported by LIEC	PMO, ADB	Detailed Design Budget
Grievance Redress Mechanism (GRM)	Impacts on Project Affected Persons	– In accordance with the GRM presented in Chapter VIII of the EIA, establish a Project Public Complaints Unit (PPCU) in IA's office; provide GRM training for PPCU members and GRM access points; disclose the PPCU's phone number, fax, address, and email to the public.	EHSU supported by LIEC	PMO, ADB	PMO Operating Budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
B. Construction Phase					
Erosion and Spoil	Soil erosion, spoil disposal	Good practice construction erosion controls and site maintenance: – HSP site storm water runoff will be assessed and estimated and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff. – Fish ponds along the northwestern boundary of the Jinqiao HSP will be protected by silt fences when nearby construction activities are underway. – Spoil will be reuse of on-site to the maximum extent feasible as fill to rehabilitate disturbed areas or for landscaping. – Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Sites will be restored at the conclusion of storage activities. – Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – Spoil and aggregate piles will be covered with landscape material. – During earthworks the area of soil is exposed to potential erosion at any one time will be minimized. – Construction and material handling activities during periods of rains and high winds will be limited or halted. – Pipelines will be installed and backfilled in a sequenced section-by-section approach, with sections not exceeding 300 m in length. Open excavation areas during trenching activities will be minimized, and appropriate construction compaction techniques utilized. – Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil. – Once construction is complete disturbed surfaces will be	Contractors directed by Branch EHSUs	EHSU supported by LIEC	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		properly sloped and revegetated with native trees and grass (see greening plan, below).			
Wastewater	Surface and groundwater contamination from construction wastewater, and domestic water	Good wastewater management practices: – Adequate temporary sanitary facilities and ablutions will be provided for construction workers. Toilets will be equipped with septic tanks in accordance with PRC standards. – Septic tanks will be pumped out on an as needed basis, and the effluent will be discharged for final treatment at the Jinqiao wastewater treatment plant. – Wastewater from the canteen should be treated in an oil-water separator, and then discharged into the municipal sewer for final treatment at the Jinqiao wastewater treatment plant. – Construction wastewater will be directed to temporary detention and settling ponds prior to discharge to urban storm sewers. – Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps.	Contractors directed by Branch EHSUs	EHSU supported by LIEC	Contractor construction budget
Air Pollution	Dust, vehicle emissions	– HSP sites, HES sites and pipeline sections under construction will be fully enclosed by a 3 m fence prior to the commencement of construction. Fence height will be increased near sensitive locations (residential areas, schools, clinics and hospitals). – Water will be sprayed on active construction sites where fugitive dust is being generated on a daily basis, and more frequently during windy days. – Construction activities will be halted during high wind events. – All construction piles with the potential to generate dust will be covered and/or regularly watered. – Transport vehicles will be limited to low speeds in construction sites. – Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be	Contractors directed by Branch EHSUs	EHSU supported by LIC EHSS	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		transported in fully contained trucks. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds. – Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical. – Vehicles and construction machineries will be maintained to a high standard (to be done off-site) to ensure efficient operating and fuel-burning and compliance with the PRC emission standards GB 11340-2005, GB 17691-2005, GB 18285 -2005 and GB 18352-2005. – The use of coal for cooking on site, heating and hot water is prohibited. – Non-ozone depleting blowing agents will be utilized for the polyurethane foam (PUR) during the construction of pre-insulated bonded heating pipes.			
Noise	Impacts from construction noise on sensitive resources	To ensure construction activities meet PRC noise standards (*Noise Standards for Construction Site Boundary*, GB 12523-2011) and protect workers: – Construction activities will be restricted to 6:00-12:00 h and 14:00-22:00 h. Construction activities will be prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, EPB and other relevant departments. – When undertaking construction planning, simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during that day rather than evening hours. Similarly, construction sites will be planned to avoid multiple high noise activities or equipment from operating at the same location. – Low-noise equipment will be selected as much as possible. – Noise levels from equipment and machinery must conform to	Contractors directed by Branch EHSUs	EHSU supported by LIC EHSS	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		the PRC standard GB 12523-2011, will be equipped with mufflers, and will be properly maintained to minimize noise. – Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum. – Noise personnel protective equipment (PPE) will be provided to workers. – Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals. – Given their location within residential areas, special attention will be paid to protect sensitive sites near HESs and along the pipeline routes: – High noise construction activities will be positioned as far away from sensitive sites as possible. – Low noise equipment will be utilized to the extent possible. – Temporary or permanent noise barriers will be installed to protect sensitive sites.			
Solid Waste	Inappropriate Waste Disposal	– Wastes will be reused or recycled to the extent possible. – Littering by workers will be prohibited. – Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements. – Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in	Contractors, local sanitation departments (domestic waste), licensed waste collection companies (construction waste)	EHSU, LIC	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		accordance with relevant PRC regulations and requirements. – Excavated soil will be backfilled onsite to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – There should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited. – Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.			
Hazardous and Polluting Materials	Inappropriate transportation, storage, use and spills	– A hazardous materials handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors. – Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes. – Suppliers of chemicals and hazardous materials must hold proper licenses. They will follow all relevant protocols in "Operation Procedures for Transportation, Loading and Unloading of Dangerous or Harmful Goods" (JT 3145-91). – A licensed company will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements. – Vehicles and equipment will be properly maintained and refueled in designated service areas on impermeable surfaces provided with oil traps, at least 300 m from drainage structures and important water bodies.	Contractors, waste management companies	EHSU, LIEC	Contractor construction budget
Flora and Fauna	Removal of vegetation	– A greening plan will be implemented in each HSP site vegetation plans will be developed, using appropriate native species. According to the domestic EIAs, the approximate area to be vegetated for each HSP is:	DI (plan design), Contractors (plan implementation)	EHSU, LIEC	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		– Haoqingying greening area: 34,486 m^2 – Xinjiaying greening area: 27,226 m^2. – Jinqiao greening area: 34,375 m^2. – Any vegetated areas impacted by pipeline works or construction of HESs will be restored post-construction using appropriate native species.			
	Waterway pipeline crossing	The Jinqiao heating zone will require one river crossing. To minimize potential impacts: – Directional drilling will be used to embed the pipeline under the waterway. – The waterbody will be protected by siltation fences.			
Socioeconomic Resources	**Community Disturbance and Safety**	**Traffic and Public Safety** Traffic control plans, agreed to by the local traffic control authority, will be developed and implemented for each heating zone in order to minimize community disturbance: – Local government, using information provided by the PMO, will inform residents, institutions, bossiness and other affected parties as to planned construction activities including schedule and duration of construction works, and expected traffic and other disruptions. – Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. – Warning signs and cones will be installed along roads to protect workers and people in the neighborhood. Safety flag people will be used if appropriate. – During evening construction warning lights will also be used. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals. – Roadside earthworks should be completed as quickly as possible, and all spoil either backfilled or removed.	DI (plan design), Contractors (plan implementation)	EHSU, LIC	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		– Road crossing will use the pipe-jacking installation method where possible in order to minimize disruption. – Public access to construction sites and other areas of danger will be restricted and temporary barriers installed.			
		Access to Public Services, Private Properties and Businesses – Local authorities will be consulted to minimize disruption of public services such as telephone, water, gas and power supply. Contactors will use good construction practices to avoid disruption of other services. – The Contractor shall take measures to minimize disruption of access to private properties and businesses where possible. – Temporary access to affected private properties, businesses and public service buildings will be provided including temporary crossings over pipeline trenches, and subsequently good quality permanent access will be provided.	Contractors directed by Branch EHSUs	EHSU supported by LIEC	Contractor construction budget

	Worker Occupational Health and Safety	Contractors will implement adequate precautions to protect the health and safety of their workers:
		– Each contractor will implement the relevant heating zone construction phase EHS plan developed by the LIC EHS experts.
		– An EHS officer will be appointed by each contractor to implement and supervise the EHS management plan.
		– The EHS Plans will:
		  – Identify and minimize the causes of potential hazards to workers.
		  – Implement appropriate safety measures.
		  – Ensure the provision of adequate type and number of fire extinguishers and first aid facilities onsite.
		  – Provide training to workers on occupational health and safety and emergency response, especially with respect to using potentially dangerous equipment.
			EHS Plan Developed by LIEC	EHSU	LIEC Budget

			EHS Plan implemented by contractors directed by Branch EHSUs	EHSU supported by LIEC	Contractor construction budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		– Ensure that all equipment is maintained in a safe operating condition. – Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers. – Provide appropriate personal protective equipment (PPE) to workers to minimize risks, including ear protection, hard hats and safety boots, and post adequate signage in risk areas. – Provide procedures for limiting exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011). – Provide training to workers on the storage, handling and disposal of hazardous wastes. – Ensure regular safety meetings with staff.			
Physical Cultural Resources	PCRs may be damaged if proper precaution is not taken.	– The tomb south of the Jinqiao HSP will be demarcated by fence and signs as a no-entry area. – A construction phase chance find procedure will be established and activated if any chance finds of PCRs are encountered: – construction activities will be immediately suspended if any PCRs are encountered; – destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations; – the local Cultural Heritage Bureau will be promptly informed and consulted; and, – construction activities will resume only after thorough investigation and with the permission of the local Cultural Heritage Bureau.	Contractors	EHSU supported by LIEC and District Cultural Heritage Bureau	In the event that a PCR is discovered, the direct cost for comp-ensation to contractor will be covered by a special fund to be devel-oped for cultural relic protection.
C. Operation Phase					

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
Air Pollution	Combustion Emissions	– Low NOx natural-gas fired boilers will utilized producing less than 100 mg/m3 NOx emissions (1,560 MW heating capacity) and ensure at least the parameters indicated in Table 54 and 55 to be met. – Zero emission wind-powered demonstration electrode boilers utilized (50 MW heating capacity).	Contractors (construction) IA (operation)	EHSU Saihan District EPB	Contractor construction budget IA operation budget
Water	Municipal Water Consumption	– Confirmations obtained from Hohhot Municipal Water Supply Company on availability of sufficient supply.	Hohhot Municipal Water Supply Company	Hohhot Water Affairs Bureau	IA operation budget
Wastewater	Discharge of Production and Domestic Wastewater	– Domestic wastewater will be treated in digestion tanks, and then in combination with the production wastewater, will be discharged to the Hohhot municipal sewerage system for treatment at the Jinqiao wastewater treatment plant. – Each HSP will be equipped with an emergency overflow tank (1200 m^3 capacity for Haoqingying and Jinqiao, and 1500 m^3 capacity for Xinjiaying). – All emission concentration of SS, COD, BOD_5 and ammonia nitrogen will be in compliance with Class III standard requirements of integrated wastewater discharge standard (GB8978-1996), which sets the emission standards for wastewater discharged to a municipal sewerage system.	IA	Saihan District EPB	IA operation budget
Solid Waste	Collection and Disposal	– Waste bins will be provided at all facilities. – Wastes will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site. – No permanent on-site solid waste disposal will be permitted at HSPs or HESs. – No burning of wastes will be permitted at HSPs or HESs.. – All structures and/or components replaced during maintenance activities will be reused or recycled to the extent possible. Non-recyclable parts will be disposed at an	District Sanitation Departments	Saihan District EPB	IA operation budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		approved waste disposal site.			
Chemical and Hazardous Materials	Inappropriate Management	– A register of all activities that involve the handling of potentially hazardous substances will be developed, including protocols for the storage, handling and spill response. This will include all fuels, oils, grease, lubricants, and other chemicals. – All chemicals, toxic, hazardous, and harmful materials will be transported in spill proof tanks with filling hoses and nozzles in working order, – All chemicals, toxic, hazardous, and harmful materials will be stored in secure areas with impermeable surfaces and protective dikes such that spillage or leakage will be contained from affecting soil, surface water or groundwater systems. Their usage will be strictly monitored and recorded. Some chemicals will be stored off-site, such as water quality analysis chemicals which will be stored at an independent laboratory. – Material safety data sheets (MSDSs) will be posted for all hazardous materials. – Oil absorbents will be readily accessible in marked containers. – Good housekeeping procedures will be established to avoid the risk of spills. – Spills will be dealt with immediately, and personnel will be trained and tasked with this responsibility. – Workers will be properly trained before handling hazardous wastes and have the requisite PPE. – Hazardous waste will be temporarily stored in closed containers away from direct sunlight, wind, water and rain in secure designated areas with impermeable surfaces and protective dikes such that spillage or leakage will be contained. - Hazardous wastes will be collected and disposed by licensed contractors on an as needed basis.	IA, Licensed Contactors	Saihan District EPB	IA operation budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
Noise	Impact on Sensitive Receptors	– The Project design will use low-noise equipment as far as possible, and will also utilize noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls to ensure the noise level indicated in Tables 68-70 to be met. – All plant and equipment, including vehicles will be properly maintained in order to minimize noise. – Appropriate personal noise protective equipment (PPE) will be provided to the workers who are likely to be exposed to high noise level environments.	Contractors (construction) IA (operation)	EHSU Saihan District EPB	Contractor construction budget IA operation budget
Occupational Health and Safety	Risks to Workers	To minimize risks associated with leaks of natural gas: – All natural gas works will be in compliance with relevant PRC building code requirements, including the *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92). – Independent gas regulation stations will be constructed at least 14 meters away from other buildings and 30 m from the site boundary, to minimize the risk of explosion damaging other Project facilities or the public.[31] – The China Gas Company of Hohhot will construct and operate the gas regulation stations. – The gas regulation stations will be specially designed to withstand and contain explosions. – Gas regulation stations and the connection to the boilers will be equipped with flammable gas detection, alarm and fire	Contractors (construction) IA (operation)	EHSU Saihan District EPB	Contractor construction budget IA operation budget

[31] In the *Code for Design of City Gas* Engineering (GB 50028-2006) the recommended distance from a gas regulation station with no more than 1.6 MPa inlet pressure to other buildings is 9 m. In the Project, the minimum distance from gas regulation stations to the nearest building is 21 m in the Xinjiaying HSP, 15 m in the Jinqiao HSP, and 14 m in the Haoqingying HSP respectively, which fully conforms to the national code requirement.

Gas regulation stations are defined as Class II explosion risks. Space within 4.5 meter away from a regulation station is included in the explosion risk region, as regulated in *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92). The minimum distance from a gas regulation station to a site boundary fence is 30 meter in three HSPs, which confines the explosion risk within the plant sites; explosions will not impact areas outside the site boundaries.

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		suppression systems. In case of a gas leak, automatic shutdown valves will shut down the gas supply, the system will generate audible and visual alarms, and the emergency ventilation system will exhaust gas from the stations so as to protect the building and operators. Normal air change for the stations will be six times per hour, but in emergencies the ventilation system will change the air 12 times per hour. Electrical devices within the explosion risk area will be safety equipped.	Plans developed by LIEC	PMO, Saihan District EPB	LIEC Budget
		– The gas pipelines feeding into the pressure regulation stations will be embedded underground, and will be coated with three layers of PE corrosion protection sleeves. The gas lines exiting the gas pressure regulation stations will be suspended overhead, and will be treated 4 times with anti-corrosion paint. Pipelines will be grounded and equipped with anti-lightning devices where applicable. – All other at risk areas will have flammable gas detection and alarm systems able generate audible and visual alarms, and automatic fire suppression systems. – All gas related devices will be brightly colored and equipped with warning signs.	Plans implemented by IA	Saihan District EPB	IA Budget
		To mitigate potential health and safety risks to workers, the following measures will be taken: – In operation phase EHS plans for each heating zone including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation. – The HSP general arrangements will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risk, and fire-resistant buildings/structures will include fire-proof doors and windows. – Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly.			

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		– The process control system will include an out-of-limit alarm to ensure all hazardous materials are safety under control at all time. – PPE, including goggles, gloves, safety shoes, will be provided to workers. – Naked fire sources, hot surfaces, electric sparks, electrostatic sparks and ignition sources will be strictly controlled, especially near natural gas. – Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems. – No unauthorized personnel should be allowed into HSPs or HESs. – Authorized personnel must have appropriate PPE at all times.			
	Emergency Response	An emergency risk and response plan for each heating zone will be established in accordance with the "National Environmental Emergency Plan" (24 January 2006) and other relevant PRC laws, regulations and standards, and will include measures in the World Bank EHS guidelines with respect to occupational and community health and safety. The plan must be established and in place before the plant is operational. Indicative plan requirements are as follows: – Procedures for responding to different types of emergency situations will be identified in the response plan. – Emergency exercises will be conducted and they should include different emergency scenarios. **Training Requirements** – Appropriate operating and maintenance employees will be trained to ensure that they are knowledgeable of the requirements of emergency response plan. Training will be provided as follows: – Initial training to all employees before the HSP plant is	Plans developed by EHSU with support from LIEC Plans implemented by IA	Saihan District EPB, local emergency authorities Saihan District EPB, local emergency authorities	LIEC budget IA budget

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		put in operation; – When new equipment, materials, or processes are introduced. – When emergency response procedures have been updated or revised. **Annual Emergency Simulation** – Simulated emergency exercises will be conducted at least annually. **Receiving Notification of a Possible Emergency** – When a supervisor receives a report of a possible emergency situation, he/she should obtain at minimum the following information from the reporting person: – Name of person reporting emergency; – Nature of emergency - leak, fire, interruption of service if leak, odor present, etc. – Details of emergency: location, amount, how long has the odor been noticed, what actions have been taken, etc. – Leaks or other emergencies require prompt investigation. **Immediate On-site Action** – The first responder will assess the nature of the report. This assessment should include the status of the emergency, an estimation of how the incident might progress, and an evaluation of the manpower, equipment, and materials needed to adequately cope with the situation. – If there is a strong odor or any measurable reading of gas detected inside a structure: – Clear the building of all occupants. – Eliminate potential ignition sources. – Localize or isolate the problem and shut off gas as			

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		needed. – Determine the extent of the hazardous area and establish a restricted area. – The responding supervisor shall determine the extent of the emergency and inform the dispatcher of the condition at the site. – If emergency procedures are put into effect, the responding supervisor should select a location and establish an emergency command post. – The responding supervisor will assign one person to remain at the command post to maintain communications until the emergency is over. – When necessary, the command post will be coordinated with the local emergency responders. When local emergency responders are involved, they will be in charge of the incident. – The responding supervisor will make himself known to fire and/or police department officials, or other authority having jurisdiction, and will remain with them during the emergency. – All employees reporting to the scene of the emergency will report to the command post for identification and instructions. – Key personnel will be alerted, and it will be their responsibility to keep the emergency personnel under their supervision informed and available for emergency call out. – When a system failure cannot be made safely by normal procedures, emergency shutdown procedures should be implemented. – Reduce system pressure or segment a section before repair procedures are implemented. – Well trained and qualified personnel will be dispatched to monitor system pressure and repair work. **Communication with Public Officials** – When an emergency resulting in a hazard to the public safety			

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Source of Funds
			Implemented by	Supervised by	
		occurs, the local fire department, police, the city medical emergency center and other relevant public officials should be notified. An emergency call list will be prepared and make it available at the plant control room.			

DI = design institute, EHSS = environment, health and safety specialist, EHSU = environment, health and safety unit, EIA = environment impact assessment, EMP = environment monitoring plan, EMS = environment monitoring station, EPB = environment protection bureau, GRM = grievance redress mechanism, IA = implementing agency, LIC = loan implementation environmental consultant. Source: Domestic Project EIA Reports (2014) and TA consultants.

Table A-4: Environmental Monitoring Plan (EMoP)

Subject	Parameter	Location	Frequency	Implemented by	Supervised by	Source of Funds
A. Construction Phase						
Erosion and Spoil	Compliance inspection of erosion protection measures and spoil management	Construction sites, spoil disposal sites	Monthly; and once after completion of spoil disposal	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIC: ADB LIEC Budget
Wastewater generated from construction	Compliance inspection of wastewater mitigation measures (detention ponds, septic systems)	HSP construction sites	Monthly	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIC: ADB LIEC Budget
Air Pollution	Ambient dust monitoring (TSP, PM_{10})	HSP construction sites; representative number (15%) of HESs and pipeline constriction segments	Monthly	Hohhot EPB EMS	PMO	EPB EMS lump sum monitoring contract
	Compliance inspection of dust mitigation measures (water spraying, cover transport vehicles, etc.); and maintenance and condition of vehicles and construction equipment.	All construction sites	Weekly when there are construction activities	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIC: ADB LIEC Budget
Noise	Leq dB(A)	HSP construction sites; representative number (15%) of HESs and pipeline constriction segments	Monthly: a day each time and two samples; once during daytime, once during nighttime.	Hohhot EPB EMS	PMO	EPB EMS lump sum monitoring contract

Subject	Parameter	Location	Frequency	Implemented	Supervised	Source of Funds
Solid Waste	Compliance inspection of domestic and construction waste collection and disposal	Waste collection and disposal sites.	Monthly	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIEC: ADB LIEC Budget
Hazardous and Polluting Materials	Compliance inspections of hazardous management, protocols, and licenses of suppliers and waste removers	Storage facilities for fuels, oil, chemicals and other hazardous materials. Vehicle and equipment maintenance areas.	Monthly	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIEC: ADB LIEC Budget
Greening Plan	Compliance inspection of implementation of greening plans (HSPs), HESs and pipelines	HSP sites, HES sites, pipeline routes.	After construction is complete.	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIEC: ADB LIEC Budget
Health and Safety	Record and report both minor and lost-time incidents	HSPs, HESs, pipelines	Continuous	IA EHS Specialists	HCHC and HCDIO	Included in IAs' operation budgets
Socioeconomic Impacts	Compliance inspection to determine if traffic and public safety measures are in place	Pipeline and HSP construction sites at or near roads. Transportation routes.	Monthly	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIEC: ADB LIEC Budget
	Compliance inspection to determine if temporary access being provided to public and private properties	Pipeline routes	Monthly	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIEC: ADB LIEC Budget

Subject	Parameter	Location	Frequency	Implemented	Supervised	Source of Funds
	Compliance inspection to determine if EHS Plans developed and implemented, and workers have appropriate PPE	All construction sites	Monthly	EHSU supported by LIEC	PMO	EHSU: PRC PMO Budget LIEC: ADB LIEC Budget
B. Operation Phase						
HSP Emissions	SO_2, NO_2, TSP, PM_{10} (Compliance with Table 54 and 55)	Internal monitoring: sampling at stack of HSPs	Online continuous emission monitoring systems (CEMs)	IAs	Saihan District EPB	Included in IAs' operation budgets
	SO_2, NO_2, TSP, PM_{10} (Compliance with Table 54 and 55)	Calibration monitoring: at stack outlet of the HSPs	Twice per heating season.	Local EMSs	Saihan District EPB	EPB EMS lump sum monitoring contract
	CO_2	Calculated from natural gas consumption	Annually	IA	HCDIO	Included in IAs' operation budgets
Ambient Air Quality	SO_2, NO_2, TSP, $PM_{10,}$ $PM_{2.5,}$	Within 500 meter down-wind locations from each HSP; No.3 and No.6 indicated in Figures 41-52	Twice per heating season.	Hohhot EPB Monitoring Stations	Hohhot EPB	Hohhot EPB (Non project funds)
Domestic and Production Wastewater Discharged to Municipal Sewer	SS, COD, BOD_5	HSP Discharge Locations	Quarterly (4 times per year)	Local EMSs	Saihan District EPB	EPB EMS lump sum monitoring contract
Noise from HSP	Leq dB(A)	Compliance monitoring: at 1m outside of the HSPs' boundary	Twice per heating season.	Local EMSs	Saihan District EPB	EPB EMS lump sum monitoring contract

Subject	Parameter	Location	Frequency	Implemented	Supervised	Source of Funds
Noise from HES	Leq dB(A)	Compliance monitoring: at 1m outside of the HESs	Twice per heating season, random selection of HESs	Local EMSs	Saihan District EPB	EPB EMS lump sum monitoring contract
Health and Safety	Compliance inspection to determine if EHS Plans developed and implemented, and workers have appropriate PPE	HSPs, HESs, pipelines	Ongoing, random	IA EHS Specialists	HCHC and HCDIO	Included in IAs' operation budgets
	Record and report both minor and lost-time incidents during construction and operation	HSPs, HESs, pipelines	Continuous	IA EHS Specialists	HCHC and HCDIO	Included in IAs' operation budgets

dB = decibel, CEMS = continuous emissions monitoring system, EHSU = environment, health and safety unit, EMS = environment monitoring station, EPB = environment protection bureau, IA = implementing agency, Leq = equivalent continuous noise level, LIC = loan implementation environmental consultant, NO_2 = nitrogen dioxide, pH = potential hydrogen, TSP = total suspended particulate matter, PMO = project management office, SO_2 = sulfur dioxide.
Source: Domestic EIA Reports (2014) and TA consultants estimate.

19. Ambient and discharge monitoring will be conducted in compliance with relevant PRC regulations, methods and technical specifications:

(i) *Regulations of Quality Management for Environmental Monitoring,* July 2006.

(ii) *Technical Guideline on Environmental Monitoring Quality Management (HJ 630-2011)* published by Ministry of Environmental Protection in September, 2011.

(iii) *Technical Specifications for Installation and Acceptance of Ambient air Quality Continuous Automated Monitoring System for SO_2, NO_2, O_3 and CO (HJ 163-2013)* published by Ministry of Environmental Protection in June, 2013.

(iv) *Manual Methods for Ambient Air Quality Monitoring (HJ/T 194-2005)* published by Ministry of Environmental Protection in November, 2005.

(v) *Technical Specifications of Quality Assurance and Quality Control for monitoring of stationary pollution source (on trial) (HJ/T 373-2007)* published by Ministry of Environmental Protection in November, 2007.

(vi) *Technical Specifications Requirements for Monitoring of Surface Water and Waste Water (HJ/T 91-2002)* published by Ministry of Environmental Protection in December, 2002.

(vii) *Technical Specifications for Environmental Noise Monitoring Routine Monitoring for Urban Environmental Noise (HJ 640-2012)* published by Ministry of Environmental Protection in December, 2012

20. The standard monitoring methods, detection limits, and the standard code for each of the monitoring parameters are shown in **Table A-5.** The data and results of environmental inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline before the project implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if non-compliance is observed.

Table A-5: Standard Monitoring Methods of Air, Noise and Wastewater

Media	Parameter	Method (Standard No.)	Standard/Averaging Period
Air	TSP (mg/m^3)	Gravimetric (GB/T15432-1995)	0.30 (24-hr)
	PM_{10} (mg/m^3)	Gravimetric with specific sampler (HJ/T 618-2011, Determination of atmospheric articles PM10 and PM 2.5 in ambient air by gravimetric method)	0.07 mg/m³ (Annual) 0.15 mg/m³ (24-hr)
	SO_2 (mg/m^3)	Formaldehyde absorbing-para rosaniline spectrophotometry (HJ 482-2009) Tetrachloromercurate(TCM)-pararosaniline method (HJ 483-2009)	.060 (annual) .150 (24-hr) .500 (1-hr)
	NO_2 (mg/m^3)	Ethylene diamine dihydrochloride spectrophotometric method (HJ 479-2009)	0.04 (annual) 0.08 (24-hr) 0.2 (1-hr)
	$PM_{2.5}$ (mg/m^3)	Gravimetric method with specific sampler (HJ/T 618-2011, Determination of atmospheric articles PM10 and PM 2.5 in ambient air by gravimetric method)	0.035 (annual) 0.07 (24-hr)
Noise	Equivalent Continuous A Sound (Leq)	Acoustimeter Method Emission standard of environment noise for boundary of construction site (GB12523-2011)	70(day) 55 (night)
		Emission standard for industrial enterprises noise at boundary (GB12348-2008).	60 day 50 night
Wastewater	pH value	Glass electrode method (GB6920-86)	6-9
	COD (mg/L)	Permanganate index (GB11914-89)	500
	Petroleum (mg/L)	Infrared spectra photograph (HJ 637-2012)	30
	SS (mg/L)	Gravimetric method (GB11901-89)	400
	BOD (mg/L)	dilution and seeding method (HJ 505-2009)	300

Source: PRC standards.
Standard Limits:

- Air pollution standard is Class II, *Ambient Air Quality Standards* (*GB3095—2012).*
- Noise at HSP boundary during construction is Class II, *Noise Standard for Construction Site Boundary* (GB12523-2011).
- Noise at boundary during operation period is Class II, *Noise Standard for Construction Site Boundary (GB12348-2008).*
- Ambient noise is Class II, *Environmental Quality Standards for Noise* (GB3096-2008).
- Wastewater is Class III, *Integrated wastewater discharge standard* (GB8978-1996).

F. Reporting Requirements

21. Based on the compliance inspection and ambient monitoring results, the EHSU, with support from the LIEC, will submit monthly monitoring reports to the PMO. The EHS with

support from the LIEC, will also prepare EMP monitoring reports semi-annually during construction and annually during operation. The repots will be submitted to the PMO, who will review them and then submit them to the ADB and the Saihan District EPB

22. No later than two months after completion of the construction work the PMO will submit a construction completion report to the Saihan District EPB. Within three months after project completion, an environmental acceptance inspection will be undertaken by the Saihan District EPB. ADB can request the PMO for a copy of the construction completion and environmental acceptance reports.

23. The environmental reporting requirements during the implementation of the project are summarized in the **Table A-6**.

Table A-6: Reporting Requirements

Report	Prepared by	Submitted to	Frequency
A. Construction Phase			
Environmental monitoring records	EHSU supported by LIEC	PMO	Monthly
Environmental monitoring report	EHSU supported by LIEC, prepares and submits to PMO	PMO reviews and submits to ADB	Semi-annually
B. Operation Phase			
Environmental monitoring report, including annual CO_2 emissions[32]	EHSU prepares and submits to PMO	PMO reviews and submits to ADB	Annually

G. Performance Indicators

24. Performance indicators (**Table A-7**) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

H. Estimated Budget for Mitigation and Monitoring

25. The estimated budgets for environmental mitigation and monitoring are summarized in **Table A-8**. Construction phase costs are estimated at 1.172 million USD; operation phase mitigation and monitoring costs are estimated at 1.236 million USD. The budget does not include major capital costs for mitigations (e.g. low NOx burners, flue gas stacks, etc).

[32] The ADB SPS requires quantification and monitoring of GHG emissions for Projects which emit more than 100,000 tCO2e per annum.

Table A-7: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO EHSU established with appropriately qualified staff. (ii) Appropriately qualified LIC EHSS recruited. (iii) Branch EHSUs established with appropriately qualified staff.
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated. (ii) Environment monitoring cost is sufficiently and timely allocated. (iii) Budget for capacity building is sufficiently and timely allocated.
3	Monitoring	(i) Compliance monitoring is conducted by EHSU and LIEC as per EMoP. (ii) Ambient and effluent monitoring is conducted by the local EMS as per EMoP. (iii) CEMS installed and functioning during operation phase.
4	Supervision	(i) ADB mission to review EMP implementation at least once a year during the construction phase. (ii) Saihan District EPB to supervise monitoring and reporting. (iii) Saihan District EPB to conduct an environmental acceptance inspection after a three months trial operation period.
5	Reporting	(i) Monthly environment monitoring reports prepared by the EHSU supported by the LIEC are submitted to PMO. (ii) (Semi-annual (during construction period) and annual (during operation) EMP monitoring reports, prepared by the EHSU supported by the LIEC, are submitted to submitted to ADB and Saihan District EPB through the PMO. (iii) Construction completion report prepared by the PMO is submitted to EA and Saihan EPB. (iv) Environment acceptance report prepared by the Saihan EPB is submitted to the PMO and the ADB after a three months trial operation period.
6	Capacity Building	(i) Construction phase HSE plan developed and in place before substantive construction activities begin. (ii) Training on HSE plan implementation, ADB safeguard policy, EMP implementation, and GRM is provided to at the beginning of project implementation. (iii) Operation phase HSE plan developed and in place before substantive Project operation activities begin. (iv) Training on HSE plan implementation and best international practices in natural-gas fired HSP operation is provided prior to Project operation.
7	Grievance Redress Mechanism	(i) Project public complaints unit (PPCU) is established in the PMO. (ii) Contact persons of PPCU are assigned and disclosed to the public before construction. (iii) Complains are recorded and processed within the set time framework in the GRM of this EIA.
8	Compliance with the PRC standards	(i) Project complies with the PRC's environmental laws and regulations and meets all required standards.

Table A-8: EMP Budget

Construction Phase									
1. Monitoring	**Unit**	**Unit Cost**	**# Months**	**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	**Budget**
Ambient Air - TSP, PM_{10}	Monthly Sampling	Included in lump sum EMS budget	60	Included in lump sum Hohhot EPB EMS budget			**98,361**	**600,000**	ADB
Noise	Monthly Sampling		60						
Wastewater	Monthly Sampling		60						
2. Capacity Building	**Unit**	**Course Cost**	**# Times**	**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	
HSE Plan Development	HSE Plan - Construction	$ 3,500	1	3,500	3,500	3,500	10,500		
Construction HSE Training	HSE Course Development	3,500	1				3,500		ADB
	HSE Course Delivery	2,750	2	5,500	5,500	5,500	16,500		
Subtotal							**30,500**	**186,050**	
3. Loan Implementation Consultant (LIC)	**Unit**	**Monthly Cost**	**# Months**				**Cost USD**	**Cost RMB**	ADB
LIC HSE Specialist	Person Months	$ 2,500	30				**75,000**	**457,500**	
4. Dust Control	**Unit**	**Unit Cost**		**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	PRC
	Pipeline dust control measures	Cost per subproject		1,639	1,967	1,967	**5,573**	**33,995**	
5. Mobile Noise Protection	**Unit**	**Unit Cost**		**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	PRC
	Pipeline mobile noise control measure	Cost per subproject		820	820	1,311	**2,951**	**18,001**	
6. Landscaping and Greening	**Unit**	**Unit Cost**		**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	PRC
	Landscaping Plan	Cost Per Subproject		$ 343,333	$ 271,667	$ 345,000	**960,000**	**5,856,000**	
TOTAL Construction Phase							***Cost USD***	***Cost RMB***	
							1,172,385	***7,151,546***	
Operation Phase									
	Unit	**Cost Per Boiler**	**# Boilers**	**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	
1. Stack Emissions Monitoring	CEMS	$ 20,000.00	Jinqiao - 7	$ 140,000	$ 140,000	100,000			PRC
Subtotal			Xinjiaying - 7				**380,000**	**2,318,000**	
			Haoqinying - 5						
2. Monitoring	**Unit**	**Sample Cost**	**# Months**	**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	ADB
Noise	Monthly Sampling	Included in lump sum EMS budget	24	Included in lump sum EMS budget			**32,787**	**200,000**	
Wastewater	Quarterly Sampling		24						
3. Noise Control	**Unit**	**Unit Cost**		**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	
HSP Noise Insulation	Insulation	Cost Per Subproject		$ 163,934	$ 196,721	$ 163,934	524,589		
HSP Noise and Vibration Reduction Measure	Noise Reduction	Cost Per Subproject		$ 85,246	$ 90,164	$ 85,246	260,656		PRC
HES Noise Control and Greening	Noise Control, Greening	Cost Per Subproject		$ 2,787	$ 2,459	$ 2,459	7,705		
							792,950	**4,836,995**	
4. Capacity Building	**Unit**	**Course Cost**	**# Times**	**Jinqiao**	**Xinjiaying**	**Haoqinying**	**Cost USD**	**Cost RMB**	
HSE Plan Development	HSE Plan - Operation	$ 3,500	1	3,500	3,500	3,500	10,500		
Operation HSE Training	HSE Course Development	3,500	1				3,500		ADB
	HSE Course Delivery	2,750	2	5,500	5,500	5,500	16,500		
Subtotal							**30,500**	**186,050**	
TOTAL Operation Phase							***Cost USD***	***Cost RMB***	
							1,236,237	***7,541,045***	
GRAND TOTAL Construction + Operation							***Cost USD***	***Cost RMB***	
							2,408,622	***14,692,591***	
							Cost USD	***Cost RMB***	
Contribution from ADB LIC and Environmental Support Budget:							***267,148***	***1,629,600***	ADB
Contribution from PRC Budget:							***2,141,474***	***13,062,991***	PRC

EMP Budget Notes:

Construction Phase

- Construction phase monitoring based on lump sum EMS proposal, with monthly monitoring at the three HSP sites and 15% of HES and pipeline sections.
- Construction phase EHS course development based on 10 consultant days at $350/day (fees and per diem). Course Delivery based on 5 consultant days per delivery at 350/day (fees and per diem) and fixed costs of $1000 per delivery.
- LIEC is a part time consultant.
- Dust and noise control based on domestic EIAs.
- Landscaping and greening costs from domestic EIAs, based on 26% of HSP area, and a cost of 60 Yuan per m^2.

Operation Phase

- CEMS costs from domestic EIAs. Cost to be incurred during construction.
- Operation phase monitoring based on lump sum EMS proposal, with monitoring at HSP sites and random selection of HESs, and HSP wastewater discharged to municipal sewer.
- HSP and HES noise control costs from domestic EIAs. Cost to be incurred during construction.
- Operation phase EHS course development based on 10 consultant days at $350/day (fees and per diem). Course Delivery based on 5 consultant days per delivery at 350/day (fees and per diem) and fixed costs of $1000 per delivery.
- Budget does not include major capital costs for mitigations (e.g. low NOx burners, stacks, etc).

I. Mechanisms for Feedback and Adjustment

26. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed then the PMO will consult with the Saihan EPB and ADB and propose appropriate changes to the EMP monitoring and mitigation plan.

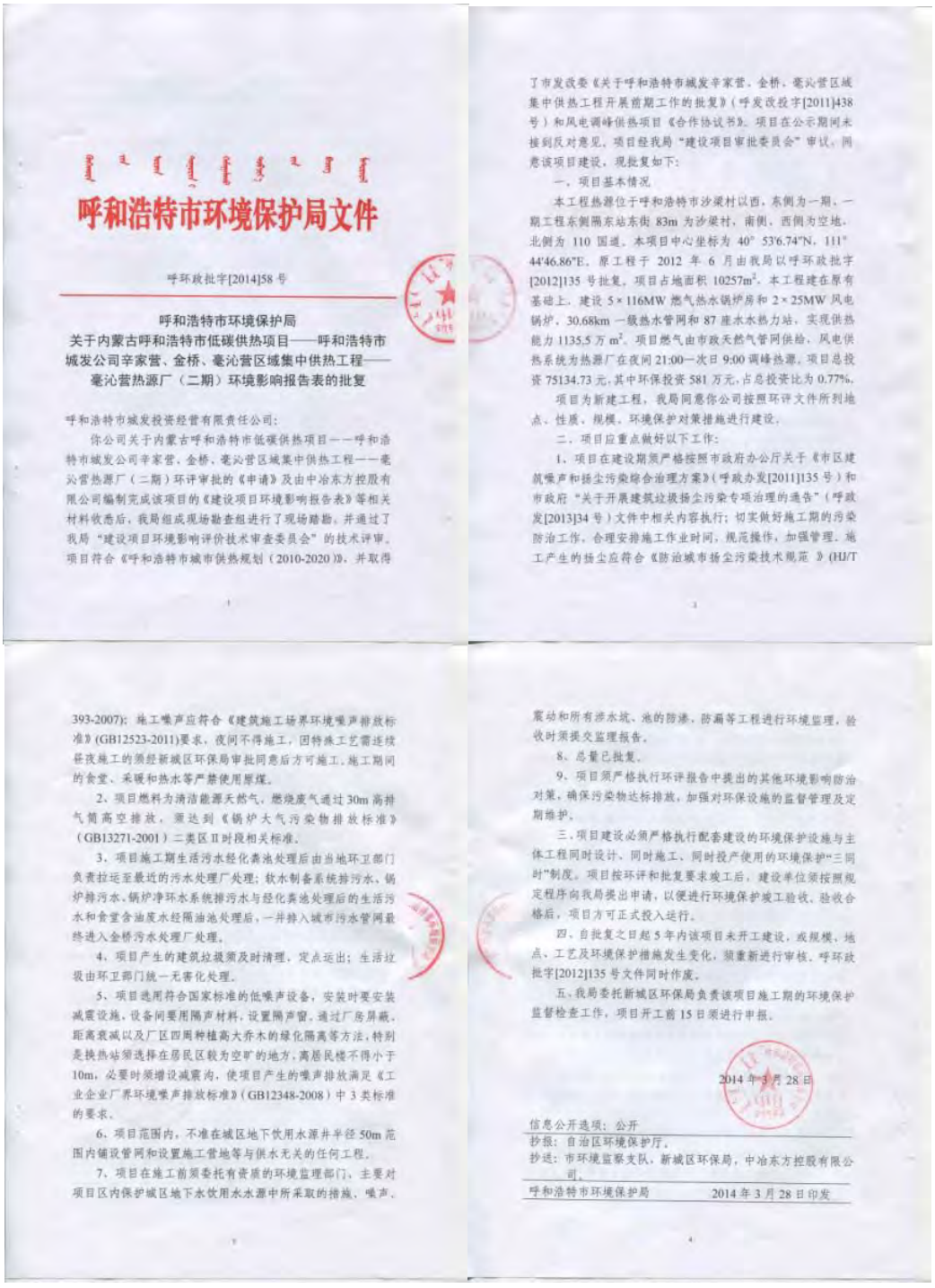
27. Any major EMP adjustments will be subject to ADB review and approval and ADB may pursue additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as the ADB public communications policy requires. The revised EMP will be passed to the PMO, the heating zone Branch PMOs, and the contractor(s) for implementation.

J. EPB Environmental Acceptance

28. After a three months trial period the Saihan District EPB will conduct an environmental acceptance inspection for the Project. If the project is in compliance with all conditions for approval of the domestic EIA (see Appendix II), the Project can be put into formal operation.

APPENDIX II: EPB APPROVALS OF DOMESTIC EIAS

Haoqingying Heating zone



呼和浩特市环境保护局文件

呼环政批字[2014]58 号

呼和浩特市环境保护局
关于内蒙古呼和浩特市低碳供热项目——呼和浩特市城发公司辛家营、金桥、毫沁营区域集中供热工程——毫沁营热源厂（二期）环境影响报告表的批复

呼和浩特市城发投资经营有限责任公司：

你公司关于内蒙古呼和浩特市低碳供热项目——呼和浩特市城发公司辛家营、金桥、毫沁营区域集中供热工程——毫沁营热源厂（二期）环评审批的《申请》及由中冶东方控股有限公司编制完成该项目的《建设项目环境影响报告表》等相关材料收悉后，我局组成现场勘查组进行了现场踏勘，并通过了我局“建设项目环境影响评价技术审查委员会”的技术评审。项目符合《呼和浩特市城市供热规划（2010-2020）》，并取得

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了市发改委《关于呼和浩特市城发辛家营、金桥、毫沁营区域集中供热工程开展前期工作的批复》（呼发改投字[2011]438号）和风电调峰供热项目《合作协议书》。项目在公示期间未接到反对意见，项目经我局“建设项目审批委员会”审议，同意该项目建设，现批复如下：

一、项目基本情况

本工程热源位于呼和浩特市沙梁村以西，东侧为一期、一期工程东侧隔东站东街 83m 为沙梁村，南侧、西侧为空地，北侧为 110 国道。本项目中心坐标为 40° 53'6.74"N，111° 44'46.86"E。原工程于 2012 年 6 月由我局以呼环政批字[2012]135 号批复，项目占地面积 10257m^2。本工程建在原有基础上，建设 5×116MW 燃气热水锅炉房和 2×25MW 风电锅炉，30.68km 一级热水管网和 87 座水水热力站，实现供热能力 1135.5 万 m^2。项目燃气由市政天然气管网供给，风电供热系统为热源厂在夜间 21:00—次日 9:00 调峰热源。项目总投资 75134.73 元，其中环保投资 581 万元，占总投资比为 0.77%。

项目为新建工程，我局同意你公司按照环评文件所列地点、性质、规模、环境保护对策措施进行建设。

二、项目应重点做好以下工作：

1、项目在建设期须严格按照市政府办公厅关于《市区建筑噪声和扬尘污染综合治理方案》（呼政办发[2011]135 号）和市政府“关于开展建筑垃圾扬尘污染专项治理的通告”（呼政发[2013]34 号）文件中相关内容执行；切实做好施工期的污染防治工作，合理安排施工作业时间，规范操作，加强管理。施工产生的扬尘应符合《防治城市扬尘污染技术规范》(HJ/T

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393-2007)；施工噪声应符合《建筑施工场界环境噪声排放标准》(GB12523-2011)要求，夜间不得施工，因特殊工艺需连续昼夜施工的须经新城区环保局审批同意后方可施工。施工期间的食堂、采暖和热水等严禁使用原煤。

2、项目燃料为清洁能源天然气，燃烧废气通过 30m 高排气筒高空排放，须达到《锅炉大气污染物排放标准》（GB13271-2001）二类区Ⅱ时段相关标准。

3、项目施工期生活污水经化粪池处理后由当地环卫部门负责拉运至最近的污水处理厂处理；软水制备系统排污水、锅炉排污水、锅炉净环水系统排污水与经化粪池处理后的生活污水和食堂含油废水经隔油池处理后，一并排入城市污水管网最终进入金桥污水处理厂处理。

4、项目产生的建筑垃圾须及时清理，定点运出；生活垃圾由环卫部门统一无害化处理。

5、项目选用符合国家标准的低噪声设备，安装时要安装减震设施，设备间要用隔声材料，设置隔声窗，通过厂房屏蔽，距离衰减以及厂区四周种植高大乔木的绿化隔离等方法，特别是换热站须选择在居民区较为空旷的地方，离居民楼不得小于10m，必要时须增设减震沟，使项目产生的噪声排放满足《工业企业厂界环境噪声排放标准》(GB12348-2008）中 3 类标准的要求。

6、项目范围内，不准在城区地下饮用水源井半径 50m 范围内铺设管网和设置施工营地等与供水无关的任何工程。

7、项目在施工前须委托有资质的环境监理部门，主要对项目区内保护城区地下水饮用水水源中所采取的措施、噪声、

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震动和所有涉水坑、池的防渗、防漏等工程进行环境监理，验收时须提交监理报告。

8、总量已批复。

9、项目须严格执行环评报告中提出的其他环境影响防治对策，确保污染物达标排放，加强对环保设施的监督管理及定期维护。

三、项目建设必须严格执行配套建设的环境保护设施与主体工程同时设计、同时施工、同时投产使用的环境保护“三同时”制度。项目按环评和批复要求竣工后，建设单位须按照规定程序向我局提出申请，以便进行环境保护竣工验收，验收合格后，项目方可正式投入运行。

四、自批复之日起 5 年内该项目未开工建设，或规模、地点、工艺及环境保护措施发生变化，须重新进行审核。呼环政批字[2012]135 号文件同时作废。

五、我局委托新城区环保局负责该项目施工期的环境保护监督检查工作，项目开工前 15 日须进行申报。

2014 年 3 月 28 日

信息公开选项：公开
抄报：自治区环境保护厅。
抄送：市环境监察支队、新城区环保局，中冶东方控股有限公司。
呼和浩特市环境保护局　　2014 年 3 月 28 日印发

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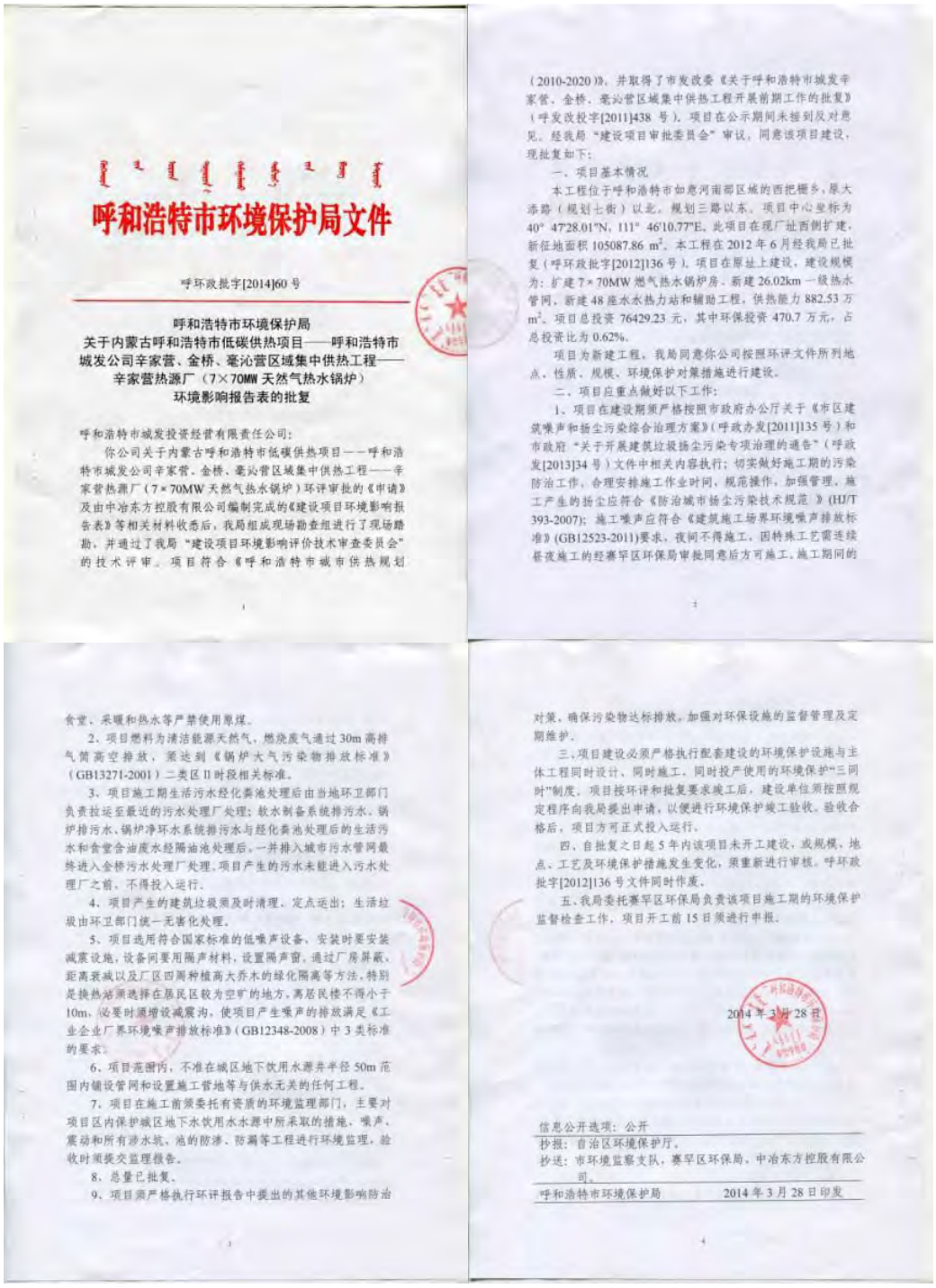
Xinjiaying Heating zone



呼和浩特市环境保护局文件

呼环政批字[2014]60号

呼和浩特市环境保护局
关于内蒙古呼和浩特市低碳供热项目——呼和浩特市城发公司辛家营、金桥、毫沁营区域集中供热工程——辛家营热源厂（7×70MW天然气热水锅炉）环境影响报告表的批复

呼和浩特市城发投资经营有限责任公司：

你公司关于内蒙古呼和浩特市低碳供热项目——呼和浩特市城发公司辛家营、金桥、毫沁营区域集中供热工程——辛家营热源厂（7×70MW天然气热水锅炉）环评审批的《申请》及由中冶东方控股有限公司编制完成的《建设项目环境影响报告表》等相关材料收悉后，我局组成现场勘查组进行了现场踏勘，并通过了我局"建设项目环境影响评价技术审查委员会"的技术评审。项目符合《呼和浩特市城市供热规划（2010-2020）》，并取得了市发改委《关于呼和浩特市城发辛家营、金桥、毫沁营区域集中供热工程开展前期工作的批复》（呼发改投字[2011]438号），项目在公示期间未接到反对意见。经我局"建设项目审批委员会"审议，同意该项目建设，现批复如下：

一、项目基本情况

本工程位于呼和浩特市如意河南部区域的西把棚乡，原大添路（规划七街）以北，规划三路以东。项目中心坐标为40° 47'28.01"N，111° 46'10.77"E。此项目在现厂址西侧扩建，新征地面积105087.86 m^2。本工程在2012年6月经我局已批复（呼环政批字[2012]136号），项目在原址上建设，建设规模为：扩建7×70MW燃气热水锅炉房。新建26.02km一级热水管网，新建48座水水热力站和辅助工程，供热能力882.53万m^2。项目总投资76429.23元，其中环保投资470.7万元，占总投资比为0.62%。

项目为新建工程，我局同意你公司按照环评文件所列地点、性质、规模、环境保护对策措施进行建设。

二、项目应重点做好以下工作：

1、项目在建设期须严格按照市政府办公厅关于《市区建筑噪声和扬尘污染综合治理方案》（呼政办发[2011]135号）和市政府"关于开展建筑垃圾扬尘污染专项治理的通告"（呼政发[2013]34号）文件中相关内容执行；切实做好施工期的污染防治工作，合理安排施工作业时间，规范操作，加强管理，施工产生的扬尘应符合《防治城市扬尘污染技术规范》（HJ/T 393-2007）；施工噪声应符合《建筑施工场界环境噪声排放标准》（GB12523-2011）要求，夜间不得施工，因特殊工艺需连续昼夜施工的经赛罕区环保局审批同意后方可施工。施工期间的食堂、采暖和热水等严禁使用原煤。

2、项目燃料为清洁能源天然气，燃烧废气通过30m高排气筒高空排放，须达到《锅炉大气污染物排放标准》（GB13271-2001）二类区II时段相关标准。

3、项目施工期生活污水经化粪池处理后由当地环卫部门负责拉运至最近的污水处理厂处理；软水制备系统排污水、锅炉排污水、锅炉净环水系统排污水与经化粪池处理后的生活污水和食堂含油废水经隔油池处理后，一并排入城市污水管网最终进入金桥污水处理厂处理。项目产生的污水未能进入污水处理厂之前，不得投入运行。

4、项目产生的建筑垃圾须及时清理，定点运出；生活垃圾由环卫部门统一无害化处理。

5、项目选用符合国家标准的低噪声设备，安装时要安装减震设施，设备间要用隔声材料，设置隔声窗，通过厂房屏蔽、距离衰减以及厂区四周种植高大乔木的绿化隔离等方法，特别是换热站须选择在居民区较为空旷的地方，离居民楼不得小于10m，必要时须增设减震沟，使项目产生噪声的排放满足《工业企业厂界环境噪声排放标准》（GB12348-2008）中3类标准的要求。

6、项目范围内，不准在城区地下饮用水源井半径50m范围内铺设管网和设置施工营地等与供水无关的任何工程。

7、项目在施工前须委托有资质的环境监理部门，主要对项目区内保护城区地下水饮用水水源中所采取的措施、噪声、震动和所有涉水坑、池的防渗、防漏等工程进行环境监理，验收时须提交监理报告。

8、总量已批复。

9、项目须严格执行环评报告中提出的其他环境影响防治对策，确保污染物达标排放，加强对环保设施的监督管理及定期维护。

三、项目建设必须严格执行配套建设的环境保护设施与主体工程同时设计、同时施工、同时投产使用的环境保护"三同时"制度，项目按环评和批复要求竣工后，建设单位须按照规定程序向我局提出申请，以便进行环境保护竣工验收。验收合格后，项目方可正式投入运行。

四、自批复之日起5年内该项目未开工建设，或规模、地点、工艺及环境保护措施发生变化，须重新进行审核。呼环政批字[2012]136号文件同时作废。

五、我局委托赛罕区环保局负责该项目施工期的环境保护监督检查工作，项目开工前15日须进行申报。

2014年3月28日

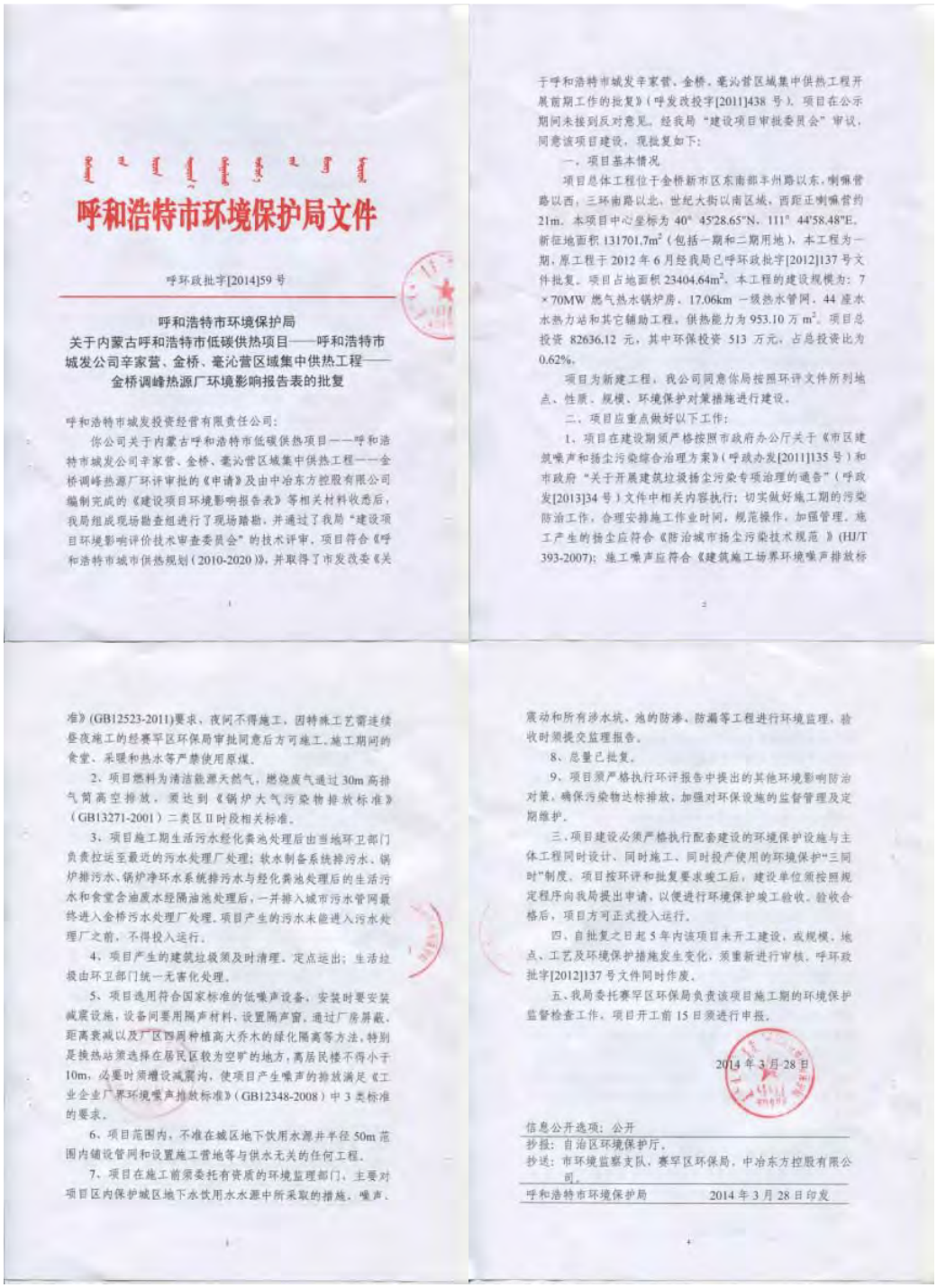
信息公开选项：公开

抄报：自治区环境保护厅。

抄送：市环境监察支队，赛罕区环保局，中冶东方控股有限公司。

呼和浩特市环境保护局　　2014年3月28日印发

Jinqiao Heating zone



呼和浩特市环境保护局文件

呼环政批字[2014]59 号

呼和浩特市环境保护局
关于内蒙古呼和浩特市低碳供热项目——呼和浩特市城发公司辛家营、金桥、毫沁营区域集中供热工程——金桥调峰热源厂环境影响报告表的批复

呼和浩特市城发投资经营有限责任公司：

你公司关于内蒙古呼和浩特市低碳供热项目——呼和浩特市城发公司辛家营、金桥、毫沁营区域集中供热工程——金桥调峰热源厂环评审批的《申请》及由中冶东方控股有限公司编制完成的《建设项目环境影响报告表》等相关材料收悉后，我局组成现场勘查组进行了现场踏勘，并通过了我局“建设项目环境影响评价技术审查委员会”的技术评审，项目符合《呼和浩特市城市供热规划（2010-2020）》，并取得了市发改委《关于呼和浩特市城发辛家营、金桥、毫沁营区域集中供热工程开展前期工作的批复》（呼发改投字[2011]438 号）。项目在公示期间未接到反对意见。经我局“建设项目审批委员会”审议，同意该项目建设，现批复如下：

一、项目基本情况

项目总体工程位于金桥新市区东南部丰州路以东，喇嘛营路以西，三环南路以北，世纪大街以南区域，西距正喇嘛营约 21m。本项目中心坐标为 40° 45'28.65"N，111° 44'58.48"E。新征地面积 131701.7m^2（包括一期和二期用地），本工程为一期，原工程于 2012 年 6 月经我局已呼环政批字[2012]137 号文件批复。项目占地面积 23404.64m^2，本工程的建设规模为：7×70MW 燃气热水锅炉房，17.06km 一级热水管网，44 座水水热力站和其它辅助工程，供热能力为 953.10 万 m^2。项目总投资 82636.12 元，其中环保投资 513 万元，占总投资比为 0.62%。

项目为新建工程，我公司同意你局按照环评文件所列地点、性质、规模、环境保护对策措施进行建设。

二、项目应重点做好以下工作：

1、项目在建设期须严格按照市政府办公厅关于《市区建筑噪声和扬尘污染综合治理方案》（呼政办发[2011]135 号）和市政府“关于开展建筑垃圾扬尘污染专项治理的通告”（呼政发[2013]34 号）文件中相关内容执行；切实做好施工期的污染防治工作，合理安排施工作业时间，规范操作，加强管理。施工产生的扬尘应符合《防治城市扬尘污染技术规范》（HJ/T 393-2007）；施工噪声应符合《建筑施工场界环境噪声排放标准》（GB12523-2011）要求，夜间不得施工，因特殊工艺需连续昼夜施工的经赛罕区环保局审批同意后方可施工。施工期间的食堂、采暖和热水等严禁使用原煤。

2、项目燃料为清洁能源天然气，燃烧废气通过 30m 高排气筒高空排放，须达到《锅炉大气污染物排放标准》（GB13271-2001）二类区Ⅱ时段相关标准。

3、项目施工期生活污水经化粪池处理后由当地环卫部门负责拉运至最近的污水处理厂处理；软水制备系统排污水、锅炉排污水、锅炉净环水系统排污水与经化粪池处理后的生活污水和食堂含油废水经隔油池处理后，一并排入城市污水管网最终进入金桥污水处理厂处理。项目产生的污水未能进入污水处理厂之前，不得投入运行。

4、项目产生的建筑垃圾须及时清理，定点运出；生活垃圾由环卫部门统一无害化处理。

5、项目选用符合国家标准的低噪声设备，安装时要安装减震设施，设备间要用隔声材料，设置隔声窗，通过厂房屏蔽、距离衰减以及厂区四周种植高大乔木的绿化隔离等方法，特别是换热站策选择在居民区较为空旷的地方，离居民楼不得小于 10m，必要时须增设减震沟，使项目产生噪声的排放满足《工业企业厂界环境噪声排放标准》（GB12348-2008）中 3 类标准的要求。

6、项目范围内，不准在城区地下饮用水源井半径 50m 范围内铺设管网和设置施工营地等与供水无关的任何工程。

7、项目在施工前须委托有资质的环境监理部门，主要对项目区内保护城区地下水饮用水水源中所采取的措施，噪声、震动和所有涉水坑、池的防渗、防漏等工程进行环境监理，验收时须提交监理报告。

8、总量已批复。

9、项目须严格执行环评报告中提出的其他环境影响防治对策，确保污染物达标排放，加强对环保设施的监督管理及定期维护。

三、项目建设必须严格执行配套建设的环境保护设施与主体工程同时设计、同时施工、同时投产使用的环境保护“三同时”制度。项目按环评和批复要求竣工后，建设单位须按照规定程序向我局提出申请，以便进行环境保护竣工验收。验收合格后，项目方可正式投入运行。

四、自批复之日起 5 年内该项目未开工建设，或规模、地点、工艺及环境保护措施发生变化，须重新进行审核。呼环政批字[2012]137 号文件同时作废。

五、我局委托赛罕区环保局负责该项目施工期的环境保护监督检查工作，项目开工前 15 日须进行申报。

2014 年 3 月 28 日

信息公开选项：公开

抄报：自治区环境保护厅。

抄送：市环境监察支队，赛罕区环保局，中冶东方控股有限公司。

呼和浩特市环境保护局　　2014 年 3 月 28 日印发

Summary Translation of EPB Approval of Domestic EIAs

The EPB's Construction Project EIA Technical Review Committee reviewed the report. Based on the evaluation's recommendation, the Hohhot EPB approved the domestic EIAs on 28 March 2014. The approval documents specify requirements for the IA to comply with during construction and operation:

i) Dust generated by construction and construction noise should comply with relevant PRC standards. Construction at night is forbidden unless the continuous day and night construction is required for some special process and approval has been obtained from the EPB in Saihan district. Coal used for canteen, heating and hot water during the construction phase is forbidden.

ii) Project fuel is clean energy-natural gas and flue gas is to be emitted through 30m high exhaust funnels. The flue gas emissions should comply with the relevant PRC standards.

iii) Domestic wastewater generated in construction phase and operation phase should be treated by digestion tank before discharge. Operation phase wastewater from water treatment plant and blowdown should be mixed with domestic waste water treated by digestion tank and canteen oily wastewater treated by oil separation tank, then discharged into the municipal sewer for final treatment at the Jinqiao wastewater treatment plant.

iv) Construction waste generated by the project should be collected in a timely manner and sent for disposal at an appropriate facility. Non-hazardous domestic waste should be collected by the local sanitation departments.

v) Noise reduction measures should be adopted such that the project noise complies with relevant PRC standards.

vi) Activities which are not related to water supply such as pipelines laying, construction camps, etc., are forbidden within a 50 meters radius of water supply wells in urban areas.

vii) Environmental supervision should be implemented by qualified environmental supervision department. Environmental supervision mainly focuses on underground water resource protection measures, noise, vibration and leakage, seepage control of water pools and tanks. Environmental supervision report should be submitted when acceptance check of project starts.

viii) Total quantity control of pollution has already been approved.

ix) Environment impact control and treatment measures in the EIAs report must be executed strictly to ensure discharge of pollution in compliance with relevant standards. Supervision, management and periodic maintenance of environmental protection should be undertaken.

x) Environmental protection measures and the main project should be designed, constructed and put into operation simultaneously. After the project is completed according to the requirement of EIA and this approval document, the construction company should apply for environment

protection acceptance of completed project according to established procedures. After the acceptance is approved, the project can start to operate formally.

xi) If the project construction has not started within 5 years of the approval date, or project scale, location, process and environmental protection measures change, the projects should be reassessed and approval documents will be obsolete.

xii) The Saihan district EPB is delegated by Hohhot EPB to be responsible for the environment protection supervision and inspection during construction phase. Application of environment protection supervision and inspection must be submitted at least 15 days before project construction begins.

APPENDIX III: EXISTING BOILERS TO BE DECOMMISSIONED, JINQIAO HEATING ZONE

No	Name	Type of boiler	Set number	Coal consumption (t/a)	Coal type	Sulphur content (%)	Precipitator type	Dust removal efficiency (%)	Chimney height(m)/ number	Flue gas emission (m^3/h)	Pollutant emission (t/a)			Heating supply area (m^2)
											Smoke	SO_2	NO_X	
1	Longde Huayuan	QXW7-0.7/95-70	1	2541	bituminous coal	0.6	wet	85	20/1	8976	7.97	20.73	7.47	100000
		DZL2.8-0.7/95-70	1	590.90	bituminous coal	0.6	wet	86	26/1	2087	1.73	4.82	1.74	
2	Ziyun plot	DHW7-1.0/115-70	1	2223	bituminous coal	0.7	wet	84	32/1	7852	7.44	21.16	6.54	100000
		DHW4.2-0.7/95-70	1	908.90	bituminous coal	0.7	wet	85	31/1	3211	2.85	8.65	2.67	
3	Xuefu Huayuan	DHW7-1.0/115-70	3	5637.41	bituminous coal	0.5	wet	87	28/1	19913	15.33	38.33	16.57	180000
4	Artificial limb factory	QXW2.8-0.7/95-70	1	438.47	bituminous coal	0.6	wet	86	20/1	1549	1.28	3.58	1.29	14000
5	Qingcheng University	DZL1.4-0.7/95-70	1	313.19	bituminous coal	0.6	wet	85	26/1	1106	0.98	2.56	0.92	10000
6	Semiconductor factory dormitory	DZL1.4-0.7/95-70	2	275.61	bituminous coal	0.5	wet	87	27/1	974	0.75	1.87	0.81	8800
7	Veterinary station	DZL2.8-0.7/95-70	1	686.00	bituminous coal	0.5	wet	85	20/1	2423	2.15	4.66	2.02	48200
		DZL4.2-0.7/95-70	1	823.57	bituminous coal	0.6	wet	86	28/1	2909	2.41	6.72	2.42	
8	Insurance company	SZL7-1.0/115-70	2	3445.09	bituminous coal	0.5	wet	84	31/1	12169	11.53	23.43	10.13	110000
9	Inner Mongolia petrochemical academy of sciences	QXW2.8-0.7/95-70	1	512.2	bituminous coal	0.6	wet	82	35/1	1809	1.93	4.18	1.51	18000
		DZL0.7-0.7/95-70	1	51.54	bituminous coal	0.6	wet	85	20/1	182	0.16	0.42	0.15	
10	Hydrology team	KZL240-1.0/110/70-A	1	939.57	bituminous coal	0.6	wet	84	35/1	3319	3.15	7.67	2.76	30000
11	Commodity Inspection and Testing Bureau	DHW4.2-0.7/95-70	1	800.31	bituminous coal	0.7	wet	85	27/1	2827	2.51	7.62	2.35	60000
		DHW7-1.0/115-70	1	1078.83	bituminous coal	0.7	wet	85	20/1	3811	3.39	10.27	3.17	

No	Name	Type of boiler	Set number	Coal consumption (t/a)	Coal type	Sulphur content (%)	Precipitator type	Dust removal efficiency (%)	Chimney height(m)/ number	Flue gas emission (m^3/h)	Pollutant emission (t/a)			Heating supply area (m^2)
											Smoke	SO_2	NO_X	
12	Stockbreeding machine Signature station	SZL7-1.0/115-70	2	256.25	bituminous coal	0.7	wet	84	20/1	905	0.86	2.44	0.75	9000
		DZL1.4-0.7/95-70	1	25.62	bituminous coal	0.5	wet	83	35/1	91	0.09	0.17	0.08	
13	Baota Zhuangyuan	DZL4.2-0.7/95-70	1	879.3	bituminous coal	0.6	wet	84	31/1	3106	2.94	7.18	2.59	41200
		DZL2.8-0.7/95-70	1	411.04	bituminous coal	0.5	wet	84	20/1	1452	1.38	2.80	1.21	
14	International Business and Economics School	QXW7-1.0/95-70	2	313.2	bituminous coal	0.6	wet	86	25/1	1106	0.92	2.56	0.92	10000
15	Xinya Cashmere Wool ltd.	DZL2.8-0.7/95-70	2	250.6	bituminous coal	0.6	wet	87	38/1	885	0.68	2.04	0.74	8000
16	Ruitong auto repair company	SZL7-1.0/115-70	1	187.9	bituminous coal	0.7	wet	84	28/2	664	0.63	1.79	0.55	6000
17	Xinshiji Lvse Zhuangyuan	DZL1.4-0.7/95-70	2	469.8	bituminous coal	0.6	wet	85	30/1	1659	1.47	3.83	1.38	15000
18	Inner Mongolia grassland workstation	SHL1.4	1	178	Fine coal	0.4	wet	80	25/1	629	0.74	0.97	0.52	15000
		KZL2.8	1	291.78		0.4	wet	82		1031	1.10	1.59	0.86	
19	Stockbreeding machine station	DHW7-1.0/115-70	2	240	bituminous coal	0.6	wet	85	35/1	848	0.75	1.96	0.71	11800
		DZL10.5-1.25/95-70	1	129.56	bituminous coal	0.6	wet	86		458	0.38	1.06	0.38	
20	Drilling crew property company of Saihan district	DHW4.2-0.7/95-70	1	626.4	bituminous coal	0.7	wet	84	34/1	2213	2.10	5.96	1.84	20000
21	Kaiao cashmere sweater factory	DZL2.8-0.7/95-70	1	156.6	bituminous coal	0.6	wet	86	20/1	553	0.46	1.28	0.46	5000
22	Power company district	QXW2.8-0.7/95-70	1	1039.8	bituminous coal	0.7	wet	85	30/1	3673	3.26	9.90	3.06	33200
23	Bluesky Residence	DHW2.8-0.7/95-70	1	213.0	bituminous coal	0.7	wet	87	34/1	752	0.58	2.03	0.63	6800
24	Chemical plant residential district	DZL2.8-0.7/95-70	2	281.9	bituminous coal	0.7	wet	83	28/1	996	1.00	2.68	0.83	9000
25	Fenghuayuan plot	SZL14-1.25/115-70	1	1660	bituminous coal	0.6	wet	86	40/1	5864	4.86	13.55	4.88	70000
		SZL7-1.0/115-70	1	532.33	bituminous	0.7	wet	85		1880	1.67	5.07	1.57	

No	Name	Type of boiler	Set number	Coal consumption (t/a)	Coal type	Sulphur content (%)	Precipitator type	Dust removal efficiency (%)	Chimney height(m)/ number	Flue gas emission (m^3/h)	Pollutant emission (t/a)			Heating supply area (m^2)
											Smoke	SO_2	NO_X	
					coal									
26	Medical institute	DHW7-1.0/115-70	1	992.8	bituminous coal	0.7	wet	86	29/1	3507	2.91	9.45	2.92	31700
27	TV cabinet factory	SZL7-1.0/115-70	1	689.0	bituminous coal	0.6	wet	84	26/1	2434	2.31	5.62	2.03	22000
28	Hohhot Cigarettes Factory (new)	SZL10.5-1.25/115-70	2	9395.7	bituminous coal	0.5	wet	83	26/1	33189	33.42	63.89	27.62	300000
29	Mengniu milk industry	DZL2.8-0.7/95-70	1	62.6	bituminous coal	0.7	wet	85	30/1	221	0.20	0.60	0.18	2000
Total			50	40548.66							130.30	315.08	119.21	1294700

Source: EIA Table Report: Low Carbon Heating Project of Inner Mongolia Jinqiao Heating Resource Plant of Hohhot City Development Company, March 6 2014. Prepared by Zhong Ye Dong Fang Ltd.

APPENDIX IV: NATURAL GAS SUPPLY LETTER OF COMMITMENT

呼和浩特中燃城市燃气发展有限公司文件

呼市中燃　　工程　　字[2013]10号　　签发人：乔庆基

关于给呼和浩特城发公司热源厂供天然气的承诺函

呼和浩特市城发投资经营有限责任公司：

根据呼和浩特城发集中供热工程辛家营热源厂、金桥热源厂、毫沁营热源厂建设位置、建设规模及天然气用气量需求，根据《呼和浩特市燃气规划（天然气部分）2010—2020》及我司近期天然气工程建设计划，我公司能够保障上述热源厂的供气需求。

特此承诺。

附：

《关于呼和浩特城发热源厂供天然气说明》

《呼和浩特中燃高压（次高压）天然气管道图》

呼和浩特市燃气发展有限公司

二〇一三年四月二十二日

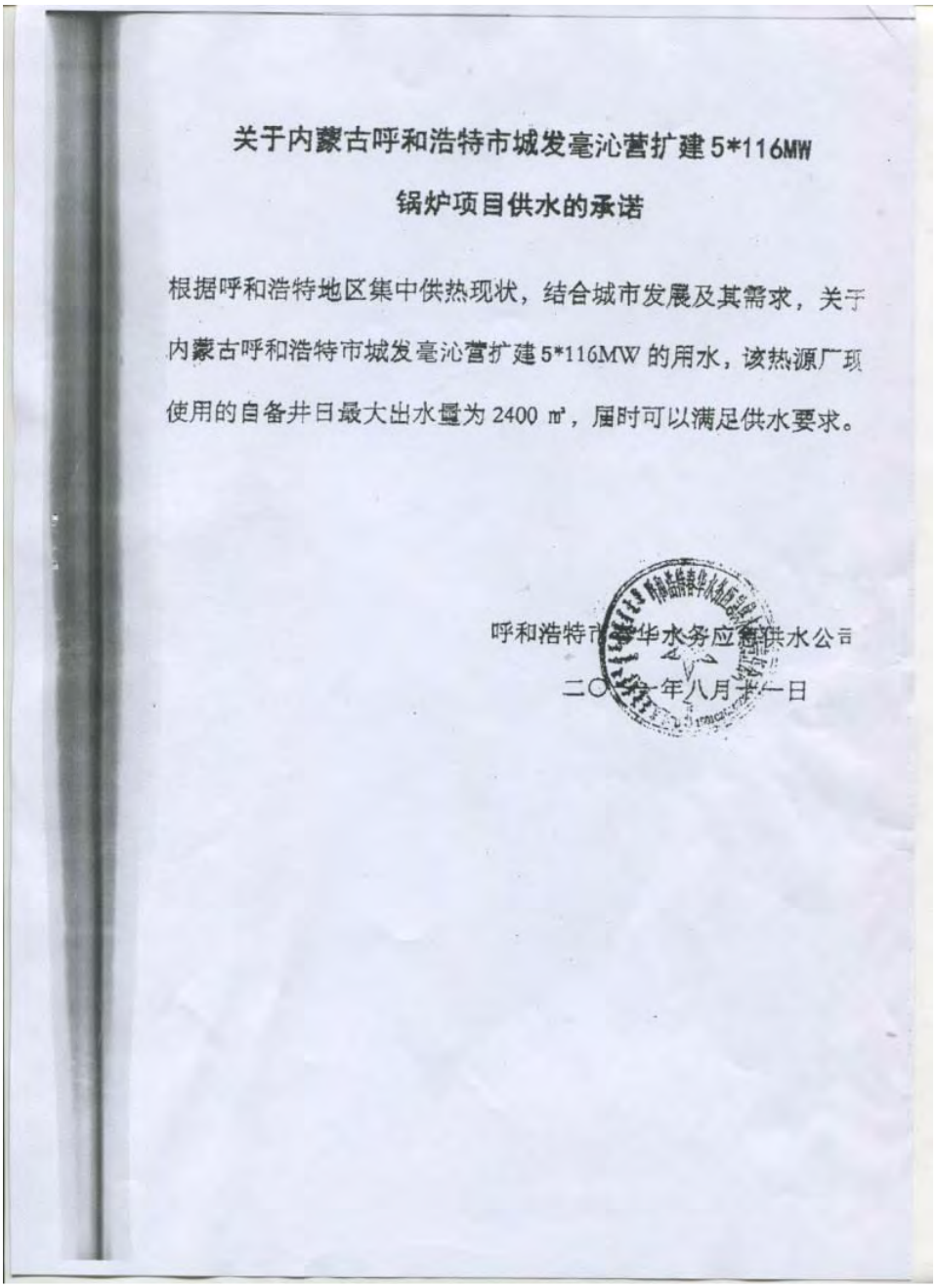
主题词：供气 承诺函

拟文单位：工程技术部　　2013年4月22日印发

审核人：丁志　　共印4份

APPENDIX V: HOHHOT CHUNHUASHUIWU WATER SUPPLY COMPANY COMMITMENT LETTERS TO SUPPLY DOMESTIC WATER

Haoqingying Heating zone



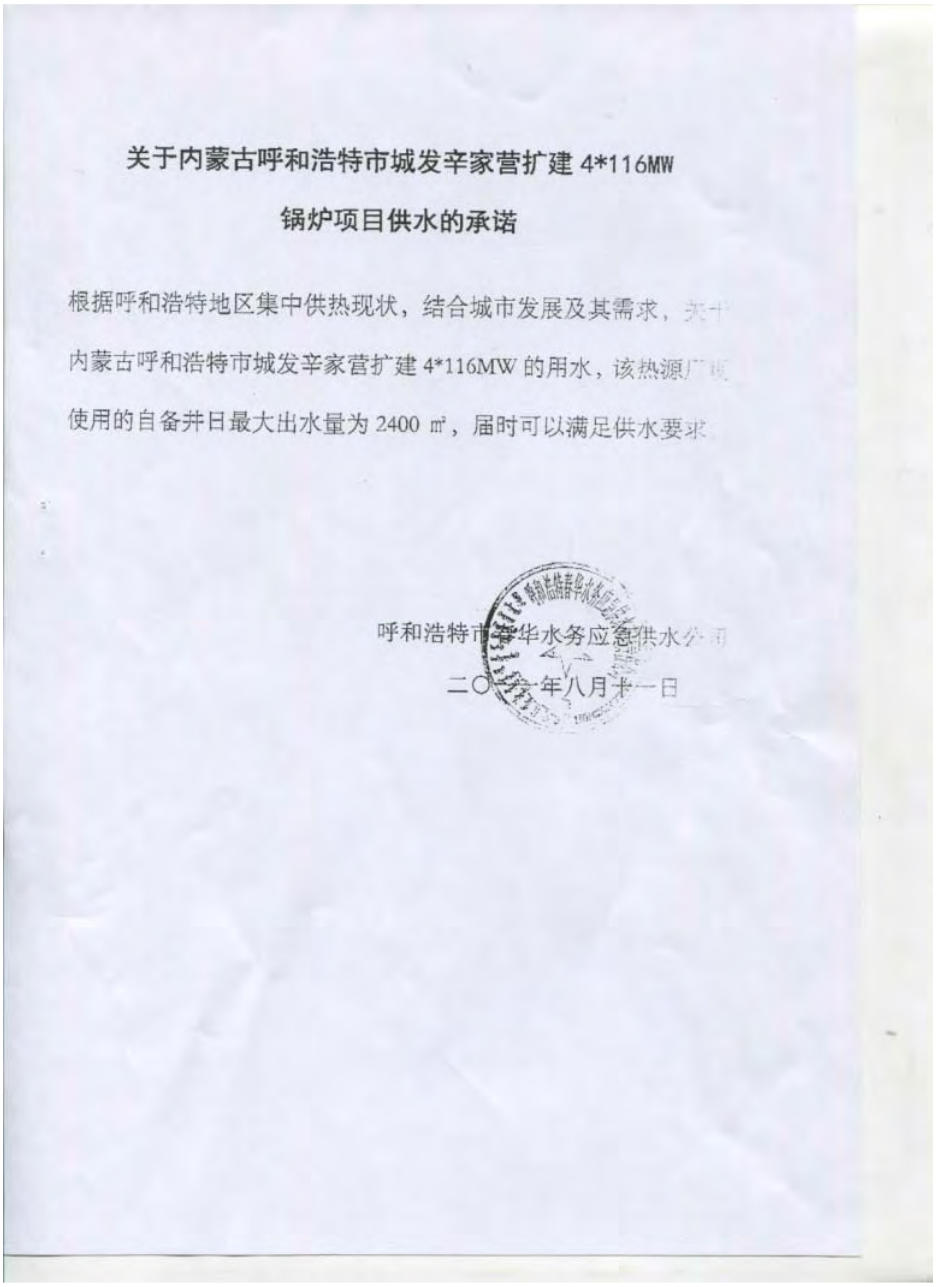
关于内蒙古呼和浩特市城发毫沁营扩建5*116MW

锅炉项目供水的承诺

根据呼和浩特地区集中供热现状，结合城市发展及其需求，关于内蒙古呼和浩特市城发毫沁营扩建5*116MW的用水，该热源厂现使用的自备井日最大出水量为2400㎥，届时可以满足供水要求。

呼和浩特市春华水务应急供水公司

二〇一一年八月十一日



关于内蒙古呼和浩特市城发辛家营扩建 4*116MW

锅炉项目供水的承诺

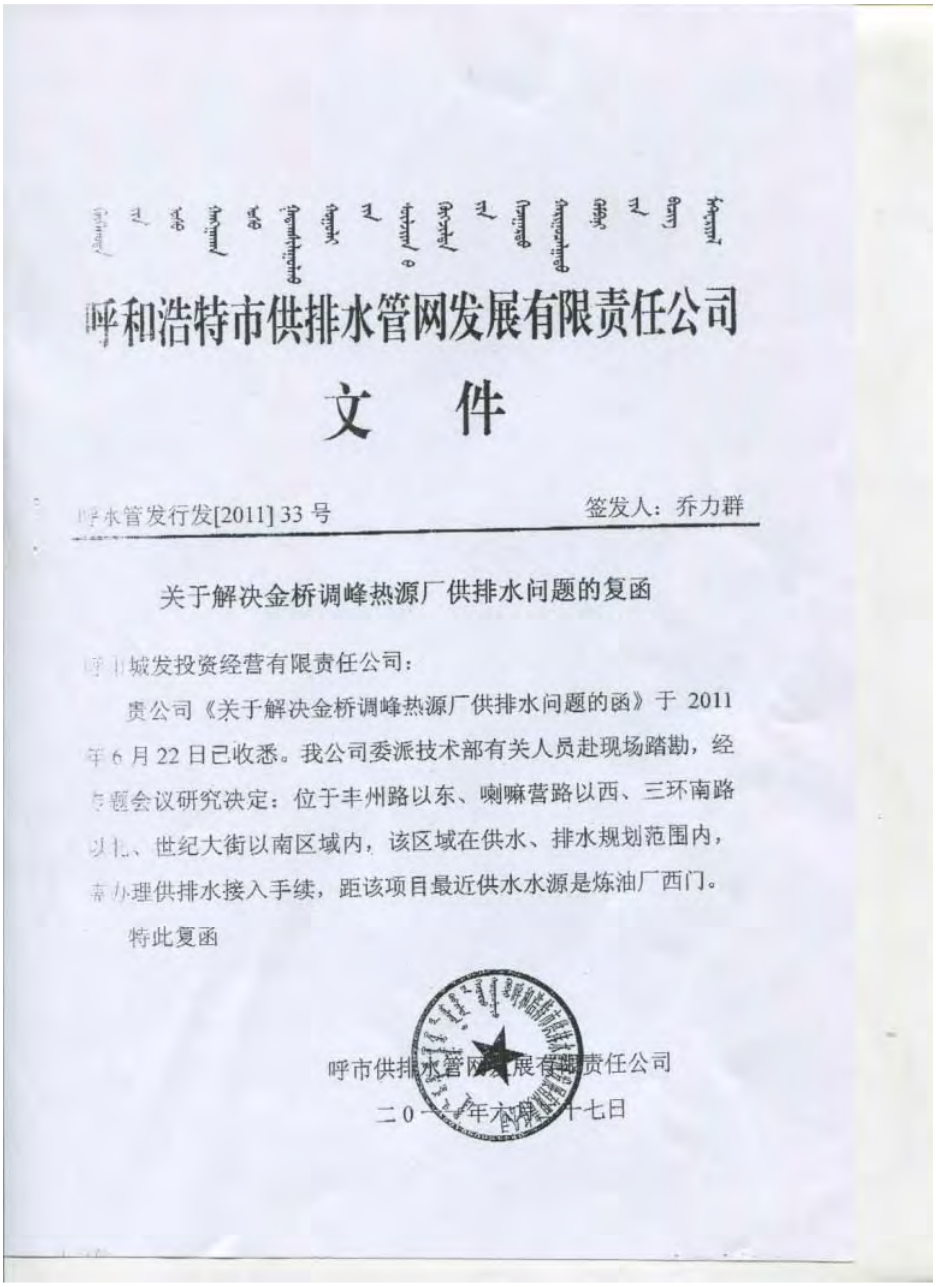
根据呼和浩特地区集中供热现状，结合城市发展及其需求，关于

内蒙古呼和浩特市城发辛家营扩建 4*116MW 的用水，该热源厂现

使用的自备井日最大出水量为 2400 ㎥，届时可以满足供水要求

呼和浩特市[illegible]华水务应急供水分[illegible]

二〇[illegible]年八月十一日



呼和浩特市供排水管网发展有限责任公司

文　件

呼水管发行发[2011] 33 号　　签发人：乔力群

关于解决金桥调峰热源厂供排水问题的复函

呼和城发投资经营有限责任公司：

贵公司《关于解决金桥调峰热源厂供排水问题的函》于 2011 年 6 月 22 日已收悉。我公司委派技术部有关人员赴现场踏勘，经专题会议研究决定：位于丰州路以东、喇嘛营路以西、三环南路以北、世纪大街以南区域内，该区域在供水、排水规划范围内，请办理供排水接入手续，距该项目最近供水水源是炼油厂西门。

特此复函

呼市供排水管网发展有限责任公司

二〇一一年六月二十七日

APPENDIX VI: COAL AND ENERGY EMISSION REDUCTION CALCULATIONS

Table 1: Jinqiao Emission Reduction Calculations

Pollutant	Project Emissions	Baseline Emissions	Reduction
	ton/a	ton/a	ton/a
CO_2	149,359	663,919	514,560
NO x	143	3,077	2,934
PM	-	8,172	8,172
SO_2	31	3,762	3,731
Fly Ash and Bottom Ash	-	59,929	59,929
Standard coal	-	266,313	266,313
Raw Coal	-	398,484	398,484

Table 2: Xinjiaying Emission Reduction Calculations

Pollutant	Project Emissions	Baseline Emissions	Reduction
	ton/a	ton/a	ton/a
CO_2	303,729	647,476	343,746
NO x	291	3,001	2,710
PM	-	7,970	7,970
SO_2	62	3,669	3,606
Fly Ash and Bottom Ash	-	58,445	58,445
Standard coal	-	259,717	259,717
Raw Coal	-	388,615	388,615

Table 3: Haoqinying Emission Reduction Calculations

Pollutant	Project Emissions	Baseline Emissions	Reduction
	ton/a	ton/a	ton/a
CO_2	362,819	803,923	441,104
NO x	348	3,726	3,378
PM	-	9,895	9,895
SO_2	74	4,555	4,481
Fly Ash and Bottom Ash	-	72,566	72,566
Standard coal	-	322,472	322,472
Raw Coal	-	482,514	482,514

Table 4: Total Project Emission Reduction Calculations

Pollutant	Project Emissions	Baseline Emissions	Reduction
	ton/a	ton/a	ton/a
CO_2	815,907	2,115,318	1,299,411
NO x	783	9,805	9,023
PM	-	26,037	26,037
SO_2	167	11,985	11,818
Fly Ash and Bottom Ash	-	190,940	190,940
Standard coal	-	848,503	848,503
Raw Coal	-	1,269,614	1,269,614

Table 5: Emission Factors

Parameter	Value	Unit	Source
General Factors			
Heat Value of Standard Coal	29,308	kJ/kg	Ministry of Environment Protection of PRC
Low Heat Value of Coal	19,587	kJ/kg	FSR with coal-based boiler prepared by Design Institute
CO_2 converting factor per standard coal	2.493	kg/kg Standard Coal	Ministry of Environment Protection of PRC
N content of coal	0.01	kg/kg	FSR with coal-based boiler prepared by Design Institute
NOx conversion rate of boiler	0.38		FSR with coal-based boiler prepared by Design Institute
Ash content of coal	0.1709	kg/kg	FSR with coal-based boiler prepared by Design Institute
Bottom Ash share of stoker boiler	0.6		FSR with coal-based boiler prepared by Design Institute
Fly Ash share of stoker boiler	0.4		FSR with coal-based boiler prepared by Design Institute
Efficiency of Bag House	0.99		FSR with coal-based boiler prepared by Design Institute
Efficiency of Cyclone	0.7		FSR with coal-based boiler prepared by Design Institute
S content of coal	0.0059	kg/kg	FSR with coal-based boiler prepared by Design Institute
SO_2 emission factor of boiler	0.8		FSR with coal-based boiler prepared by Design Institute
Efficiency of Heat Source	0.6		FSR with coal-based boiler prepared by Design Institute
Emission Factors - Baseline (Small Boilers, Jinqiao)			
Standard Coal to CO_2	1,666.11	g/kg coal	Calculation
Standard Coal to NOx	7.72294	g/kg coal	Calculation
Standard Coal to PM	20.508	g/kg coal	Calculation
Standard Coal to SO_2	9.44	g/kg coal	Calculation
Standard Coal to slag and ash	150.392	g/kg coal	Calculation
Emission Factors - Project			
Natural gas to CO_2	1950.672174	g/m^3 Natural Gas	2006 IPCC Guidelines for National Greenhouse Gas Inventories and EIA
Natural gas to NOx	1.871	g/m^3 Natural Gas	National survey of industrial gas boiler in the PRC (2007)
Natural gas to PM	0	g/m^3 Natural Gas	National survey of industrial gas boiler in the PRC (2007)
Natural gas to SO_2	0.4	g/m^3 Natural Gas	National survey of industrial gas boiler in the PRC (2007)
Natural gas to slag and ash	0	g/m^3 Natural Gas	National survey of industrial gas boiler in the PRC (2007)
Annual Coal Consumption for Baseline			
Jinqiao	398.5	million kg/a	Calculation
Xinjiaying	388.6	million kg/a	Calculation
Haoqinying	482.5	million kg/a	Calculation
Total Heat Energy Supply			
Jinqiao	4,683,067	GJ/a	FSR with coal-based boiler prepared by Design Institute
Xinjiaying	4,567,080	GJ/a	FSR with coal-based boiler prepared by Design Institute
Haoqinying	5,670,606	GJ/a	FSR with coal-based boiler prepared by Design Institute
Annual Gas Consumption			
Jinqiao	76.568	million Nm^3/a	EIA for natural gas boilers prepared by EIA Institute
Xinjiaying	155.705	million Nm^3/a	EIA for natural gas boilers prepared by EIA Institute
Haoqinying	185.997	million Nm^3/a	EIA for natural gas boilers prepared by EIA Institute